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Open Science

Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

Open Science Index

The Open Science Index (OSI) currently provides access to over thirty thousand full-text journal articles and is working with member and non-member organizations to review policies to promote and assess open science. As part of the open science philosophy, and by making open science a reality; OSI is conducting an assessment of the impact of open science principles and restructuring the guidelines for access to scientific research. As digitalization continues to accelerate science, Open science and big data hold enormous promise and present new challenges for policymakers, scientific institutions, and individual researchers.

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Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

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Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

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or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. These changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

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engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

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towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

Open Science

Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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Scholarly Research Review

The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

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All submitted manuscripts are subject to the scholarly research review process, in which there are three stages of evaluation for consideration: pre-review manuscripts, chair-review presentation, and final-review manuscripts. All submitted full text papers, that may still be withstand the editorial review process, are presented in the conference proceedings. Manuscripts are tracked and all actions are logged by internal and external reviewers according to publication policy. External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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The World's Inevitable Transition to Sustainable Aviation

Gusenga David

Abstract— Sustainability in aviation is one of the measures to take to attain a simultaneous growth of two contradicting substantial phenomenon that include aviation and climate justice. To effectively meet sustainability and net-zero targets, all sectors of the global economy must decarbonize, in other words, reduce the carbon emissions that contribute to climate change. To jump-start and catalyze these goals, however, certain sectors and industries must be prioritized, notably those that are mass emitters of greenhouse gases, and therefore mass contributors to climate change. Of these sectors is transportation in its entirety, as it contributes to over a fifth of global emissions since most of the sector is still heavily dependent on fossil fuels. While light vehicles are the dominant category when analyzing emissions distribution, due to prevalence and frequency of use, the aviation sector is also a considerable polluter with expected increases in emissions as the world's demand increases.

Keywords— Sustainable aviation, SAFs, Climate change, emissions.

Sustainable Agricultural Techniques and Farming Systems in Ethiopia: A Comparative Study

Misganaw Ayele Gelaw

Abstract—

1. INTRODUCTION:

Ethiopia, with its rich agricultural heritage and diverse climate, has been facing various challenges related to sustainable agriculture and farming systems. This research study aims to examine the current sustainable agricultural techniques and farming systems in Ethiopia and compare their effectiveness in terms of environmental conservation, economic viability, and social sustainability.

2. RESEARCH OBJECTIVES:

Identify and evaluate the existing sustainable agricultural techniques and farming systems in Ethiopia.

Assess the impacts of these techniques and systems on environmental sustainability, including soil fertility, water management, and ecosystem conservation.

Evaluate the economic benefits and feasibility of implementing sustainable agricultural practices for small-scale and large-scale farmers in Ethiopia.

Examine the social aspects of sustainable farming, including community engagement, knowledge sharing, and gender equity.

Generate recommendations for policymakers, farmers, and stakeholders for improving sustainable agricultural practices in Ethiopia.

3. METHODOLOGY:

a) Data Collection:

Conduct literature reviews of academic journals, research papers, and published reports on sustainable agricultural techniques in Ethiopia.

Review government policies, projects, and initiatives related to sustainable farming systems.

Engage with relevant stakeholders, such as farmers, agricultural experts, and representatives from NGOs, to gather local perspectives and insights.

b) Data Analysis:

Analyze collected data using quantitative and qualitative methods.

Compare and contrast different sustainable agricultural techniques and farming systems.

Assess the strengths, weaknesses, opportunities, and threats associated with each technique/system.

4. STUDY AREAS:

The research study will focus on different regions of Ethiopia to represent the diversity of agricultural practices across the country. Study areas include Oromia, Amhara, Tigray, and Southern Nations, Nationalities, and Peoples' Region (SNNPR).

5. EXPECTED OUTCOMES:

Identification and documentation of sustainable agricultural techniques and farming systems currently implemented in Ethiopia.

Evaluation of the environmental, economic, and social impacts of these techniques/systems.

Insights into the challenges and opportunities faced by farmers in adopting sustainable agriculture practices.

Recommendations for policymakers, farmers, and stakeholders to enhance the adoption and implementation of sustainable farming practices in Ethiopia.

6. TIMELINE:

The research study was conducted over a period of six months, as outlined below:

Month 1: Literature review and data collection.

Month 2-3: Data analysis and comparison of sustainable agricultural techniques and farming systems.

Month 4-5: Assessment of environmental, economic, and social impacts.

Month 6: Report writing, conclusion, and recommendations.

7. ETHICAL CONSIDERATIONS:

Ensure the confidentiality and anonymity of participants during data collection.

Obtain proper consent from participants, ensuring their willingness to participate in the study.

Maintain the integrity of the research process by following ethical guidelines and standards.

8. CONCLUSION:

This research study aims to shed light on the current state of sustainable agricultural techniques and farming systems in Ethiopia. By evaluating their effectiveness, this study will provide valuable insights and recommendations for improving agricultural practices, fostering environmental conservation, and enhancing the livelihoods of farmers.

Keywords— food security, sustainable agriculture, development, technology.

The Effect of Artificial Intelligence on the Production of Agricultural Lands and Labor

Ibrahim Makram Ibrahim Salib

Abstract— Agriculture plays an essential role in providing food for the world's population. It also offers numerous benefits to countries, including non-food products, transportation, and environmental balance. Precision agriculture, which employs advanced tools to monitor variability and manage inputs, can help achieve these benefits. The increasing demand for food security puts pressure on decision-makers to ensure sufficient food production worldwide. To support sustainable agriculture, unmanned aerial vehicles (UAVs) can be utilized to manage farms and increase yields. This paper aims to provide an understanding of UAV usage and its applications in agriculture. The objective is to review the various applications of UAVs in agriculture. Based on a comprehensive review of existing research, it was found that different sensors provide varying analyses for agriculture applications. Therefore, the purpose of the project must be determined before using UAV technology for better data quality and analysis. In conclusion, identifying a suitable sensor and UAV is crucial to gather accurate data and precise analysis when using UAVs in agriculture.

Keywords— agriculture land, agriculture land loss, Kabul city, urban land expansion, urbanization agriculture yield growth, agriculture yield prediction, explorative data analysis, predictive models, regression models drone, precision agriculture, farmer income.

Studies on the Use of Locally Available (Coxs Bazar and Saint Martin) Renewable Seaweed Wastes as Compost Organic Fertilizer Resources

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Abstract

Marine red algae from the Bangladesh Bay of Bengal *Hypnea* Sp have been used as organic materials due to the presence of a number of plant growth-stimulating compounds. The effect of various seaweed species on plant growth and development with an emphasis on the use of this renewable bio-resource in sustainable agriculture of northern fertilizers raw materials system. Organically made fertilizers play an important role in increasing crop yield and the quality of crops promises improvements considering climate adaptation. Seaweed wastes compost was put in evaluation trials at Sreemangal, Bangladesh to evaluate its efficacy and find out the optimum dose for profitable Betel leaf production. This part of the study is directed toward the analysis of the future trend and performances of composting seaweed wastes. The science of seaweeds explores, how analysis of the future trend and performances of composting seaweed wastes. A field study was conducted at three treatments at Khasia farmers of Sreemangal Khasia betel leaf cultivation community area of Bangladesh. Seaweed wastes mixed with compost organic fertilizer dose of 25g and 50g per support tree . The highest betel leaf yield was obtained from seaweed wastes mixed with compost organic fertilizer applied to plants. Table 1. (2880 leaf). The use of seaweed based compost organic fertilizer had a positive effect of betel leaf yield. This study suggests that seaweed wastes mixed with organic fertilizer are suitable for betel leaf cultivation. Area-based conservation is a key tool for delivering the Sustainable Development Goal of responsible production and consumption and climate action.

Keywords: Seaweed, Plant Growth, Organic Material, northern fertilizer, Sustainable.

INTRODUCTION

Background

Seaweeds , also known as marine macroalgae, have gained attention as a potential sustainable and organic compost fertilizer resource due to their rich nutrient content and numerous environmental benefits: Seaweeds are abundant in coastal regions and have been traditionally used for various purposes, including as a soil conditioner and fertilizer. Seaweeds are rich in essential nutrients such as nitrogen (N), phosphorus(P),potassium(K) and trace elements like iron, magnesium and calcium. These nutrients are crucial for plant growth and development, making seaweed an excellent natural fertilizer source. Seaweeds are an organic and renewable resource, making them suitable for organic farming practices. When incorporated into compost, they enhance the

organic matter content of the soil, improving soil structure, water retention and microbial activity. Seaweeds contain various growth promoting compounds like cytokinins, auxins and gibberellins, which act as natural biostimulants. These compounds can enhance seed germination, root development and overall plant vigor. Seaweeds have allelopathic properties that can suppress weed growth and deter certain pests, reducing need for chemical herbicides. Using locally available seaweeds for compost reduces the need for synthetic fertilizers, which can lead to nutrient runoff and water pollution. It also promotes sustainable harvesting practices, reducing the impact of marine ecosystems. Seaweed compost enhances soil structure, increases nutrient availability and encourages beneficial microorganisms, contributing to improved soil health and fertility. Incorporating seaweed compost reduces the reliance on synthetic chemicals in agriculture, aligning with organic and sustainable farming practices. Research has shown that seaweed based compost can enhance crop yields, improve crop quality and increase resistance to environmental stressors such as drought and disease. Utilizing locally available seaweeds can create economic opportunities for coastal communities and reduce transportation costs associated with importing conventional fertilizers.

Providing a safe alternative to chemical fertilizers is a crying need of present time. Although chemical crop fertilizers boost crop yield. They are also responsible for environmental pollution all around the world. Northern Organic and Balanced fertilizers provide a safe alternative to chemical fertilizers while having more agricultural output and reducing chemical fertilizer usage.

Technology based Circular Economy Model -Supplies plant food to both crop and soil in an integrated way, Increase production and reduce cost, Fertilizer can be used easily and directly by the farmers, no hassle of calculating, mixing and handling, Fertilizer also contains essential micro nutrients, Enhance crop quality and storage capacity, Safeguard the environment. Seaweeds or marine macroalgae are rich in diverse compounds like lipids, proteins, carbohydrates, phytohormones, amino acids, osmoprotectants, antimicrobial compounds and minerals. Their potentials for agricultural applications has been used since antiquity, but recent demands of organic farming and organic food stimulated much the application of organic treatments like seaweed extracts in agriculture.

The benefits of seaweeds application in agricultural field are numerous and diverse such as stimulation of seed germination, enhancement of health and growth of plants namely shoot and root elongation, improved water and nutrient uptake, frost and saline resistance, biocontrol and resistance toward phytopathogenic organisms, remediation of pollutants of contaminated soil and fertilization. In this review, scientific progress in this field was collected and critically assessed to lay grounds for further investigations and applications.

Seaweeds are the important marine resources available at negligible cost and rich in diverse bioactive compounds like lipids, proteins, carbohydrates, amino acids, phytohormones, Osmo protectants, mineral nutrients and antimicrobial compounds. They are key component in food, feed, and medicine since ancient times. Recent trend of organic farming has exploited the possible application of seaweed as organic/bio-fertilizer in agriculture. Many studies have demonstrated the benefits of seaweed in enhancing the plant growth and productivity. Added to this they are known to be a promising soil conditioner, protect the plants under abiotic and biotic stress and increase plant resistance against pest and diseases. In this chapter an attempt has been made to highlight the scientific progress on usefulness of seaweed in the context of utilization in agriculture as organic fertilizer and prospects for further research and use. Seaweeds are marine plants contributing significantly to the society, economy and environment. Worldwide suitable seaweeds farming areas cover approximately 48 million km² across 132 countries,

although about 37–44 countries are active in production with only 0.001% of suitable area Froehlich et al (2019) .

Seaweeds farming is one of the fast-growing sectors in the world with an annual production of ~32.4 million tonnes (wetweight) in 2018 valued at US\$11.8 billion, which is expected to rise US\$22.13 billion by 2024 Cotas et al, (2020), Froehlich (2019).

Compared to land-based crop production using expensive fertilizers and harmful pesticides, seaweeds extract nutrients from the water, purify surrounding water and maintain ecosystem health, thereby sustaining a viable habitat for marine organisms Hasseltr. et al (2018). For instance, seaweeds aquaculture in China annually removes about 75,000 tons of nitrogen and 9500 tons of phosphorus that can significantly mitigate coastal eutrophication XiXiao ., et al (2017).

Moreover, the symbiotic system of seaweeds and bacteria constitutes an ecological basis for natural treatment of running waters. Additionally, seaweeds are characterized by a rapid increase in biomass and contribute to climate change adaptation by protecting seashore from erosion, elevating pH and supplying oxygen to the aquatic ecosystem, and thus locally reducing ocean acidification and deoxygenating effects ChungI. *et al.* (2013), Duarte *et al.* (2017), Fernandez. et al. (2019), Krause -Jensen. et al (2015). The use of seaweeds as carbon dioxide scavengers contributes to mitigation of atmospheric CO₂ and in turn, reducing the effect of global greenhouse Sondak et al (2017).

Significance of the study

After reviewing many literatures on compost organic fertilizer and seaweeds, In the present review, compost is described as an excellent soil amendment and a biocontrol agent which make it the best organic fertilizer and more eco-friendly as compared to chemical fertilizers. compost is an ideal organic fertilizer for better growth and yield of many plants. It can increase the production of crops and prevent them from harmful pests without polluting the environment.

OBJECTIVES OF THE STUDY

Objectives will guide the research in understanding the performance and practical implications of composting seaweed waste.

Main Research objectives-

Performances of composting Bangladesh Bay of Bengal Hypnea Sp seaweed wastes.

Research objectives for a study on the performance of composting seaweed waste include-

1. Assessing the effectiveness of different composting methods for seaweed waste.
2. Determining the optimal composting conditions- temperature, moisture, C/N ration, for seaweed waste decomposition.
3. Analyzing the potential use of seaweed based compost in Betel leaf cultivation.

MATERIALS AND METHODS



Sreemangal- Moulvibazar, Bangladesh

Location of the study Area

A field study was conducted at three sites at Khasia farmers of Sreemangal khasia betel leaf cultivation community area of Sreemangal, Bangladesh.

Duration- Six months.

Design of the experiment –

T₁ = Farmers practice (control)

T₂ = Seaweed wastes mixed organic compost fertilizer 25g per support tree.

T₃ = Seaweed wastes mixed organic compost fertilizer 50g per support tree



Seaweed

Organic Fertilizer

Betel Leaf

Betel Leaf with support tree

The present study proceeds to examine the following research questions:

1. Main research question-The Science of Seaweeds explores how analysis of the future trend and performances of composting seaweeds wastes ?

RESULTS

A step by step guide for betel leaf farming (Pan), planting, plant care, harvesting procedure along with economics and profit of betel leaf cultivation. Sample rich Khasia farmers of Sreemangal khasia betel leaf cultivation community area map selected for meticulous study.

After the field work primary and secondary data collected from different areas. The highest betel leaf yield was obtained from seaweed wastes mixed with compost organic fertilizer applied to plants. Table 1. (2880 leaf) showed highest betel leaf production. This study suggests that seaweed wastes mixed with organic fertilizer are suitable for betel leaf cultivation.

TABLE 1. Yield of betel leaf as influenced by seaweed wastes based organic fertilizer

Treatments	Description	Betel Leaf Plucking per day
T ₁	Farmers practice (control)	2780 ±
T ₂	Seaweed wastes mixed organic compost fertilizer 25g per support tree	2780 ±
T ₃	Seaweed wastes mixed organic compost fertilizer 50g per support tree	2880 ±

"In this case, 'Farmers practice (control) 2780 ± betel leaf plucking per day' is the description of Treatment 1. Treatment 1 involves farmers practicing a controlled method of plucking betel leaves, aiming for an average of 2780 leaves per day. The '±' indicates that there is a range of variation around this average, which could be influenced by various factors."

"Treatment T2 involves the application of seaweed waste mixed with organic compost fertilizer at a rate of 25 grams per support tree. The aim of this treatment is to study its effects on betel leaf production. Similar to Treatment T1, the statement '2780 ± betel leaf plucking per day' indicates that farmers under Treatment T2 are expected to pluck an average of 2780 betel leaves per day, with a certain degree of variability or fluctuation within a specific range around this average. This experimental setup compares the effects of different agricultural treatments (T1 and T2) on betel leaf production, with Treatment T1 serving as a control and Treatment T2 involving the application of seaweed waste mixed with organic compost fertilizer. The ± symbol indicates the expected range of variation in the number of leaves harvested per day around the average of 2780."

"Treatment T3 involves a similar approach to Treatment T2, with seaweed waste mixed with organic compost fertilizer being applied, but at a higher rate of 50 grams per support tree. This treatment is likely being studied to assess the impact of a higher application rate of fertilizer on betel leaf production. The statement '2880 ± betel leaf plucking per day' indicates that, similar to the other treatments, farmers under Treatment T3 are expected to pluck an average of 2880 betel leaves per day, with the ± symbol representing the expected range of variation around this average. This variability suggests that the actual number of leaves harvested per day may fluctuate within a certain range around the average of 2880. Just like Treatments T1 and T2,

Treatment T3 is likely part of an experiment or study comparing different agricultural practices' effects on betel leaf production.

CONCLUSION

Khasia community people in Sreemangal Upazila, Bangladesh are used to cultivating betel leaf as their main livelihood. It is their only living means. Their families live on sale of several Kuri (20 kanta or 2880 pieces) of betel leaves daily.

Marine red algae from the Bangladesh Bay of Bengal *Hypnea* Sp have been used as organic materials due to the presence of a number of plant growth-stimulating compounds. The effect of various seaweed species on plant growth and development with an emphasis on the use of this renewable bio-resource in sustainable agriculture of northern fertilizers raw materials system. Organically made fertilizers play an important role in increasing crop yield and the quality of crops promises improvements considering climate adaptation. Seaweed wastes compost was put in evaluation trials at Sreemangal, Bangladesh to evaluate its efficacy and find out the optimum dose for profitable Betel leaf production. This part of the study is directed toward the analysis of the future trend and performances of composting seaweed wastes. The science of seaweeds explores, how analysis of the future trend and performances of composting seaweed wastes. A field study was conducted at three treatments at Khasia farmers of Sreemangal Khasia betel leaf cultivation community area of Bangladesh. Seaweed wastes mixed with compost organic fertilizer dose of 25g and 50g per support tree . The highest betel leaf yield was obtained from seaweed wastes mixed with compost organic fertilizer applied to plants. Table 1. (2880 leaf). The use of seaweed based compost organic fertilizer had a positive effect of betel leaf yield. This study suggests that seaweed wastes mixed with organic fertilizer are suitable for betel leaf cultivation. Area-based conservation is a key tool for delivering the Sustainable Development Goal of responsible production and consumption and climate action.

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Assessment of Sustainability in the Wulo Abiye Watershed, Central Highlands of Ethiopia

Getabalew Derib , Arragaw Alemayehu *

Abstract— Assessing the sustainability of watersheds holds significant importance for regional natural resource management and to achieve sustainable development. This study investigated the sustainability of the Wulo Abiye watershed, central highlands of Ethiopia. The sustainability status of the watershed was evaluated by using 17 indicators representing the economic, social, and environmental dimensions of sustainable development goals (SDGs) based on the local and existing conditions of the watershed. The results indicated that environmental sustainability was at a 'high' level, while social and economic sustainability and the aggregate index were at 'moderate' levels. The overall level of community participation in the planning and evaluation phases of watershed management was at 'low' levels. The implementation phase was at 'high' level. Overall, the sustainability status of the watershed management practices and the level of community participation were at a moderate level. The study concluded that integrated support is needed to overcome the identified challenges to achieve sustainable development in watersheds.

Keywords—: Wulo Abiye watershed, Community participation, Watershed management, and sustainable development.

1. INTRODUCTION

Ethiopia's highlands have been seriously affected by land degradation and soil erosion. Topography, geology, climate, population growth, the nature of the economy and land related policy are contributing factors [1], [2], [3]. This impacts agricultural sustainability and national food security [4], [5].

In response, the Ethiopian government has initiated national watershed management campaigns through soil and water conservation and tree planting. Large areas are covered by terraces, soil bunds, stone bunds, and millions of tree seedlings [6], [7], [8]. These initiatives also serve as climate change mitigation measures [5].

Watershed management plays a critical role in achieving the UN Sustainable Development Goals (SDGs) [9]. (directly contributing to more than 41 % of the targets. This included ending poverty (Goal One), ending hunger (Goal Two), good health and well-being (Goal Three), sustainable economic growth (Goal Eight), sustainable production (Goal Twelve), climate change mitigation (Goal Thirteen), and protecting and restoring degraded lands (Goal Fifteen) [10]. Environmental sustainability, which is central to the 2030 Agenda, is directly linked with more than half of the 17 SDGs [11]. This clearly shows that the issue of sustainability in watershed

management has received due attention in the SDGs.

Since 1970, there has been a long history of watershed management initiatives in Ethiopia [8]. Due to the top-down strategies, poor integration, and unmanageable watersheds (for monitoring and management), most of the implemented measures failed. These call for a shift towards a sustainable development approach that encompasses community participation and livelihood integration [8]. Thus community-based participatory watershed development approach has established [7].

Despite the extensive soil and water conservation efforts initiated by the government, NGOs, and the community, challenges in sustaining watershed management persist in the country including the Wulo Abiye watershed. These are ongoing soil erosion, a decrease in soil fertility, and unsustainable natural resource use. Many watersheds are food insecure [1], [6]. The community repeatedly implemented various soil and water conservation activities on the same land every year. However, these conservation efforts end in crises and make watershed management practices unsustainable.

Assessing the sustainability of watersheds holds significant importance for natural resource management and achieving sustainable development [12]. To ensure the sustainability of watershed management, it is crucial to measure the levels of community participation in the planning, implementation, and evaluation phases of watershed management [13]. Studies on the sustainability of watershed management have been limited in Ethiopia. The available studies have focused on socioeconomic and biophysical constraints [14], [15], financial and incentive constraints [16], lack of policy implementation [14], [17], and community participation [8], [18]. [19] offer valuable insights by focusing on sustainability, institutional arrangement, and challenges of community-based climate smart practices.

To the best of our knowledge, there are no published studies assessing the sustainability status of watershed management in the country. An in-depth assessment of watershed sustainability is therefore needed to implement appropriate watershed management strategies and address sustainability [12]. Hence, this study focused on assessing the existing sustainability status of watershed management by taking the Wulo Abiye watershed as a case study site and using indicators selected from social, economic, and environmental pillars of sustainable development. The study's outcome will lead to the generation of evidence-based data on the sustainability of watershed management, which could be used for water resource management, agricultural development, and

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climate change adaptation.

2. MATERIALS AND METHODS

2.1. Description Of The Study Area

The watershed is located from 10°13'31"N to 10°14'59"N and 39°45'13"E to 39°47'9"E, with an elevation between 3081 and 3231 m above sea level (Fig. 1). The primary economic activity in the area is agriculture.

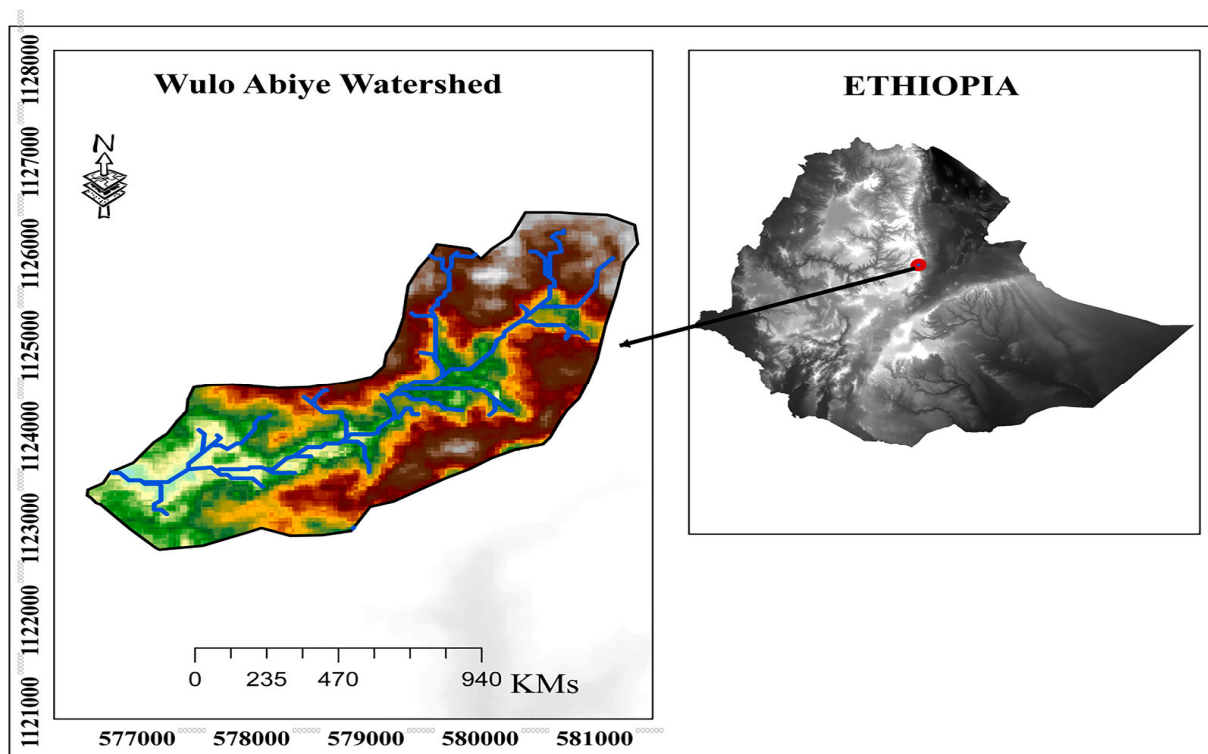


Fig. 1. Location of the study area.

Barley is the dominant crop grown under rained agriculture with limited traditional irrigation. Sheep are the dominant livestock in the area. The total population of the watershed is 817, of which of which 498 (61 %) are males and 319 (39 %) are females. About 27 % of the total area is mountainous, 25 % is rugged terrain and 48 % is plain lands. Black soils cover about 10 % of the area, reddish soils cover about 35 % and brownish soils cover about 55 %. The major land-use types include cultivation (78 %), forest and bush (10 %), grassland (9 %). The remaining 3 % included bare land, settlement and waterbody. It has an annual rainfall of 1057 mm; while the annual maximum and minimum temperature range between 8 °C and 21 °C, respectively[4], [20].

2.2. Data Collection and Analysis

The Wulo Abiye watershed was purposely selected based on severe and accelerated land degradation, food insecurity, and vulnerable to climate change and variability. The watershed has a total of 382 households, of which 213 (56 %) are males and 169 (44 %) are females. The study used two datasets: quantitative data from a survey of 102 households and qualitative data from two focus group discussions, ten key informant interviews, and field observations. A list of watershed communities was used to randomly select 102 respondents (representing 27 % of the households). The

formula provided by [21]. was used to determine the sample size of the respondents.

$$n_0 = \frac{z^2 pq}{d^2} \text{ --- (equation 1)}$$

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \text{ --- (equation 2)}$$

$$n_0 = \frac{z1.96^2 * 0.1 * 0.9}{0.05^2} = 138$$

$$n = \frac{138}{1 + \frac{(138 - 1)}{N382}} = 102$$

Where,

n = number of sample size when the population is less than 10,000

n0= desired sample size

Z = 95 % confidence limit, i.e. 1.96

p = 0.1 (proportion of the population to be included in the sample i.e.10 %)

q = 1-0.1 i.e. (0.9)

N = total number of population that is 382 and

d = margin of error or degree of accuracy desired (0.05).

Before conducting the survey, respondents provided informed consent, and no personally identifiable information was collected during data collection. The quantitative data were used to develop a watershed sustainability index, while the qualitative data substantiate the results obtained from the quantitative results. The focus group discussions were conducted with the watershed committee and the watershed community, while the key informant interviews were carried out with knowledgeable farmers having long years of farming experience, agricultural development workers, district natural resources and small-scale irrigation development experts, and youth association.

2.2.1. *Assessing Sustainability in Watershed Management*

To assess watershed management sustainability, various approaches can be used depending on the objective, scale, and scope of the assessment. These approaches included the use of indicators or indices, integrated assessment tools, and a barometer of sustainability [12]. In this study, the sustainability of watershed management is measured by constructing indicators selected from the social, economic, and environmental pillars of sustainable development. This method is easy to use and describes local and existing conditions of watershed management [22].

To measure the sustainability of the Wulo Abiye watershed, the criteria developed by [22] to measure the sustainable development status of micro and small enterprises was adapted, with modifications made to the watershed context.

Seventeen indicators encompassing the economic, social, and environmental dimensions of sustainability were identified based on the local and specific conditions of watershed management. These indicators, along with their sub-components and assumed relationships with sustainability, are presented in Table 1. During the evaluation, the indicators were assessed at three levels of sustainable development: 'low', 'moderate' and 'high' with values of <50 %, 50–75 %, and >75 %, respectively. This is a linear average explained in terms of the percentages of respondents and so does not give weight to the different criteria. These values provide a measure of the extent to which sustainable development measures have been implemented for each indicator. To determine the overall sustainability status of watershed management, the indicator scores are aggregated. Equal weights are assigned to each indicator, if all the indicators have equal importance in assessing sustainability. However, the use of equal weights has advantages and limitations. Equal weights are easy to use and are free from bias in the evaluation process. In contrast, equal weights might not accurately reflect the relative importance of each indicator [22].

2.2.2. *Measuring Levels of Community Participation in Watershed Management*

To ensure the sustainability of watershed management, it is crucial to measure the levels of community participation at different phases of watershed management [13]. These phases include planning, implementation and evaluation. Variation in the level of participation on watershed management affects motivation to participate in campaigns, follow-up on

Table 1 Indicators, sub-components, and assumed relationships with sustainability

Indicator	Sub-components	Description and assumed
Environmental sustainability	Reduce soil loss	Soil and water conservation measures have been proven effective ways to reduce soil loss[23]
	Increase groundwater level	Watershed management activities have improved surface and ground water availability [24].
	Increases soil fertility	Watershed management activities aimed at alleviating runoff can significantly improve soil fertility and depth [7].
	Increases soil moisture	Watershed management interventions have a key role in improving soil moisture [3]
	Increases vegetation cover and biodiversity	Watershed management intervention at a given area likely contributes to improve biodiversity and natural environment[24]
Economic sustainability	Improve crop yields and farm income	Watershed management intervention has increased soil fertility and crop productivity[24]
	Create job opportunities for disadvantaged groups	Watershed management intervention brought improve income source of the society specially for youth and landless [25]
	Enhances food supplements for livestock	Watershed management intervention has increased the availability of pasture for their livestock in the watershed [24]
	Diversification of income sources	Due to the introduction of watershed management, income diversification has occurred from crops under irrigated and rain-fed farms[25]
	Increased irrigation area	The implementation of watershed management has great impact on the availability of surface and ground water and it leads to the expansion of irrigation[25]
Social Sustainability	Access to extension service	The knowledge and skills gained through extension service accelerate farmer's decision on conservation practices [26]
	Community awareness	People have understood the importance of watersheds and are working harder to uplift their economic status [27]
	Increased recreational opportunities	Watershed development has diverse social benefits like amenities and shade value, meeting places for various social events, and recreational purposes [28]
	Build and strengthen community institutions	Watershed requires cooperation among stakeholders and requires the establishment of institutions and customary rules that can address the benefit and cost sharing systems[29]
	Reduces conflict over resources like water	Soil and water conservation measures enhance infiltration and can lead to improved water availability and regulated seasonal streamflow fluctuations[29]
Social Sustainability	Improved food security status	Watershed management interventions have a key role in contributing to poverty alleviation and sustainable livelihoods [3]
	Access to healthcare and social services	Watershed development can have indirect impacts on healthcare by improving food and nutrition security[30]

structures, and ownership. This in turn affects watershed sustainability. The active involvement of all stakeholders in all phases is crucial for the long-term success of watershed management [15]. To measure the level of community participation in watershed management, the criteria developed by [31] to measure the extent to which people participated in different stages of watershed programs was adapted, with modifications made to the local context.

$$PPI = \frac{\text{mean participation } (p)}{\text{max participation}} * 100$$

$$P = \frac{\sum_{i=1}^N pi}{N}$$

$$pi = \sum_{j=1}^k (PPj + PIj + PMj)$$

Where,

PPj = total score obtained by a respondent due to participation in program planning;

PIj = total score obtained by a respondent due to participation in program implementation;

PMj = total score obtained by a respondent due to participation in program evaluation;

k = total number of activities on which the responses of the respondents were recorded;

p_i = Total participation scores obtained by individual respondents in planning, implementation and evaluation.

PPI=people participation index

Table 2 Watershed management phases, activities, and description.

p = mean participation score

N = Total number of respondents

Phase	Activities	Description
Planning	Site selection of watershed area	Area selection is an activity in which a degraded land selected as a watershed area[32]
	Identification and prioritization of problems	Working with community members to collectively identify their problem and priority needs [33]
	plan preparation for resource management	Collaborating with residents to assess socio-economic and environmental problems and potential areas for management interventions [33]
	Formulation of Customary rules	Customary rules shape how natural resources are used and conserved in a given area, promoting sustainable management [34]
	Time scheduling	Develop action plans that align with the identified needs and priorities [33]
	Identification of active work forces	Identification of individuals of any gender between the ages of 18 and 65 to participate in local watershed activities[25]
Implementation	Soil and water conservation Work	The workforce was actively participating in physical SWC soil conservation mechanisms[25]
	Digging of planting pit	he workforce was actively participating in preparation for biological soil conservation mechanisms[25]
	Planting of seedlings	The workforce was actively participating in biological soil conservation mechanisms[25]
	Management activity	The participation of the working force in the protection of biological conservation measures.[25]
Evaluation	Sharing information and Consultation	Exchanging data, insights, and feedback among watershed communities[33]
	Assessment of results and limitations	It is the act of assessing WSMs achievements and failures through subjective analysis[33]
	Capacity Building and Empowerment	Building the capacity of local communities and extension workers is an important component in watershed management[33]

Community participation was assessed and measured in relation to the three stages of participation; planning, implementation evaluation through a five-point continuum scale (1 = never, 2 = rarely; 3 = sometimes; 4 = often; and 5 = always). An instrument consisting of 12 activities was developed and used to measure community participation. These activities were identified through conducting field surveys, consulting with local experts and reviewing literature. Each activity was rated against three levels namely, ‘low’, ‘moderate’ and ‘high’ with values of <50 %, 50–75 % and >75 %, respectively. The scores for each of these items are aggregated to determine the overall level of community participation as did in the sustainability assessment. Table 2 presented watershed management phases, activities, and description.

3. RESULTS AND DISCUSSION

3.1. Background of Respondents

The average age of the respondents is 46.0 years and varied between 27 years and 71 years. About 75 % are males and 25 % are females. Almost all respondents are within the active working-age group and there is a high chance of engaging in labor demanding watershed management practices. The average family size was 4.7. Large family size implies a high level of participation in watershed management. Educational levels are low: more than 73 % of them have not attended any formal education. These have negative implications on participation in watershed management.

3.2. Sustainability Status of Watershed Management

3.2.1. Component Wise Sustainability

3.2.1.1. Environmental Sustainability.

Table 3 presents component wise sustainability assessment. The environmental sustainability of watershed management was assessed using conditions of natural resources and watershed services. Results indicated that of the five subcomponents, reducing soil loss and increasing groundwater level were found at ‘high’ levels and had

scores of 94 % and 77 %, respectively. An increase in soil fertility, vegetation cover and biodiversity, and soil moisture were found at ‘moderate’ levels with a score ranging from 68 % to 72 %. The indicator wise assessment of environmental sustainability had a score of 76 %, implying environmental sustainability was found at ‘high’ level. This finding is different from a study focusing on sustainability, institutional arrangement, and challenges of community-based climate smart practices in northwest Ethiopia where environmental dimension of climate smart practices can be sustained but at a risk level [19]

Regarding the rehabilitation of natural resources such as soil, water, and vegetation cover, a 63- year-old farmer, a key informant explains: over the past several decades, the government has implemented comprehensive soil and water conservation campaigns that focus on watershed management. These initiatives did not significantly contribute to enhancing ecosystem services and improved livelihoods. However, the approach did not initially consider the concerns of the community as it mainly aimed to satisfy the campaign objectives. As a result, the community developed a sense of participation through obligation without their consent and priorities. Recently, we observed a slight improvement in ownership and participation within the community which brought positive outcomes from the watershed.

3.2.1.2. Economic Sustainability.

Improve crop yields and farm income, create job opportunities for disadvantaged groups, diversification of income sources, enhances food supplements for livestock and increased irrigation area were used to assess the economic sustainability of watershed management. These sub-components can maximize the wellbeing of the community through the optimal use of natural resources. Accordingly, crop yields and farm income improved, job opportunities were created for disadvantaged groups, food supplements were enhanced for livestock, and income sources were diversified at ‘moderate’ levels, with a score ranging from 54 % to 73 %. Increased irrigation area was

found at a ‘high’ level of sustainability, with a score of 77 %. The indicator wise assessment of economic sustainability had a score of 68 %, which was rated at ‘moderate’ level [19] reported that the economic dimension of climate smart practices in northwest Ethiopia had positive outcomes and found at sustainable level.

Participants of the focus group discussion (FGD) and key informant interview (KII) highlighted that watershed management intervention had a positive impact on the well-being of individuals and society in the study area. They mentioned that various watershed management activities, such as biological and physical soil and water conservation, resulted in increased surface and groundwater availability. This, in turn, led to increased cropping intensity and expanded irrigation areas, allowing farmers to produce not only crops but also vegetables such as potatoes, carrots, onions, and red roots.

3.2.1.3. Social Sustainability.

The social sustainability of watershed management was assessed by focusing on how management practices impact community well-being, social cohesion, equitable resource distribution, stakeholder engagement, livelihoods, access to social services, and governance. Access to extension services, community awareness, increased recreational opportunities, conflict reduction, food security improvement, and healthcare and social service access were used to measure social sustainability of watershed management. Results indicated access to extension service, which is an important source of information for any agricultural technology adoption and climate change adaptation, was at ‘low’ level of sustainability with a score of 48 %. Watershed committee and other community institutions enhance the sustainability of watersheds. Accordingly, building and strengthening community institutions were at ‘high’ level with a score of 78 %. Overall, social sustainability was at ‘moderate’ level with a score of 60 %. This assessment shows conditions for improvement compared to other dimensions of sustainability. Enhancing social sustainability requires

Table 3

Indicator wise sustainability status of the Wulo Abiye watershed.

Indicators	Sub-components	Score	Status
Environmental sustainability	Reduce soil loss	94	High
	Increase groundwater level	77	High
	Increases soil fertility	68	Moderate
	Increases soil moisture	72	Moderate
	Increases vegetation cover and biodiversity	71	Moderate
	Improve crop yields and farm income	71	Moderate
Economic sustainability	Create job opportunities for disadvantaged groups	73	Moderate
	Enhances food supplements for livestock	63	Moderate
	Diversification of income sources	54	Moderate
	Increased irrigation area	77	High
	Access to extension service	48	Low
	Community awareness	65	Moderate
Social sustainability	Increased recreational opportunities	55	Moderate
	Build and strengthen community institutions	78	High
	Reduces conflict over resources like water	52	Moderate
	Improved food security status	66	Moderate
	Access to healthcare and social services	54	Moderate

promoting social cohesion, community engagement, equitable resource access, and emphasis on education and awareness[19] reported that the social dimension of climate smart practices in northwest Ethiopia can be sustained but are at risk level.

A district natural resources expert, a key informant explains:

The implementation of watershed management in the Wulo Abiye watershed has resulted in the formation of a watershed user cooperative. This cooperative provides numerous advantages for land management and sustainability of the watershed, including the development of strategic and annual plans for the watershed, providing support for watershed activities, managing the watershed's resources sustainably, serving as a representative for the watershed in development initiatives, and engaging communities in watershed development to address local challenges.

3.2.2. Overall Status of Sustainability

The overall sustainability was assessed from the ratings of each pillar (Table 4). The overall sustainability of watershed management was assessed by considering environmental, economic, and social indicators. Accordingly, environmental sustainability was at 'high' level with a high score of 76 %, indicating that natural resource rehabilitation and watershed services were in good condition, contributing to the conservation and improvement of the environment. This approach is beneficial for ensuring ecological health and overall

sustainability of management systems. Economic and social sustainability were at 'moderate' level with a score of 67 % and 60 %, respectively. This suggests more effort is needed to improve economic and social aspects of the watershed. The overall sustainability was assessed from the ratings of each pillar. Accordingly, Wulo Abiye watershed was at 'moderate' level with a high score of 68 %. This indicates that the sector is not fully operating in economic, social, and environmental aspects.

Despite the significant efforts in watershed management made by the government of Ethiopia, only environmental sustainability was at 'high' level, while the rest were at 'moderate' levels. Environmental sustainability is indeed a central focus of the SDGs, and watershed management plays a crucial role in achieving this objective[9]. As highlighted by [10], watershed management, especially soil and water conservation practices, directly contributes to more than 41 % of the 2030 UN-SDGs. Nevertheless, results indicated that the need for a balance among environmental, economic, and social aspects.

To achieve sustainable outcomes, it is essential to harmonize the objectives of watershed management with those of the SDGs, comprehensively addressing environmental, social, and economic sustainability. Sustainable watershed management must be environmentally compatible, economically viable, and socially acceptable. This requires integrated and holistic approaches that signify a shift toward sustainable use and integrated system-based management.

To achieve this, a comprehensive planning and involvement of stakeholders is needed to enhance the sustainability of the watershed. Continued investment in sustainable land and water management practices,

community engagement, capacity building, and conservation of natural resources can contribute to improving the overall sustainability in the watershed. By addressing the identified areas for improvement and building on existing initiatives, it is possible to enhance the

sustainability of Wulo Abiye watershed and contribute to the achievement of the SDGs in the other watershed as well. The overall assessment of sustainability in climate smart practices in northwest Ethiopia was found at a risk level [19].

Table 4

Overall sustainability status of watershed management s in the Wulo Abiye watershed.

Indicators	Score	Status
Environmental sustainability	76	High
Economic sustainability	67	Moderate
Social sustainability	60	Moderate
Overall/aggregate	68	Moderate

3.3. Community Participation in Watershed Management

Sustainability of watershed management is closely linked with the active participation of communities in the planning, implementation and evaluation phases of watershed projects [15]. Community participation increases acceptance, builds trust between communities and institutions, eases effective implementation of environmental policy, and develops ownership [35]. This ensures the sustainability of watershed management programs [35].

3.3.1. Level of Community Participation During The Planning Phase

During the planning phase of watershed management, the level of community participation was assessed in various activities (Table 5). The results indicated that participation across different aspects of the planning process was at 'low' level with a score of 40 %. From all aspects of the planning phase, nearly half of the respondents reported that the community was involved in time scheduling. The low level of community participation during the planning phase implies that decisions were made without the consent of the local community. In addition, results obtained from KIIs indicated that watershed management planning was begun from the top management and laid down to the lower administration level without involving the community. This affects sense of ownership which in turn affects the sustainability of the watersheds in the long run. On the other hand, if the community does not participate in the planning phase, it is difficult to properly implement and sustain the watershed activities. This shows the need to enhance community engagement and participation in this

critical stage. The findings are similar to a previous study by [36], who reported lower participation of the community during watershed program planning.

3.3.2. Level of Community Participation During The Implementation Phase

During the implementation phase of watershed management, 'high' level of community participation was observed with a score of 92 %. All respondents participated in soil and water conservation work and digging of planting pits. Almost 98 % of the respondents were involved in planting seedlings. The high level of community involvement suggests strong government enforcement for labor contributions during the implementation phase. This finding is in line with the study by [13] who reported a high level of community participation in watershed management programs during the implementation phase.

3.3.3. Level Of Community Participation During The Evaluation Phase

During the evaluation phase, activities such as sharing information and consultation, assessment of results and limitations, and capacity building and empowerment are considered. Some 30 % of the respondents participated in information sharing and consultation. About 30 % and 39 % of the respondents participated in capacity building and empowerment, and assessment of results and limitations, respectively. The overall community participation during the evaluation phase was 'low' level with a score of 40 %. The low level of community participation in the evaluation phases of watershed management programs results lack of follow-up on the structures and willingness to participate in the annual campaigns. [13] also reported low level of community participation in the evaluation phases of watershed management programs.

Table 5

Levels of community participation in different phases of watershed management practices.

Phase	Watershed management activities	Degree of participation in planning phase					Total participation
		Never	Rarely	Sometimes	Often	Always	
Planning	Site selection of watershed area	77	16	4	2	1	23
	Identification of problems	53	37	7	2	1	47
	plan preparation for resource management	60	30	7	2	1	40
	Customary rules	64	23	8	4	1	36
	Time scheduling	51	20	10	19	1	49
	Identification of active work forces	56	16	14	13	1	44
Implementing	PPI	60	24	8	7	1	40
	Soil and water conservation Work	-	2	3	45	50	100
	Digging of planting pit		46	25	27	3	100
	Planting of seedlings	2	47	31	18	2	98
	Management activity	31	41	18	9	1	69
	PPI	8	34	19	25	14	92
Monitoring	Sharing information and Consultation	70	13	9	7	1	30
	Assessment of results and limitations	61	25	7	6	1	39
	Capacity Building and Empowerment	70	13	10	6	1	30
Overall PPI	PPI	67	17	9	6	1	33
Overall PPI		45	25	12	13	5	55

3.3.4. Overall Community Participation in Watershed Management

Community involvement was most successful during the implementation phase of the watershed management program and rated a 'high' level with a score of 92 %. However, community participation during the planning and evaluation phases were at 'low' level, with scores of 40 % and 40 %, respectively. This indicates that there was greater enforcement by the local government for labor contribution. The involvement of the community in the critical stages (planning and evaluation) was limited. During field survey, it was observed that a significant number of farmers were implementing soil and water conservation practices mainly to avoid penalties from local administrators instead of a genuine commitment to the work. Furthermore, most farmers arrive at watersheds in the early morning but leave shortly afterward.

Generally, the overall community participation index was 'moderate' level with a score of 55 % (Table 6). The scores indicated that only some decisions were made in consultation with the local community. This finding is in line with the study by [18] who reported a moderate level of community participation in watershed management programs.

3.3. Associations between the Sustainability Status of Watershed Management and The Level of Community Participation

Understanding the association between watershed management sustainability and community participation is crucial for natural resource management. Overall, the sustainability status of watershed management and level of community participation were at 'moderate' levels. The study revealed high level environmental sustainability of watershed management while economic and social indexes were moderate. Community participation reached a peak level during the implementation phase. On the other hand, planning and evaluation phases observed moderate level of community participation, indicating varying degrees of involvement at different phases. Limited community participation in planning and evaluation significantly affects the sustainability of watershed management. Similarly, [18] reported inconsistencies in community engagement in different phases of watershed management programs.

To address these challenges and achieve sustainable outcomes, it is crucial to harmonize the objectives of watershed management with SDGs in a way to comprehensively address environmental, social, and economic aspects. This approach is vital for ensuring the long-term success of watershed management practices. Thus, understanding the association between the sustainability status of watershed management and community engagement is essential for achieving lasting positive environmental and socioeconomic impacts. A previous research indicated that greater community involvement leads to better sustainability outcomes [35].

When local communities actively participate in decision-making and implementation, long-term success in watershed management is more likely observed [15]. This

can lead to program sustainability, improved resource allocation, increased support for conservation efforts, and enhance policy effectiveness [6].

Table 6

Overall community participation in watershed management.

No	Participation phase	PPIs values	Level
1	Planning	40	Low
2	Implementation	92	High
3	Evaluation	33	Low
4	Overall PPI	55	Moderate

3.5. Challenges Faced in Sustaining Watershed Management

Sustaining watershed management faces different environmental, economic and social challenges. Some of these are shortage of farmland, free grazing, lack of follow-up, climate variability, limited youth participation, lack of integration between sectors and stakeholders' sectors, conflicts between households and local leaders, and lack of awareness. Addressing these multifaceted challenges is crucial for sustainable watershed management. These challenges were identified through conducting a field survey, consultation with local agricultural experts and elderly farmers, and reviewing literature [15], [25], [37], [38]. Table 7 presented challenges faced in sustaining watershed management.

3.5.1. Free Grazing

Results revealed that free grazing is a significant challenge for sustaining watershed management in the study area, with 88 % of respondents rating it as a high-level problem. This practice has adverse effects on soil and water conservation measures, crop residues, and the overall sustainability of watershed management. Moreover, results from FGDs confirmed that free livestock grazing in watersheds causes damage to biological and physical soil and water conservation measures. This finding aligns with the findings of [19] where free grazing is a major challenge in sustaining watershed management activities.

3.5.2. Shortage Of Farmland

The average landholding size was 0.85 ha, which is less than the national average (1.0 ha). Results revealed that farmland shortage was a critical challenge in sustaining

watershed management. About 86 % of the respondents reported shortage of farmland as the second most prominent factor affecting watershed management sustainability. In addition, results from KIIs and FGDs participants revealed that shortage of farmland results in reluctance to engage in watershed management practices, particularly physical soil and water conservation measures. This finding corroborates the results of [38] who reported that shortage of farm land is a major challenges in sustaining watershed management practices in Ethiopia.

3.5.3. Lack of Follow-Up

About 78 % of the respondents stated that lack of follow-up was a major challenge for sustaining watershed management. This has made the lack of follow-up the third most important constraint on the sustainability of watershed management activities. Insights from FGDs and KIIs confirm the seasonal and ad hoc nature of watershed management activities, emphasizing the substantial impact of this challenge. Similarly, [19] showed that the problem of sustainable watershed development is associated with a lack of follow-up.

3.5.4. Lack Of Awareness

About 76 % of the respondents reported that the community had low awareness on watershed management. The different soil and water conservation measures lack sustainability due to mismanagement and some deliberate actions. Participants in the FGD mentioned that although the community's awareness of watershed management has improved due to the outputs of watershed interventions, it has not achieved the expected level of success. Similarly, [15] reported that the low awareness level of the community in the Amhara National Regional State is an obstacle to the sustainability of watershed management projects.

Table 7

Challenges faced in sustaining watershed management.

No	Challenges	% of respondents
1	Shortage of land	86
2	Lack of community awareness	76
3	Free grazing	88
4	Lack of follow up	78
5	Lack of integration between sectors and stakeholders sectors	21
6	Climate variability	50
7	Limited youth participation	40
8	Conflicts between households and local leaders	20

3.5.5. Climate Variability

Almost half of the respondents reported that climate variability, particularly frost, was a challenge affecting the sustainability of watershed management. The heavy frost which occurrences from October to December and shortage of rainfall have impact on the sustainability of watershed management practices. Climate variability leads to destruction of biological conservation measures and rehabilitated area closures. The trees planted could not survive because of frost and prolonged dry conditions. [38] reported that climate change often has a negative impact on the sustainability of watershed management practices in Ethiopia. Similarly, erratic rainfall, and recurrent droughts lead to the deterioration of SWC practices in Konso, Ethiopia [39].

3.5.6. Limited Youth Participation

Watershed management activities are labor demanding. However, the results indicated there is limited participation of the youth due to landlessness. Some 40 % of the respondents replied that limited youth participation was a challenge for sustaining watershed management. According to results from FGD participants, involvement of youth in watershed management is increased from time to time due to the output of watershed intervention such as creating job opportunities from irrigation and forestation activities. However, the intervention was not as successful as expected. [37] showed that the unwillingness of young people to participate in conservation practices due to landlessness is a major challenge in watershed management practices in Ethiopia.

3.5.7. Lack of Integration Between Sectors And Stakeholders' Sectors

Lack of integration between sectors and stakeholders' sectors as a major barrier to implementing sustainable watershed management was mentioned by 21 % of the respondents. Results from key informant interviews showed that integration between sectors/stockholders are

important in sustaining watersheds. A working space was very difficult and marred with corrupt practices in the study town. This finding supports a previous study by [25], who found that uncoordinated interventions of actors and institutions within a watershed were the major challenge in watershed management practices.

3.6. Conflicts between Households and Local Leaders

Conflicts between households and local leaders were reported by some 20 % of the respondents. Results obtained from FGD and KII participants also confirmed that most watershed interventions are made without the consent of the local community. This not only affects the sustainability of the watershed but sometimes leads to conflicts between households and local leaders. Accordingly, some of the structures are deliberately destroyed. The results support a study by [37] who indicated that conflicts between households and local leaders is a major challenge for watershed management practices.

To assess the watershed management sustainability, the indicators approach, integrated assessment tools, and a barometer of sustainability are used depending on the objective, scale, and scope of the assessment. In this study, an attempt is made to develop the sustainability of watershed management using 17 indicators for the three pillars of sustainable development (economic, social and environmental). The indicators are aligned to local and existing conditions of watershed management. Moreover, the level of participation in watershed management affects watershed sustainability. With this assumption, the levels of community participation at different phases of watershed management (planning, implementation, and monitoring and evaluation) are measured using an instrument consisting of 12 activities developed through conducting field survey, consulting with local experts and reviewing literature. The 12 activities reflect the watershed context. These make our model different from the previously developed models.

4. CONCLUSIONS

This study presents an assessment of the sustainable development status of the Wulo Abiye watershed.

Indicators were selected from key sustainability determinants covering the economic, social and environmental dimensions as the three pillars identified based on local and existing conditions of the watershed. The results show environmental sustainability was at 'high' level. Social and economic sustainability and the aggregate index were at 'moderate' levels. Level of community participation during the implementation phase was at a 'high' level, while 'low' levels were observed in the planning and evaluation phases of watershed management. This affects sense of ownership, willingness to participate in the annual campaigns and lack of follow-up on the structures which in turn affects the sustainability of the watersheds in the long run. The result indicates a shift in approach to ensure the watershed remains environmentally compatible, economically viable, and socially acceptable. Sustaining watershed management faces different environmental, economic and social challenges which need to be managed in the short and long-term. Understanding the association between the sustainability status of watershed management and community engagement is essential for achieving lasting positive environmental and socioeconomic impacts.

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Investigation into the Socio-ecological Impact of Migration of Fulani Herders in Anambra State of Nigeria Through a Climate Justice Lens

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Abstract— The study was designed to investigate into the socio-ecological impact of migration of Fulani herders in Anambra state of Nigeria, through a climate justice lens. Nigeria is one of the world's most densely populated countries with a population of over 284 million people, half of which are considered to be in abject poverty. There is no doubt that livestock production provides sustainable contributions to food security and poverty reduction to Nigeria economy, but not without some environmental implications like any other economic activities. Nigeria is recognized as being vulnerable to climate change. Climate change and global warming if left unchecked will cause adverse effects on livelihoods in Nigeria, such as livestock production, crop production, fisheries, forestry and post-harvest activities, because the rainfall regimes and patterns will be altered, floods which devastate farmlands would occur, increase in temperature and humidity which increases pest and disease would occur and other natural disasters like desertification, drought, floods, ocean and storm surges, which not only damage Nigerians' livelihood but also cause harm to life and property, would occur. This and other climatic issue as it affects Fulani herders was what this study investigated. In carrying out this research, a survey research design was adopted. A simple sampling technique was used. One local government area (LGA) was selected purposively from each of the four agricultural zone in the state based on its predominance of Fulani herders. For appropriate sampling, 25 respondents from each of the four Agricultural zones in the state were randomly selected making up the 100 respondent being sampled. Primary data were generated by using a set of structured 5-likert scale questionnaire. Data generated were analyzed using SPSS and the result presented using descriptive statistics. From the data analyzed, the study indentified; Unpredicted rainfall (mean = 3.56), Forest fire (mean = 4.63), Drying Water Source (mean = 3.99), Dwindling Grazing (mean 4.43), Desertification (mean = 4.44), Fertile land scarcity (mean = 3.42) as major factor predisposing Fulani herders to migrate southward while rejecting Natural inclination to migrate (mean = 2.38) and migration to cause trouble as a factor. On the reason why Fulani herders are trying to establish a permanent camp in Anambra state; Moderate temperature (mean= 3.60), Avoiding overgrazing (4.42), Search for fodder and water (mean = 4.81) and (mean = 4.70) respectively, Need for market (4.28), Favorable environment (mean = 3.99) and Access to fertile land (3.96) were identified. It was concluded that changing climatic variables necessitated the migration of herders from Northern Nigeria to areas in the South were the variables are most favorable to the herders and their animals.

Keywords— socio-ecological, migration, fulani, climate, justice, lens.

Characterization of Shorebird Populations in the Algerian Coast

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Abstract— The Algerian coast is an important site for wintering and migratory birds. Four species of shorebirds were surveyed, including Kentish plover *Charadrius alexandrinus*, Little ringed plover *Charadrius dubius*, Common ringed plover *Charadrius hiaticula*, and black-winged stilt *Himantopus hilarious* in three different sites, two important wetlands: Reghaia lake and Macta and a small area Sublette promenade to provide a new data about time activity budget. The study found a higher frequency of abundance in April during the study period (February to May), with a mean of 49. Estimating the temporal activity budget of these coastal birds, it was found that there were three main activities in different proportions between males and females: Pecking (29.51 %) for males, (26.59%) for females, Looking above (28.01%) for males, (19.54 %) for females And Away (9.95%) for males, (11.75%), contrarily the two previous one. Differences between study areas revealed differences in species behavior and distribution.

Keywords— wetland, behavioral, algerian coast, shorebirds, time budget activity.

In Silico Exploration of Quinazoline Derivatives as EGFR Inhibitors for Lung Cancer: A Multi-Modal Approach Integrating QSAR-3D, ADMET, Molecular Docking, and Molecular Dynamics Analyses

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Abstract

A series of thirty-one potential inhibitors targeting the epidermal growth factor receptor kinase (EGFR), derived from quinazoline, underwent 3D-QSAR analysis using CoMFA and CoMSIA methodologies. The training and test sets of quinazoline derivatives were utilized to construct and validate the QSAR models, respectively, with dataset alignment performed using the lowest energy conformer of the most active compound. The best-performing CoMFA and CoMSIA models demonstrated impressive determination coefficients, with R^2 values of 0.981 and 0.978, respectively, and Leave One Out cross-validation determination coefficients, Q^2 , of 0.645 and 0.729, respectively. Furthermore, external validation using a test set of five compounds yielded predicted determination coefficients, R^2 test, of 0.929 and 0.909 for CoMFA and CoMSIA, respectively. Building upon these promising results, eighteen new compounds were designed and assessed for drug likeness and ADMET properties through in silico methods. Additionally, molecular docking studies were conducted to elucidate the binding interactions between the selected compounds and the enzyme. Detailed molecular dynamics simulations were performed to analyze the stability, conformational changes, and binding interactions of the quinazoline derivatives with the EGFR kinase. These simulations provided deeper insights into the dynamic behavior of the compounds within the active site. This comprehensive analysis enhances the understanding of quinazoline derivatives as potential anti-cancer agents and provides valuable insights for lead optimization in the early stages of drug discovery, particularly for developing highly potent anticancer therapeutics.

Keywords: 3D-QSAR, CoMFA, CoMSIA, ADMET, Molecular Docking, Quinazoline, Molecular Dynamic, EGFR inhibitors, Lung Cancer, Anticancer.

Advancing Cancer Therapy: Discovery of Potent Anti-VEGFR-2 Kinase Inhibitors via Computational Biochemistry Approaches of DrugBank

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Abstract

Since their discovery in the early 2000s, tyrosine kinase inhibitors (TKIs) have attracted considerable attention as highly effective targeted cancer therapies. TKIs have proven to be very useful in the treatment of malignant blood cancer and solid tumors. Given the toxicity of current chemotherapeutic agents, there is a great need in the field of oncology to develop novel molecules that are non-toxic or minimally toxic while successfully killing tumour cells and inhibiting their proliferation. To address this need, exploring existing drugs in the drug database provides an excellent starting point for exploring therapeutic interventions with proven safety and efficacy in clinical trials. In this work, through virtual screening, molecular docking, MD simulations and MMPBSA calculations, we identified several compounds from the DrugBank database that have the potential to act as potent inhibitors of VEGFR-2 kinase. Most notably, DB01988 exhibited a remarkable binding affinity for the active site of VEGFR-2 kinase, surpassing Regorafenib, as indicated by a docking score of -11.8 Kcal/mol and consistently small RMSD values. In addition, DB01988 displayed favorable values for RMSF, Rg and hydrogen bond formation. In conclusion, our results suggest that DB01988, also known as 6((S)-3-Benzylpiperazin-1-Yl)-3-(Naphthalen-2-Yl)-4-(Pyridin-4-Yl) Pyrazine, is promising in the category of anti-VEGFR-2 kinase drugs. The results from our study can offer valuable insights into the development of effective treatments for inhibiting angiogenesis.

Keywords: Cancer, ADMET, Molecular Docking, Molecular Dynamic, VEGFR2 inhibitors, Anticancer.

Structural, Vibrational, Magnetic, and Electronic Properties of La_2MMnO_6 Double Perovskites with $\text{M} = \text{Ni}, \text{Co},$ and Zn

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Abstract

This study delves into the structural, vibrational, magnetic, and electronic properties of La_2MMnO_6 double perovskites, where M denotes Ni, Co, and Zn. Recognized for their versatile ionic configurations within the A and B sub-lattices, double perovskite oxides have attracted considerable interest due to their extensive array of physical properties, which include multiferroic behavior, colossal magnetoresistance, and ferroelectric/piezoelectric functionalities. These materials are pivotal for energy-related technologies like solid oxide fuel cells and water-splitting catalysis, attributed to their superior oxygen ion transport and storage capabilities. This research places particular emphasis on $\text{La}_2\text{NiMnO}_6$ and $\text{La}_2\text{CoMnO}_6$, known for their distinct magnetic, electric, and multiferroic properties, and extends the investigation to $\text{La}_2\text{ZnMnO}_6$, synthesized via high-temperature solid-state chemistry. This addition aims to ascertain the impact of zinc substitution on these properties. Structural analysis through X-ray diffraction has confirmed a monoclinic structure within the $\text{P2}_1/\text{n}$ space group. Comprehensive vibrational studies utilizing infrared and Raman spectroscopy, alongside additional XRD assessments, provide a detailed examination of the dynamic and electronic behaviors of these compounds. The results underscore the significant role of chemical composition in modulating their functional properties. Comparatively, this study highlights that zinc substitution notably alters the electronic and magnetic responses, which could enhance the applicability of these materials in advanced energy technologies. This expanded analysis not only reinforces our understanding of La_2MMnO_6 's physical characteristics but also highlights its potential applications in the next generation of energy solutions.

Keywords: Double Perovskites, Structural Analysis, Vibrational Spectroscopy, Magnetic Properties, Electronic Properties, High-Temperature Solid-State Chemistry, La_2MMnO_6 , Monoclinic Structure, X-ray Diffraction.

Influence of Cation Substitution on Magnetic Transitions and Ordering in $\text{La}_2\text{Ni}_x\text{Co}_{1-x}\text{MnO}_6$ Compounds ($x = 0.2 - 0.8$)

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Abstract

This study explores the structural and magnetic characteristics of newly synthesized double perovskite oxides, $\text{La}_2\text{Ni}_x\text{Co}_{1-x}\text{MnO}_6$, with x ranging from 0.2 to 0.8. Utilizing X-ray powder diffraction and SQUID magnetometry, we analyzed the compounds that consistently exhibit a monoclinic structure with the $P2_1/n$ space group at ambient temperature. Our findings reveal that as Ni^{2+} is progressively substituted by Co^{2+} , there is a corresponding decrease in cell parameters, attributable to the smaller ionic radius of Ni^{2+} (0.69 Å) compared to Co^{2+} (0.74 Å). The crystal structure features octahedrally coordinated $(\text{Co/Ni})^{2+}$ and Mn^{4+} cations with oxygen, forming $(\text{Co/Ni})\text{O}_6$ and MnO_6 octahedra linked via oxygen atoms along different crystallographic axes. Magnetic characterization conducted over a temperature range of 2 to 300 K in both DC and AC magnetic fields, showed a predominant paramagnetic to ferromagnetic transition between 232 K and 260 K, with the Curie temperature notably increasing with higher x values. Samples with $x=0.2$, 0.25, and 0.5 exhibited a secondary PM-FM transition between 200 K and 208 K. Cation ordering was quantitatively assessed, indicating a higher ordering in Ni^{2+} -rich samples ($x=0.75$ and 0.8) at over 96%, whereas the sample with $x=0.25$ showed minimal ordering. Furthermore, the out-of-phase component of the AC susceptibility displayed frequency-dependent transitions between 65 K and 110 K, suggesting the presence of superparamagnetic domains across all samples.

Keywords: Double perovskite oxides, Magnetic transitions, Cation ordering, SQUID magnetometry.

Assessing the Material Determinants of Cavity Polariton Relaxation using Angle-Resolved Photoluminescence Excitation Spectroscopy

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Abstract— Cavity polaritons form when molecular excitons strongly couple to photons in carefully constructed optical cavities. These polaritons, which are hybrid light-matter states possessing a unique combination of photonic and excitonic properties, present the opportunity to manipulate the properties of various semiconductor materials. The systematic manipulation of materials through polariton formation could potentially improve the functionalities of many optoelectronic devices such as lasers, light-emitting diodes, photon-based quantum computers, and solar cells. However, the prospects of leveraging polariton formation for novel devices and device operation depend on more complete connections between the properties of molecular chromophores and the hybrid light-matter states they form, which remains an outstanding scientific goal. Specifically, for most optoelectronic applications, it is paramount to understand how polariton formation affects the spectra of light absorbed by molecules coupled strongly to cavity photons. An essential feature of a polariton state is its dispersive energy, which occurs due to the enhanced spatial delocalization of the polaritons relative to bare molecules. To leverage the spatial delocalization of cavity polaritons, angle-resolved photoluminescence excitation spectroscopy was employed in characterizing light emission from the polaritonic states. Using lasers of appropriate energies, the polariton branches were resonantly excited to understand how molecular light absorption changes under different strong light-matter coupling conditions. Since an excited state has a finite lifetime, the photon absorbed by the polariton decays non-radiatively into lower-lying molecular states, from which radiative relaxation to the ground state occurs. The resulting fluorescence is collected across several angles of excitation incidence. By modelling the behavior of the light emission observed from the lower-lying molecular state and combining this result with the output of angle-resolved transmission measurements, inferences are drawn about how the behavior of molecules changes when they form polaritons. These results show how the intrinsic properties of molecules such as the excitonic lifetime affect the rate at which the polaritonic states relaxes. While it is true that the lifetime of the photon mediates the rate of relaxation in a cavity, the results from this study provide evidence that the lifetime of the molecular exciton also limits the rate of polariton relaxation.

Keywords—Fluorescence, molecules in cavities, optical cavity, photoluminescence excitation, spectroscopy, strong coupling.

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Improving Fingerprinting-Based Localization (FPL) System Using Generative Artificial Intelligence

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Abstract

With the rapid advancement of artificial intelligence, low-power built-in sensors on Internet of Things devices, and communication technologies, location-aware services have become increasingly popular and have permeated every aspect of people's lives. Global navigation satellite systems (GNSSs) are the default method of providing continuous positioning services for ground and aerial vehicles, as well as consumer devices (smartphones, watches, notepads, etc.). However, the environment affects satellite positioning systems, particularly indoors, in dense urban and suburban cities enclosed by skyscrapers, or when deep shadows obscure satellite signals. This is because (1) indoor environments are more complicated due to the presence of many objects surrounding them; (2) reflection within the building is highly dependent on the surrounding environment, including the positions of objects and human activity; and (3) satellite signals cannot be reached in an indoor environment, and GNSS doesn't have enough power to penetrate building walls. GPS is also highly power-hungry, which poses a severe challenge for battery-powered IoT devices. Due to these challenges, IoT applications are limited. Consequently, a precise, seamless, and ubiquitous Positioning, Navigation and Timing (PNT) systems are crucial for many artificial intelligence Internet of Things (AI-IoT) applications in the era of smart cities. Their applications include traffic monitoring, emergency alarming, environmental monitoring, location-based advertising, intelligent transportation, and smart health care. This paper proposes a generative AI-based positioning scheme for large-scale wireless settings using fingerprinting techniques. In this article, we presented a novel semi-supervised deep convolutional generative adversarial network (S-DCGAN)-based radio map construction method for real-time device localization. We also employed a reliable signal fingerprint feature extraction method with t -distributed stochastic neighbor embedding (t-SNE), which extracts dominant features while eliminating noise from hybrid WLAN and long-term evolution (LTE) fingerprints. The proposed scheme reduced the workload of site surveying required to build the fingerprint database by up to 78.5% and significantly improved positioning accuracy. The results show that the average positioning error of GAILoc is less than 0.39 m, and more than 90% of the errors are less than 0.82 m. According to numerical results, SRCLoc improves positioning performance and reduces radio map construction costs significantly compared to traditional methods.

Keywords: Location-aware services, feature extraction technique, generative adversarial network, , long short-term memory, support vector machine.

Abandoned Mine Methane Mitigation

Jerome Blackman, Pamela Franklin, Volha Roshchanka

Abstract—Abandoned Mine Methane Mitigation in the United States. The US coal mining sector accounts for 6% of total US Methane emissions (2021). 60% of US coal mining methane emissions come from active underground mine ventilation systems. Abandoned mines contribute about 13% of methane emissions from coal mining. While there are thousands of abandoned underground coal mine in the US, the Environmental Protection Agency (EPA) estimates that fewer than 100 have the sufficient methane resources for viable methane recovery and use projects. Many abandoned mines are in remote areas far from potential energy customers and may be flooded, further complicating methane recovery. Because these mines are no longer active, recovery projects can be simpler to implement.

Keywords—abandoned mines, coal mining, methane emissions, methane mitigation, recovery and use.

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The Use of Remotely Sensed Data to Model Habitat Selections of Pileated Woodpeckers (*Dryocopus pileatus*) in Fragmented Landscapes

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Abstract

Light detection and ranging (LiDAR) and four-channel red, green, blue, and near-infrared (RGBI) remote sensed imageries allow an accurate quantification and contiguous measurement of vegetation characteristics and forest structures. This information facilitates the generation of habitat structure variables for forest species distribution modelling. However, applications of remote sensing data, especially the combination of structural and spectral information, to support evidence-based decisions in forest managements and conservation practices at local scale are not widely adopted. In this study, we examined the habitat requirements of pileated woodpecker (*Dryocopus pileatus*) (PW) in Hamilton County, Ohio, using ecologically relevant forest structural and vegetation characteristics derived from LiDAR and RGBI data. We hypothesized that the habitat of PW is shaped by vegetation characteristics that are directly associated with the availability of food, hiding and nesting resources, the spatial arrangement of habitat patches within home range, as well as proximity to water sources. We used 186 PW presence or absence locations to model their presence and absence in generalized additive model (GAM) at two scales, representing foraging and home range size, respectively. The results confirm PW's preference for tall and large mature stands with structural complexity, typical of late-successional or old-growth forests. Besides, the crown size of dead trees shows a positive relationship with PW occurrence, therefore indicating the importance of declining living trees or early-stage dead trees within PW home range. These locations are preferred by PW for nest cavity excavation as it attempts to balance the ease of excavation and tree security. In addition, we found that PW can adjust its travel distance to the nearest water resource, suggesting that habitat fragmentation can have certain impacts on PW. Based on our findings, we recommend that forest managers should use different priorities to manage nesting, roosting, and feeding habitats. Particularly, when devising forest management and hazard tree removal plans, one needs to consider retaining enough cavity trees within high-quality PW habitat. By mapping PW habitat suitability for the study area, we highlight the importance of riparian corridor in facilitating PW to adjust to the fragmented urban landscape. Indeed, habitat improvement for PW in the study area could be achieved by conserving riparian corridors and promoting riparian forest succession along major rivers in Hamilton County.

Keywords: Species distribution models; LiDAR; RGBI aerial imagery; Deadwood detection; Random Forest (RF); Individual tree crown delineation; Pileated Woodpecker (*Dryocopus pileatus*).

Sustainable Integrated Waste Management System

Lidia Lombardi

Abstract— Waste management in Europe and North America is evolving towards sustainable materials management, intended as a systemic approach to using and reusing materials more productively over their entire life cycles. Various waste management strategies are prioritized and ranked from the most to the least environmentally preferred, placing emphasis on reducing, reusing, and recycling as key to sustainable materials management. However, non-recyclable materials must also be appropriately addressed, and waste-to-energy (WtE) offers a solution to manage them, especially when a WtE plant is integrated within a complex system of waste and wastewater treatment plants and potential users of the output flows. To evaluate the environmental effects of such system integration, Life Cycle Assessment (LCA) is a helpful and powerful tool. LCA has been largely applied to the waste management sector, dating back to the late 1990s, producing a large number of theoretical studies and applications to the real world as support to waste management planning. However, LCA still has a fundamental role in helping the development of waste management systems supporting decisions. Thus, LCA was applied to evaluate the environmental performances of a Municipal Solid Waste (MSW) management system, with improved separate material collection and recycling and an integrated network of treatment plants including WtE, anaerobic digestion (AD) and also wastewater treatment plant (WWTP), for a reference study case area. The proposed system was compared to the actual situation, characterized by poor recycling, large landfilling and absence of WtE. The LCA results showed that the increased recycling significantly increases the environmental performances, but there is still room for improvement through the introduction of energy recovery (especially by WtE) and through its use within the system, for instance, by feeding the heat to the AD, to sludge recovery processes and supporting the water reuse practice. WtE offers a solution to manage non-recyclable MSW and allows saving important resources (such as landfill volumes and non-renewable energy), reducing the contribution to global warming, and providing an essential contribution to fulfill the goals of really sustainable waste management.

Keywords— anaerobic digestion, life cycle assessment, waste-to-energy, municipal solid waste.

Study on the Rapid Start-up and Functional Microorganisms of the Coupled Process of Short-range Nitrification and Anammox in Landfill Leachate Treatment

Lina Wu

Abstract— The excessive discharge of nitrogen in sewage greatly intensifies the eutrophication of water bodies and poses a threat to water quality. Nitrogen pollution control has become a global concern. Currently, the problem of water pollution in China is still not optimistic. As a typical high ammonia nitrogen organic wastewater, landfill leachate is more difficult to treat than domestic sewage because of its complex water quality, high toxicity, and high concentration. Many studies have shown that the autotrophic anammox bacteria in nature can combine nitrous and ammonia nitrogen without carbon source through functional genes to achieve total nitrogen removal, which is very suitable for the removal of nitrogen from leachate. In addition, the process also saves a lot of aeration energy consumption than the traditional nitrogen removal process. Therefore, anammox plays an important role in nitrogen conversion and energy saving. The process composed of short-range nitrification and denitrification coupled an ammo ensures the removal of total nitrogen and improves the removal efficiency, meeting the needs of the society for an ecologically friendly and cost-effective nutrient removal treatment technology. Continuous flow process for treating late leachate [an up-flow anaerobic sludge blanket reactor (UASB), anoxic/oxic (A/O)–anaerobic ammonia oxidation reactor (ANAOR or anammox reactor)] has been developed to achieve autotrophic deep nitrogen removal. In this process, the optimal process parameters such as hydraulic retention time and nitrification flow rate have been obtained, and have been applied to the rapid start-up and stable operation of the process system and high removal efficiency. Besides, finding the characteristics of microbial community during the start-up of anammox process system and analyzing its microbial ecological mechanism provide a basis for the enrichment of anammox microbial community under high environmental stress. One research developed partial nitrification-Anammox (PN/A) using an internal circulation (IC) system and a biological aerated filter (BAF) biofilm reactor (IBBR), where the amount of water treated is closer to that of landfill leachate. However, new high-throughput sequencing technology is still required to be utilized to analyze the changes of microbial diversity of this system, related functional genera and functional genes under optimal conditions, providing theoretical and further practical basis for the engineering application of novel anammox system in biogas slurry treatment and resource utilization.

Keywords— nutrient removal and recovery, leachate, anammox, partial nitrification.

Assessing Livelihood Vulnerability to Climate Change and Adaptation Strategies in Rajanpur District, Pakistan

Muhammad Afzal, Shahbaz Mushtaq, Duc-Anh-An-Vo, Kathryn Reardon Smith, Thanh Ma

Abstract— Climate change has become one of the most challenging environmental issues in the 21st century. Climate change-induced natural disasters, especially floods, are the major factors of livelihood vulnerability, impacting millions of individuals worldwide. Evaluating and mitigating the effects of floods requires an in-depth understanding of the relationship between vulnerability and livelihood capital assets. Using an integrated approach, sustainable livelihood framework, and system thinking approach, the study developed a conceptual model of a generalized livelihood system in District Rajanpur, Pakistan. The model visualizes the livelihood vulnerability system as a whole and identifies the key feedback loops likely to influence the livelihood vulnerability. The study suggests that such conceptual models provide effective communication and understanding tools to stakeholders and decision-makers to anticipate the problem and design appropriate policies. It can also serve as an evaluation technique for rural livelihood policy and identify key systematic interventions. The key finding of the study reveals that household income, health, and education are the major factors behind the livelihood vulnerability of the rural poor of District Rajanpur. The Pakistani government tried to reduce the livelihood vulnerability of the region through different income, health, and education programs, but still, many changes are required to make these programs more effective especially during the flood times. The government provided only cash to vulnerable and marginalized families through income support programs, but this study suggests that along with the cash, the government must provide seed storage facilities and access to crop insurance to the farmers. Similarly, the government should establish basic health units in villages and frequent visits of medical mobile vans should be arranged with advanced medical lab facilities during and after the flood.

Keywords— livelihood vulnerability, rural communities, flood, sustainable livelihood framework, system dynamics, Pakistan.

An Integrated Approach to Solid Waste Management of Karachi - Waste-to-Energy Option -

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Abstract

Solid Waste Management (SWM) is perhaps one of the most important element constituting the environmental health and sanitation of urban developing sector. The management system has several components which are integrated as well as interdependent thus the efficiency and effectiveness of the entire system is affected when any of its functional component fails or does not perform up to the level mark of operation.

Sindh Solid Waste Management Board (SSWMB) is responsible for the management of solid waste of the entire city. There is a need to adopt engineered approach in the redesigning of existing system. In most of the towns street sweeping operations have been mechanised and done by machinery operated by vehicles. Construction of Garbage Transfer Stations (GTS) at number of locations within the city will cut the cost of transportation of waste to disposal sites. Material processing, recovery of recyclables, compaction, volume reduction, and increase in density will enable transportation of waste to disposal sites/landfills via long vehicles (bulk transport), minimizing transport/traffic and environmental pollution related issues. Development of disposal sites into proper sanitary landfill sites is mandatory. The transportation mechanism is through garbage vehicles using either hauled or fixed container system employing crew for mechanical or manual loading. The number of garbage vehicles is inadequate and due to comparatively long haulage to disposal sites there are certain problems of frequent vehicular maintenance and high fuel costs.

Foreign investors have shown interest in enterprising in improvement schemes and proposed for operating solid waste management system in Karachi. Waste to Energy option is being considered to provide a practical answer to be adopted to generate power and reduce waste load – a two prong solution for the increasing environmental problem.

The paper presents results and analyse of recent study into waste generation and characterisation probing into waste-to-energy option for Karachi City.

1 INTRODUCTION

The required infrastructure of Karachi Solid Waste Management is almost non-existent. In current scenario storage, collection and transfer & transportation of waste is being carried out in a very old and inefficient manner. Hence the mechanism of waste management and disposal in the city is very not up to any international standard despite outsourcing the Front End Collection (FEC) contracts to interational companies.

In context to invitation to foreign collaboration and interest of international parties in improvement and upgrading of solid waste management of Karachi, Sidh Solid Waste Maagemet (SSWMB) undertook a study to investigate into prospects of Waste to Energy option for Karachi metropolis. Generally Waste to Energy project has been successful in many cities of developed and as well as developing countries depending upon their waste management system and more on the characteristic composition of waste such as calorific / heat value contents.

The study project was based on carrying out comprehensive waste generation and compositional studies at different levels of i.e. at source (household), community bin, transfer stations and final disposal sites. Also the impact of income level or socioeconomic status on the waste characteristics was also analyzed. The independent group of consultants included representations both from academia and industry were; Mehran University of Engineering & Technology, Jamshoro and NAA Consulting (Pvt) Ltd. [3],[5]

Three (03) representative Towns of Karachi were selected; Saddar, Gulshan and Gulberg Town and the formal landfill site Surjani Town was selected as the disposal site. The informal dumping grounds / Temporary Garbage Transfer Stations (GTS) were Baloch Colony, Gulshan Iqbal and Korangi- Ibrahim Hyderi.

This paper encompasses the overview of SWM current practices and problems of Karachi City, the methodology and approach used for carrying the SWM studies in Karachi from June 20, 2023 to 26th July 2023. The physical analysis include determination of waste composition and segregation of garbage collected from households into different components; recyclable, organic fractions and inert as identified physically by manual sorting. The percentage weight composition was measured weight with bulk density measurements. For chemical analysis, samples were sent to laboratory (SGS Labs) for determination of chemical composition and calorific / heat content value. Solid waste management system in selected towns and project area (High, Medium & Low income level) localities was also observed.

Representative waste samples were collected and analyzed from source to disposal site for physical and chemical analysis results with evaluation & assessment of state of waste are presented in the paper. Waste characterization and investigation studies have been carried out earlier for Karachi metropolitan for prospects and options of deriving waste from energy with an improvement in waste management system through technical and financial assistance from international agencies support. However, these endeavors are yet to be materialized due to lack of institutional arrangements and unanimous collaborative action at local and provincial level amongst the concerned functional departments.

1.1 METHODOLOGY OF WASTE SAMPLING

Out of 25 Towns, 03 representative towns (Saddar, Gulshan and Gulberg) selected for the collection and analyses of samples, however it should be understood that the Waste Composition analysis involves determination of waste characterization at various sources and levels of waste management levels. Hence needs to be carried out accordingly in order to determine the impact on residual components of waste and change occurring in waste stream with the management processes; storage, collection, transfer & transport and at the ultimate point of disposal so that the mechanism and functional components of SWM could be planned, designed and implemented and the cost factor and viability of treatment processes associated such as composting, recovery and recycling of waste could be realistically determined. More importantly to decide the ultimate safe disposal of waste, composition of waste; physical, biological and chemical properties is significant in determining the waste disposal. [1],[2],[7]

Laboratory Analysis

- a) Moisture content
- b) Organic and inorganic content
- c) Nitrogen content
- d) Carbon content
- e) Calorific Value

2 WASTE GENERATION & COMPOSITIONAL STUDIES CONDUCTED JUNE-JULY, 2023

The section presents the observations made in the field regarding the waste generation characteristics; generation rate, weight composition – recyclables, organics & inert and the calorific / heat content present in waste and the variation in waste composition across the waste stream i.e. at door-to-door (household), collection and transfer; community bin, garbage transfer station and landfill. Also the impact of income level / socioeconomic status on waste generation and waste composition characteristics is highlighted.[6]

2.1 Saddar Town Waste Compositional Studies

The variation in generation and characteristics of waste; describing its recyclables, organic fraction and inert material thereby specifying its heat / calorific value arising from high, medium and low income group residential areas of Saddar Town is shown in the Fig 2.1.

Fig 2.1: MSW Characteristics comparison for Income Level groups (Door to Door Collection) Saddar Town

Saddar Town Recyclables	Door to door Saddar Town			Community Bin - Saddar Town			GTS AND LANDFILL SITE			
	High Income	Low High Income	Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Paper/C.B	14.44	14.81	5.58	4.6	3.79	4.02	1.98	0.53	0.51	2.6
PC	5.71	4.68	8.21	6.37	7.58	7.37	5.16	4.9	5	11.9
PET	2.39	5.32	1.15	0.38	0.45	0.48	0.38	0.55	0.57	0.3
METALS	0.81	0.68	1.25	0	0	0	0	0	0	0
GLASS	3.1	3.05	1.08	0.41	0.98	0	0.53	0.15	0.25	0.2
INERT	0.02	3.35	10.54	8.34	11.61	14.56	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Recyclable Value %	26.35	28.53	16.19	11.76	12.8	11.87	8.06	7.67	6.32	14.95

Fig 2.2: MSW Characteristics comparison for Income Level groups (Transfer stages) Saddar Town

A considerable reduction is observed in the recyclable contents of waste as shown in the tabulated representation given in Fig 2.2 reflecting the waste contents of different components at Transfer stage. The reduction of recyclables in waste stream from door to door stage to transfer stage is experienced in all income group levels. [9]

Saddar Town Calorific Value Products	Door to door Saddar Town			Community Bin - Saddar Town			GTS AND LANDFILL SITE			
	High Income	Low High Income	Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Paper/C.B	14.44	14.81	5.58	4.6	3.79	4.02	1.98	0.53	0.51	2.6
PC	5.71	4.68	8.21	6.37	7.58	7.37	5.16	4.9	5	11.9
PET	2.39	5.32	1.15	0.38	0.45	0.48	0.38	0.55	0.57	0.3
TEXTILE	1.02	0.87	2.63	1.77	1.36	5.12	5.17	7	6.81	7.5
RUBBER	0.43	0.33	0	0.16	0.56	0.93	0.59	0.6	0.61	0.3
INERT	0.02	3.35	10.54	8.34	11.61	14.56	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Calorific Value %	23.27	26.01	13.24	8.68	13.74	17.93	13.82	13.57	13.49	30.22

Fig 2.3: Comparison of Calorific / Heat value of MSW across Waste Stream for Income Level groups in Saddar Town

Saddar Town Calorific Value Products	Door to door Saddar Town			Community Bin - Saddar Town			GTS AND LANDFILL SITE			
	High Income	Low High Income	Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Paper/C.B	14.44	14.81	5.58	4.6	3.79	4.02	1.98	0.53	0.51	2.6
PC	5.71	4.68	8.21	6.37	7.58	7.37	5.16	4.9	5	11.9
PET	2.39	5.32	1.15	0.38	0.45	0.48	0.38	0.55	0.57	0.3
TEXTILE	1.02	0.87	2.63	1.77	1.36	5.12	5.17	7	6.81	7.5
RUBBER	0.43	0.33	0	0.16	0.56	0.93	0.59	0.6	0.61	0.3
INERT	0.02	3.35	10.54	8.34	11.61	14.56	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Calorific Value %	23.27	26.01	13.24	8.68	13.74	17.93	13.82	13.57	13.49	30.22

Saddar Town - High income group (Door-to-Door Collection) is the Clifton area (UC 10 and UC 11) comprises of Bungalows of 500 to 2000 square yards. The rate of generation of waste is estimated to be 0.73 kg/person/day. Usually every household have 02 bins (01 in kitchen and 01 in open area) the recyclable material consists of; paper, cardboard, plastic bags, PET, glass and metals), Calorific content items include; paper, cardboard, plastic bags, PET, textile, rubber and leather, *diapers were not initially included in the analysis (sampling and compositional analysis) at Household waste level*, Organic Fraction; mostly food remnants, kitchen waste, little yard waste. Yard waste is mainly collected on Monday; the diapers are included with inert material.

- Referring to Fig 2.2, the percentage of organic component is comparatively greater in High income area presumably due to open and vegetative area associated with the premises (gardens yielding yard/green) waste in addition to the normal content of organic waste. The recyclable material is high due to the use of packaging material (Plastic, Paper/cardboard, glass bottles etc). [8],[9]

Saddar Town - Medium Income group (Door-to-Door Collection) is representing High Medium Income and Low Medium Income Level groups as the demographic feature is almost same dwelling in apartments having similar socioeconomic stature. The area (UC 1 and UC 09) comprises of all residential apartments (02 beds to 06 bed size apartments). The rate of generation of waste is estimated to be 0.38 kg/person/day. The rate of generation of waste is low in comparison to High income group likely due to small area of occupancy or size of household and relatively less posh living standard. Households mostly use 01 bin or 01 plastic bag for the storage of all types of waste.

The percentage of organic fractions is comparatively high obtained during the door to door collection waste compositional studies. Diapers content weight is high however it is not included in waste composition and is remains in inert material at door to door collection analysis. The Fig 2.2 signifies that amongst recyclable materials paper/cardboard fraction is reduced almost to half in comparison to high income group which significantly affects calorific value of the waste. This also indicates that there is a high tendency of waste segregation and recovery being practiced at household level / door to door collection level.[8]

It is further reflected from the waste analysis arising from the medium income level group that packaging material waste content is reduced to almost half in comparison to high income group featured by regular home-cooking yielding high organic fractions in waste stream.

Saddar Town - Low High Income group (Door-to-Door Collection) is identified in the Clifton area of UC 10 and UC 11 consisting of residential apartments (02 beds to 06 bed sized apartments). The rate of generation of waste is estimated around 0.45 kg/capita/day.

- The rate of generation of waste is comparatively lower than High income group; the percentage of organic material is comparatively is also on lower side in the category primarily due to devoid of open spaces in dwelling units such as; gardens, yards, etc. During the door to door waste compositional analysis, the diaper contents are segregated from the household recyclable and organic fractions and included in inert material. It is further established during the social survey that the infant population is low in comparison to High Medium and Low Medium Income groups which produces significant quantities of the specific waste. The Calorific / Heat value reflected in Fig 2.3 is mainly due to paper/cardboard, plastic bags, PET, textile & rubber / leather. It is evident from the Figure that the recyclable material, specifically PET fraction is doubled in comparison to quantities generated in high income groups imparting higher recyclable and calorific / heat values than high income group. The household mostly uses 01 bin for the storage of all types of waste. The life style and cooking habits reflects the change in recyclable material (food packaging) which is higher and organic fraction is low in comparison to High income group.

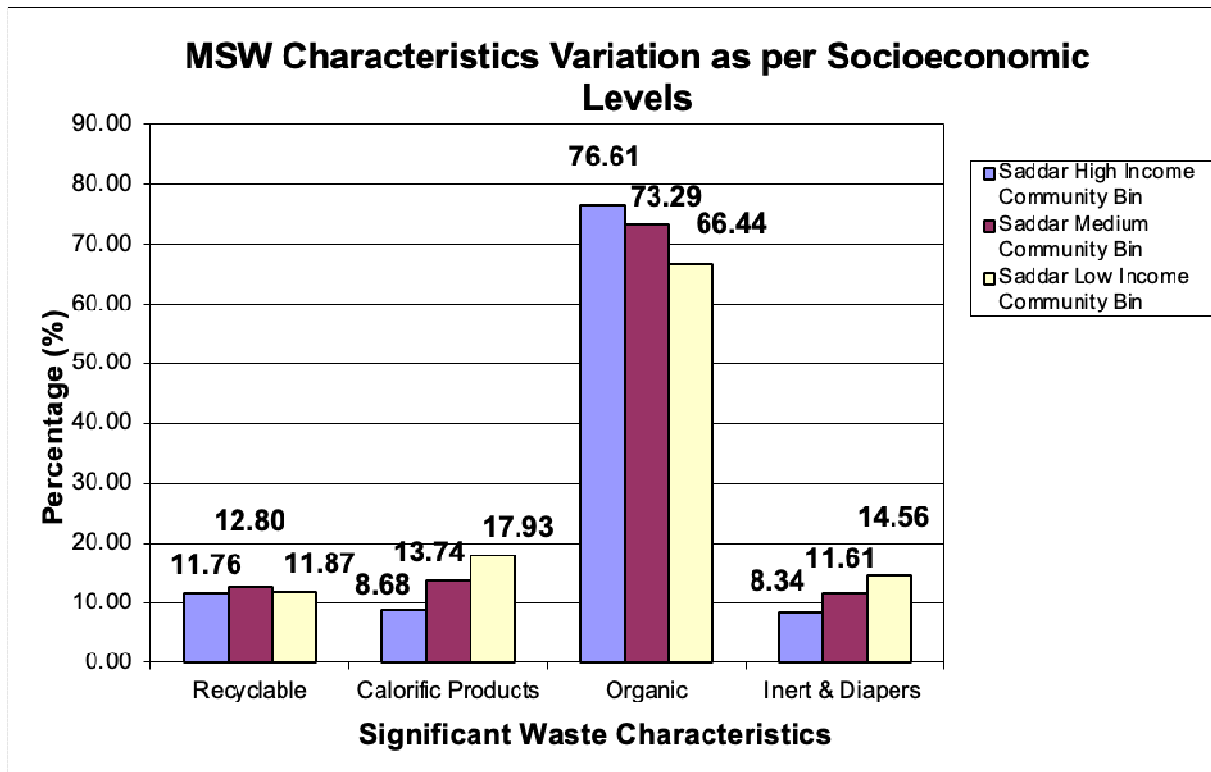


Fig 2.4: MSW Characteristics comparison in Income level groups (Community Bin) Saddar Town

Saddar Town - High Income group (Community Bin) are identified in Clifton area to be around 20 designated points where garbage is dumped indiscriminately, collected and transported. Only 20% of the total collection bins provided at these sites are demountable / hauled bins whereas remaining are open / fixed or yards along the road side.

Recyclables

- The comparison of recyclables in MSW waste arising from different categories of socio-economic level given in Fig 2.4 showing trend of collection from household to the community bins for high income group suggests that the quantity of recyclable material is reduced significantly almost over 50%. The prime reason is engagement of informal staff which collects waste from door to door and sorts the recyclable material after collection and before discharging into the community bins. The second round of segregation and recovery is carried out by street scavengers that remove the leftover recyclables for sale in the informal market. The informal removal of recyclable at community bin or street level however does not remove the tetra pack waste and plastic bags which has no current recycling market (nearly 5%). The inert material increases from (3.02% to 8.54%) because of the two reasons additional loading of diapers (being considered in the inert category) and mixing of dirt material due to indiscriminate dumping of waste onto the un-metal ground.

Calorific Value Item

- There is not much significant increase in the heat content of waste observed owing to the recyclable contents of the waste.

Organic Waste Fraction

- From source the organic waste fraction increases from (68% to 76%), the reason is the recyclable and calorific value products decrease to almost 15% which has an overall impact on the increase in organic fraction. The organic fraction at the communal bin of high income area generally has 10% of yard waste.

Saddar Town - Medium Income group (Community Bin Transfer), there are 02-03 large size cement-concrete community bin designated per Union Council where the waste from nearby dwelling units is regularly dumped.

Medium income group largely comprised of residential apartments rising from 04 to 07 floors high. Each apartment has privately hired sanitary staff which collect waste from door to door, sort, segregate and recover the recyclable at specific place within or outside the apartment / residential complex prior to disposal and transfer / transport using wheel barrows, hand driven carts to discharge the waste into the nearby community bins. The secondary sorting is carried out at the community bins where the scavengers collect and transfer the recyclables for transport to local recycling vendors on daily basis.

Organic Waste Fraction

The percentile value of organic waste at the source compared to the community bins in case of Saddar Town Medium income group is more or less the same.

Saddar Town - Low income group (Community Bin Transfer), has number of low income areas associated with Saddar Town such as; Dehli Colony, PNT Colony, Sheeren Jinnah Colony and others. Survey team in consultation with the administration of South Zone – DMC selected Sheeren Jinnah Colony as representative locality for low income group category having a mix of 40-90 square yard residential units and generally the people residing in area are low bread earner.

The community bins in the area are low walled, open structure allowing indiscriminate dumping along the roadside. It is observed that due to lack of operational funds DMC-South and SSWMB fails to maintain the vehicular fleet, hence the lifting from low income residential areas is mostly neglected and due priority is given to high income, medium income areas. It was further observed during waste compositional studies that due to the reduction in the collection efficiency of waste lifting, the waste mounds are found in various spots cumulating garbage for up to few weeks which has deteriorated the aesthetics as well as affected the contents of waste.[9],[8],[5]

Recyclables

- The change in recyclable contents for the socioeconomic variation as highlighted by the comparison of the graphs shown in Fig 2.4 and 2.2 obtained for the community bin transfer stage is significant. It is reported that at the community bin the composition of paper/cardboard material remains at 4% containing mainly tetra pack, plastic around 8% with no metal and glass. Inert material is high containing diapers around 14% and dirt. It is also observed that the plastic bags content in the low income community bin is highest in comparison to the medium and high income residential area.

Calorific value Items

- The percentage of calorific value items is found to increase and exceed the recyclable content due to increase in textile fraction which is observed to be 5.12% at the community bin, plastic is 7.37% and the overall heat / calorific value item content of waste reaches almost 18%.

Organic Waste Fraction

- More than two-third of waste content is found to be organic in nature i.e. comprising of food, kitchen, vegetable / fruit and grass / leaves and degradable waste.

2.2 Gulshan Town Waste Compositional Studies Results

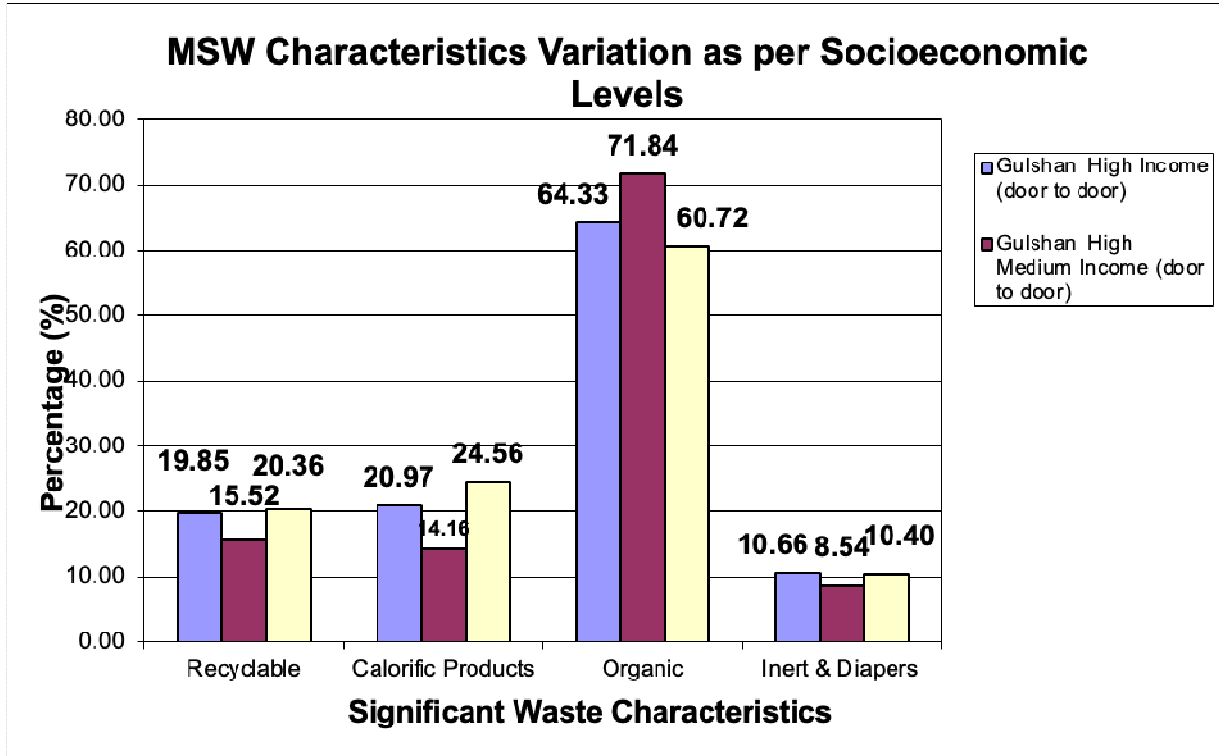


Fig 2.5: MSW Characteristics comparison in Income level groups (Door to Door Collection) Gulshan Town[4]

Gulshan Town	Door to door Gulshan Town			Community Bin - Gulshan Town			GTS AND LANDFILL SITE			
	High Income	High Medium Income	Low Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Recyclables										
Paper/C.B	11.01	8.07	6.5	4.54	2.47	2.53	1.98	0.53	0.51	2.6
PC	3.84	3.99	7.29	6.32	8.41	8.43	5.16	4.9	5	11.9
PET	2.58	1.58	4.95	0.35	0.49	0.48	0.38	0.55	0.57	0.3
METALS	0.24	0.33	0.16	0	0	0	0	0	0	0
GLASS	2.19	1.56	1.45	0	0	0	0.53	0.15	0.25	0.2
INERT	10.66	8.54	10.4	18.56	18.68	19.56	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Recyclable Value	19.80%	15.52%	20.36	11.21%	11.37%	11.44%	8.06	7.67	6.32	14.95

Fig 2.6 : MSW Characteristics recyclable variations observed for Income Levels & Transfer stages in Gulshan Town

Gulshan Town Calorific Value Products	Door to door Gulshan Town			Community Bin - Gulshan Town			GTS AND LANDFILL SITE			
	High	High Medium	Low Medium	High Income	Medium	Low Income	GTS	GTS	GTS	Landfill
	Income	Income	Income		Income		Gulshan	Korangi	Baloch	
Paper/C.B	11.01	8.07	6.5	4.54	2.47	2.53	1.98	0.53	0.51	2.6
PC	3.84	3.99	7.29	6.32	8.41	8.43	5.16	4.9	5	11.9
PET	2.58	1.58	4.95	0.35	0.49	0.48	0.38	0.55	0.57	0.3
TEXTILE	3.54	0.41	5.56	1.79	4.57	3.85	5.17	7	6.81	7.5
RUBBER	0	0.11	0.26	0.24	0.16	0.2	0.59	0.6	0.61	0.3
INERT	10.66	8.54	10.4	18.56	18.68	19.56	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Calorific Value %	20.97	14.16%	24.56%	13.24%	16.10%	15.49%	13.82	13.57	13.49	30.22

Fig 2.7 : Variation in Calorific/Heat values of MSW observed at different Transfer Levels in Gulshan Town

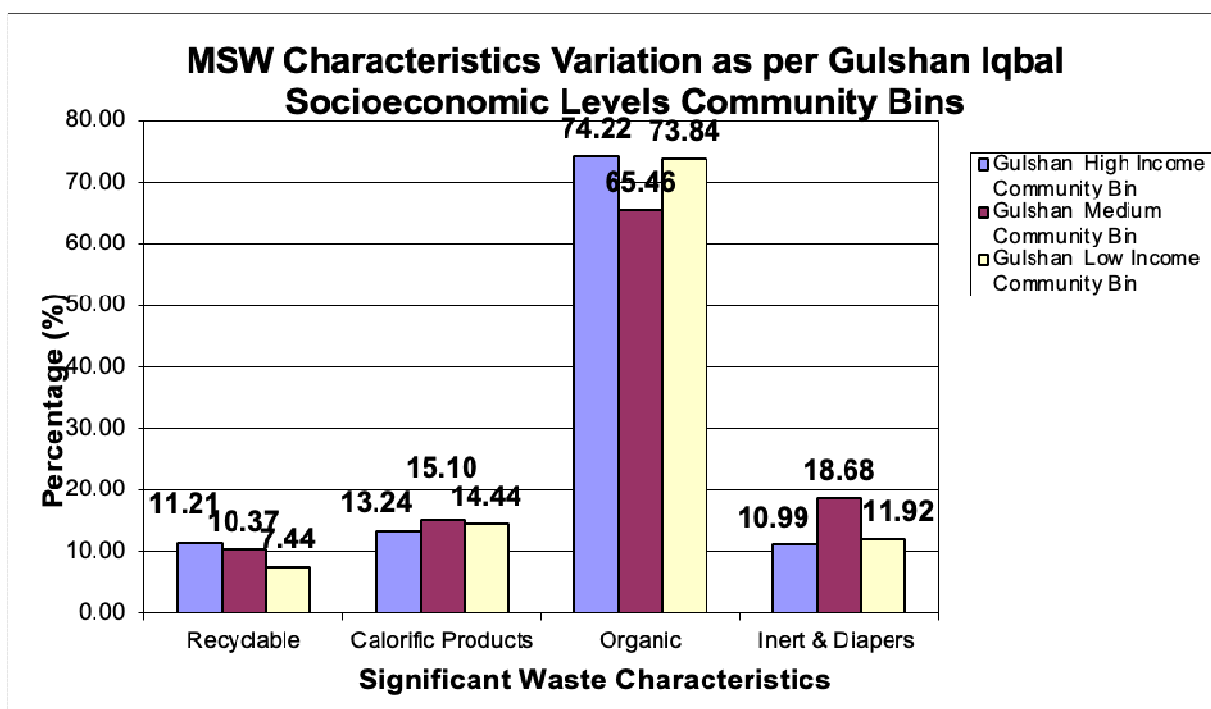


Fig 2.8: MSW Characteristics Variation observed in Income level groups (Community Bin) Gulshan Town

2.3 Gulberg Town Waste Compositional Studies Results

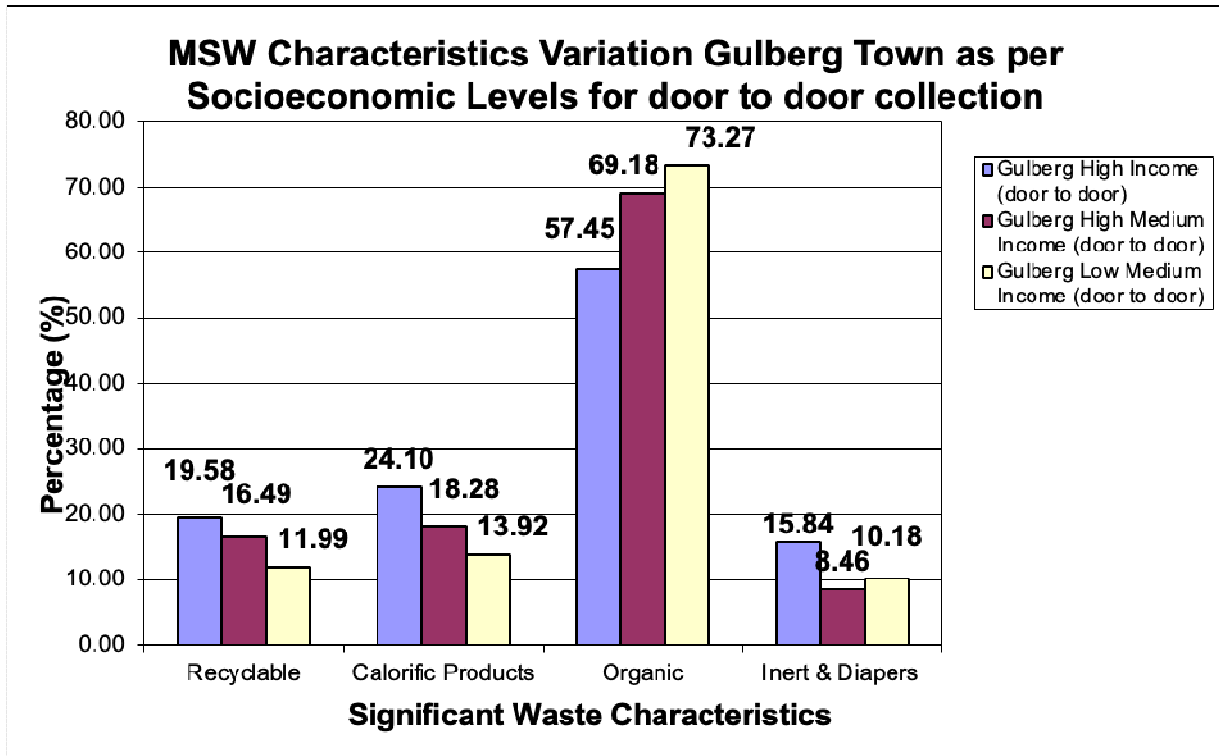


Fig 2.9: MSW Characteristics Variation in Income level groups (Door to Door Collection) Gulberg Town

GulbergTown Recyclables	Door to door Gulberg Town			Community Bin - Gulberg Town			GTS AND LANDFILL SITE			
	High Income	High Medium Income	Low Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Paper/C.B	9.38	6.81	2.76	2.34	1.32	1.6	1.98	0.53	0.51	2.6
PC	6.78	5.83	5.03	6.02	6.51	5	5.16	4.9	5	11.9
PET	2.28	2.33	2.28	0.33	0.49	0.5	0.38	0.55	0.57	0.3
METALS	0.49	0.42	0.29	0.07	0	0.11	0	0	0	0
GLASS	0.65	1.1	1.62	0	0	0.83	0.53	0.15	0.25	0.2
INERT	15.84	8.49	10.18	24.78	18.17	22.72	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Recyclable Value	25.24%	16.49%	11.99%	8.75%	8.32	12.73	8.06	7.67	6.32	14.95

Fig 2.10 : MSW Characteristics variations observed for Income Levels & Transfer stages in Gulberg Town

Gulberg Town Calorific Value Products	Door to door Gulberg Town			Community Bin - Gulberg Town			GTS AND LANDFILL SITE			
	High Income	High Medium Income	Low Medium Income	High Income	Medium Income	Low Income	GTS Gulshan	GTS Korangi	GTS Baloch	Landfill
Paper/C.B	9.38	6.81	2.76	2.34	6.81	1.6	1.98	0.53	0.51	2.6
PC	6.78	5.83	5.03	6.02	5.83	5	5.16	4.9	5	11.9
PET	2.28	2.33	2.28	0.33	2.33	0.5	0.38	0.55	0.57	0.3
TEXTILE	3.49	2.98	2.63	3.4	4.59	4.68	5.17	7	6.81	7.5
RUBBER	2.17	0.32	1.21	0.66	0	0.66	0.59	0.6	0.61	0.3
INERT	15.84	8.46	10.18	24.78	18.17	22.72	17.27	13.17	13.61	6.3
Diapers	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	with inert	7.6
Calorific Value %	19.58%	18.28%	13.92%	12.75%	11.59%	12.44%	13.82	13.57	13.49	30.22

Fig 2.11: Variation in Calorific/Heat values of MSW observed at different Transfer Levels in Gulberg Town

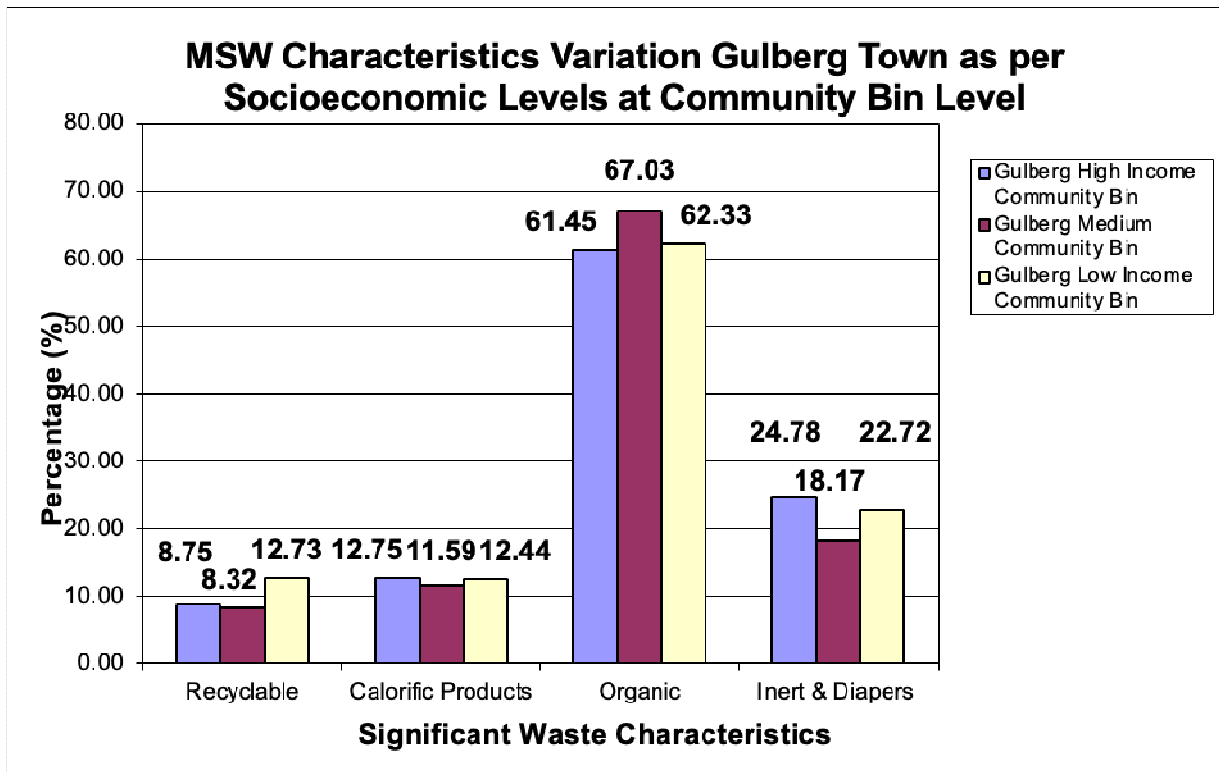


Fig 2.12: MSW Characteristics Variation in Income level groups (Community Bin) Gulberg Town

2.4 Garbage Transfer Stations Waste Compositional Results

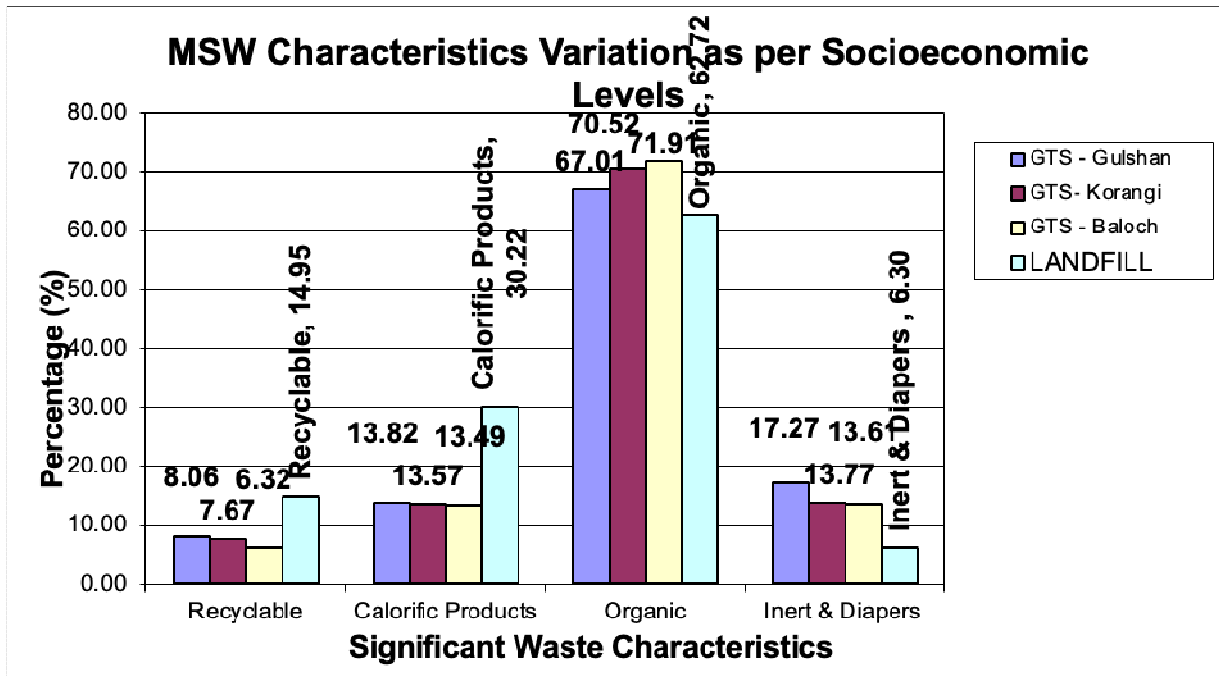


Fig 2.13 : Comparison of Variation in MSW Characteristics at Garbage Transfer Stations (GTS) and Landfill [4] Garbage Transfer Stations

There is no specifically designed and constructed nor formally recognized Garbage Transfer Stations (GTS) established in Karachi metropolis. However DMCs and Towns have selectively adopted or designated temporary stations for centralized discharge and onward transfer and bulk transport of waste to final burial grounds and dumpsite. It is observed during the study project that are 03 actively functioning GTS which are receiving waste in sufficient quantities on daily basis. It is further noted that their service / coverage area was considerable large to yield good representative sampling of waste for the study and analytical purpose. The transfer and transport of waste to disposal sites is made in two ways; either through GTS or directly through collection from the community bins depending upon the localities and their distances from the disposal site – Surjani Landfill. The GTS is currently servicing 30% load capacity of the collected waste i.e. transferring this volume of waste to Surjani Landfill while the rest 70% goes directly through directly collection & transfer method to the designated landfill.[10]

GTS Gulshan Iqbal

It is a temporary waste handling and storage facility situated close to the Lyari River bed in UC No. 05 jurisdiction of Gulshan Iqbal. The same site is being used by almost 40% of Gulshan Town area for storing its waste as temporary grounds and is also served by Baloch Colony GTS which serves nearby few areas bins which are lifted and directly transported to the landfill site. The waste is lifted within a day with the help of large garbage lift tripper trucks which are filled by front end loader. The entire setup is not neither well-planned nor a designed, constructed face. All activity is being carried out on an uneven and earthen ground the dirt and other inert material mixes with the waste and deteriorates its quality. At GTS site, waste lying over 24 hours is at the mercy of scavengers who are free to sort / segregate and recover/remove almost all the recyclable material available in the waste dump. The comparison of the Gulshan Town waste characteristics at the community bin and at the Gulshan Town GTS significantly shows the difference.[2],[10]

- **Recyclable from High Income Community Bin to GTS Gulshan Level (8.75% to 8.06%)**
- **Calorific Value Items from High Income Community Bin to GTS Gulshan increased from (12.15% to 13.82%) which does not include the % of diapers which is mixed and taken with inert material**
- **Organic Waste composition has been changed from 61.45% to 67.02%**

While taking the field observations, waste samples from all income groups; low, medium and high income categories were collectively discharged at the temporary facility and composite samples. In total, 12 samples were prepared gathered over a period of 12 days, on continuous basis. The sample size approximately 1% by weight of the total was drawn. The samples which were collected from the very moment after discharged by vehicles at GTS were observed to have rich recyclable and calorific value contents but after a day (24 hours) of retention the composition of waste deteriorated due to scavenging activity at the GTS site. The observed change in the percentage weight contents of the items are given below. [2],[7],

Recyclables

- The recyclable content in municipal waste arising from high income communal bin level is reduced to the GTS level as a change is observed from 8.75% to 8.06%. The marked or notable change is in the paper/cardboard material which reduces from (4.60% to 2.0%). The main reason informal sector is active in scavenging in transfer stage from community bin to GTS hence the waste composition is likely to vary and recyclable content is to reduce considerably. Inert material increases from (8.34% to 17.34%) is likely due to two reasons; additional loading of diapers and mixing of dirt material due to indiscriminate dumping of waste onto the un-metal ground. The main reason of dropping down of recyclable material item wise is the excessive sorting practices at GTS.

Calorific Value Items

- A certain rise in the percentage of calorific value items is observed from high income group Gulshan Town community bin in comparison to that at the Gulshan temporary GTS. It is noted that the recyclables has increased from 12.15% to 13.82%, owing to increase in inclusion of textile content from 1.77% to 5.17%. Inert material increases from (8.54% to 17.24%) again likely due to either additional loading of diapers which have not been included in other waste contents and mixing of inert material due to indiscriminate dumping of waste onto the un-metal ground.

Organic Material

- Organic Waste composition has changed from 61.45% to 67.02%. The contents and the quality have changed with mixing of dirt and small plastic waste is observed. Such quality of waste is not useful and difficult to manage for the composting and gains weight for handling and transportation.

Waste Generation Rates

It is estimated that in Saddar Town the waste generation rate is (0.38 to 0.73 kg/capita/day) for low to high income category. Gulshan Town the waste generation rate is (0.53 to 0.953 kg/capita/day) low to high income category. Gulberg Town the waste generation rate is (0.37 to 0.70 kg/capita/day) low to high income category.

2.5 Landfill Site Waste Compositional Results

General Conditions Landfill Site

At the dumping site the waste characterization / compositional studies at only 01 designated site selected as the Surjani Landfill Site for a prescribed 12 days continuous period.

During the sampling period it was observed that on an average about 2500 tons/day of waste is being hauled from various Towns of Karachi to the designated site. The main towns which are transporting and discharging their waste at Surjani Landfill site named as Jam Chakro are; Gulshan, Gulberg, Saddar, Nazimabad, North Nazimabad, Shah Faisal, Jamshed, North Karachi and Liaquatabad, and the cantonment areas are; Cantonment Board Clifton / DHA, Cantonment Board Faisal, other areas.

At the landfill site it was observed that vehicles having different configurations, types and capacities are arriving with waste loads having small to large waste (weight/volume) load capacities (2.5 to 32 tons). The second variation observed is the change in waste composition arising from various locations representing different stages / levels of collection of waste management in Karachi being hauled to Landfill Site. [10]

Table I reviews the different levels of collection, transfer and transportation of waste at various stages of waste management in Karachi.

Table I: Mechanism of Waste Collection and Transportation from Various Municipal Areas of Karachi culminating at Surjani Landfill Site

Towns	Waste Collection and Transportation mechanism to the landfill site	Assessment
Gulberg Town and 30% part of Gulshan Town	Scavengers involved at door to door collection brings the leftover waste to the demountable / roll arm containers / community bins after sorting which is being collected mechanically by garbage vehicles transported directly to the landfill site	The waste reaching the landfill site from Gulberg Town undergoes two-stage sorting; 1 st stage occurs at door to door collection by informal collection services and 2 nd stage sorting during the transferring / filling of waste from informal waste-picking carts to the community bins / roll arm containers. It is observed at the landfill site that the quality of waste is intact and has gathered not much of the dirt material enabling further processing.
Saddar	High income group of Saddar Town UC No.10 & 11 of Clifton residential area generates high quantities and contents of waste however the waste is not transported to the Surjani Landfill site. The waste arising from medium / low income group is hauled to the Surjani Landfill site.	In the middle and low income area of Saddar Town the private sanitary staff collects waste using the wheel barrows and transports the same to the larger waste collection points / community bins made of cement concrete structure. The two-stage sorting of waste took place at the source and at the bin. The waste from the community bins are removed by tripper trucks using the front end loaders and hauled to the landfill site. The quality of waste reaching landfill site form collection points is good enough to be used for further processing

		where cement concrete bins are intact and surface is lined.
Shahfaisal Town, 40% of Gulshan Town, Jamshed Town using the Temporary Garbage Transfer Station	The towns management are transferring and hauling waste to the Surjani Landfill via temporary garbage transfer station which is almost 30% of the total collection in the jurisdiction.	The waste hauled from GTS to the landfill site is perhaps the most contaminated with dirt and of low recyclable contents. It is due to the reason that it undergoes a repeated cycle of sorting, segregation and recovery exercise, at source, at the community bin at the temporary GTS..
Nazimabad, North Nazimabad, Liaquatabad & other areas (unspecified)	An ordinary type of collection system exists in these areas and waste is generally discharged at the community bin from source after door to door collection or voluntary drop by residents at the communal bin. Waste is lifted from the community bin by front end loader and hauled to the landfill site in tripper trucks.	Tripper trucks directly discharge the waste at landfill site. The waste arising from these areas have already undergone two-stage recovery.
DHA, Cantonment Board Clifton, Faisal and similar agencies	Such areas have been outsourced to private operators for the collection of waste from source by the cantonment agencies. The private operators deploy small tripper trucks and small compactors trucks with crew which collects waste from door to door, sort the waste and transports the disposable load to the landfill site.	This type of operations involves one-stage sorting that takes place at the time of door to door collection by private operator's staff, the quality of waste reaches to the landfill site is very fresh and good and has good potential for further processing. Also to certain extent the recyclable contents are higher than the other areas and the calorific value is also good due to one-stage sorting, secondly the waste characteristics are also good owing to its origin being from very high income group category.

Sample Number	Waste Source	Dated	Total Quantity (Kg)	Total % of Organic Waste	Total %age of Recyclable (Paper, CB, Plastic, PET, Metals and Glass)	Total % of Waste with High Calorific Value (Plastic/PET, Rubber, Textile & Diapers)	Inert
Sample 01(a) by weight	Vehicle 01-Mix waste from Liaquatbad No 09, Vehicle 02-UC # 09, Vehicle 03-Gulberg GTS, Vehicle 04-Gulshan Iqbal UC #11, Liaquatbad-Saadatullah, Golimar Bara Market, Petal Padba	13-Jul-23	954				
by percentages (%)			%ages	71.87	12.28	23.42	4.72
Sample 02 (a) by weight		14-Jul-23	1006				
by percentages (%)			%ages	58.81	15.02	35.43	5.77
Sample 3(a) by weight		15-Jul-23	1030				
by percentages (%)			%ages	67.06	12.71	26.87	6.02
Sample 3(b) by weight	Vehicle 01-Nazimabad, Vehicle 02- Vehicle 03-Gulshan Iqbal and Vehicle 04- Gulberg GTS	15-Jul-23	1007				
by percentages (%)			%ages	68.50	12.94	25.84	5.66
Sample 4(a)	Vehicle 01- Nazimabad Block B (Board Office, Vehicle 02- Liaquatbad UC#02, Vehicle 03-Gulshan Gulistane Jauher Cantonment Area, Vehicle 04-Gulberg GTS	16-Jul-23	1006				
by percentages (%)			%ages	64.66	14.36	28.48	6.86
Sample 4(b)		16-Jul-23	1069				
by percentages (%)			%ages	61.47	13.14	30.95	7.30
Sample 5(a)		17-Jul-23	1255				
by percentages (%)			%ages	62.98	14.08	29.85	7.09
	Vehicle 01- Gulshan Iqbal UC05 GTS, Vehicle 02- CBF- Model Colony Katchra Kundi	17-Jul-23	1259				
			%ages	66.76	12.63	25.66	7.39
Sample 6(a)		18-Jul-23	1256				
by percentages (%)			%ages	63.60	13.87	29.67	6.69
Sample 6(B)	Vehicle 01- New Karachi, Vehicle 02- CBF-Jauhar, Vehicle 03 N.Nazimabad		157				
by percentages (%)			%ages	62.42	8.66	32.48	5.10
Sample 7(a)	Vehicle 01- Gulshan e Jamal CBF, Vehicle 02- CBF Shahahe-Faisal	20-Jul-23	1259				
by percentages (%)			%ages	62.74	15.79	30.37	6.51
Sample 7(B)	Vehicle 01- Nazimabad UC#09, Vehicle 02- GTS Gulberg Town	20-Jul-23	1252				
by percentages (%)			%ages	60.22	16.47	31.74	7.83
Sample 8(a)		22-Jul-23	1261				
by percentages (%)			%ages	60.22	18.99	33.55	6.03
Sample 8(B)	Vehicle 01- Gulberg Town, Vehicle 02- Saddar Cant Station		1256				
by percentages (%)			%ages	65.39	15.29	28.91	5.49
Sample 9(a)	Vehicle 01- Liaquatbad UC 01, Vehicle 02- Saddar Cant Station, Vehicle 03- North Nazimabad 2K Stop and Vehicle 04- New Karachi UP Modh	23-Jul-23	1275				
by percentages (%)			%ages	62.95	17.42	31.00	5.73
Sample 9(b)			1253				
by percentages (%)			%ages	68.97	13.15	24.64	6.23
Sample 10 (a)		24-Jul-23	1000				
by percentages (%)			%ages	62.76	16.71	30.04	5.70
Sample 10 (b)	Vehicle 01- Saddar Town Bath Island, Vehicle 02- Liaquatbad UC#09, Vehicle 03- North Karachi UC # 11 & 08		1004				
by percentages (%)			%ages	62.90	14.23	29.23	7.77
Sample 11 (a)		25-Jul-23	1007				
by percentages (%)			%ages	63.40	15.90	30.64	5.86
Sample 11(b)	Vehicle 01- Saddar Town Eid Gah UC#06, Vehicle 02- Gulberg Town UC#08, Vehicle 03- Liaquatbad UC#02		1011				
by percentages (%)			%ages	57.93	18.76	35.59	6.33
Sample 12 (a)		26-Jul-23	1015				
by percentages (%)			%ages	59.86	18.39	33.78	6.31
Sample 12 (b)	Vehicle 01- Saddar Town Bath Island, Vehicle 02- North Karachi, Vehicle 03- UP Modh, Vehicle 04- 5M		1022				
by percentages (%)			%ages	56.95	18.04	36.74	6.26
AVERAGE VALUES ITEMS WISE			23.6	63.29	14.95	30.22	6.30
				Organic %	Recyclables %	Calorific Items %	Inert %

Fig 2.14: Physical Analytical Results of Landfill

Waste Compositional study at the Landfill site:

The study conducted at the GTS and the subsequent analysis carried out concluded that owing to the prevailing practices of collection, transfer and transport from community bins to GTS and to landfill site with the waste repeatedly undergoing sorting and recovery of recyclable items the change in composition is significant. It is estimated that the waste composition can change up to 30% (cumulative of all percentage weight contents) in terms of its recyclable contents which have undergone 3-cycles or stages of sorting and recovery affecting the composition turning up at landfill significantly particularly in context to its calorific or heat value contents.

However practicing a different management system in which door to door collection just allowing one-stage sorting & recovery of recyclables can produce a rich content recyclable as well as organic fraction for both composting and waste to energy options prior to ultimate disposal of waste (landfill). This has been experienced in cantonment areas of Karachi and is working successfully.

The sample for determining the physical waste composition as well as for chemical analysis, a representative sampling of waste material arising at landfill site from various locations of Karachi having different levels of transfer and sorting & recovery stages was rather a difficult task but was carefully and intelligently handled by obtaining a proper mix, blending the different wastes into representative and appropriate scaled proportions so as to ensure that waste samples prepared are true representative having the components in a proportions as being dumped at the landfill site. Keeping all the constraints and requirements, 22 samples were prepared for the waste compositional study at the landfill site programmed to identify garbage vehicles for tapping waste selectively. Out of 22 samples, 06 samples were blended with the GTS waste to ensure that waste arising from GTS should also be contributed in the sampling regime. Hence directly and indirectly hauled waste composition scenarios both were included in the sampling for compositional analysis. [3],[6]

WASTE COMPOSITIONAL ANALYSIS AT LANDFILL SITE

Recyclables

Table II: Recyclable Items weight percent – Waste Compositional Studies at Landfill Site

Recyclable Item	Saddar Town High Income Door to Door (%)	Saddar Town High Income Community Bin (%)	Temporary storage at GTS (%)	Surjani Site Landfill Site (%)	Comments
Paper/Cardboard	14.42	4.60	0.51	2.60	
Plastic Bags	5.71	6.37	5.0	11.90	
PET	2.39	0.38	0.57	0.30	
Metals	0.81	0	0	0	
Glass	3.10	0.41	0.25	0.20	
Percent Recyclable contents	26.35	11.76	6.32	14.95	Increase in quantity and no. of plastic bags,

It is observed that variation in the recyclable content of waste is gradually decreasing from across the transfer stages as the waste progress towards the disposal site from its source. However an increase in the content is observed at the disposal site which is understandably due to the gathering of unwanted plastic bags and other contaminated plastic waste that is added to it as a residual.

Calorific Value Items

Table III: Calorific value Items weight percent – Waste Compositional Studies at Landfill Site

Calorific Value Item	Saddar Town High Income Door to Door (%)	Saddar Town High Income Community Bin (%)	Temporary storage at GTS (%)	Surjani Site Landfill Site (%)	Comments
Paper/Cardboard	14.42	4.60	0.51	2.60	
Plastic Bags	5.71	6.37	5.0	11.90	
PET	2.39	0.38	0.57	0.30	
Textile	1.02	1.77	6.81	7.50	
Rubber	0.43	0.16	0.61	0.30	
Diapers	Included in inert material	Included in inert material	Included in inert material	7.6	
Inert	3.02	8.34	13.61	6.30	
Percent Calorific	23.27	8.68	13.49	30.22	Increase of

Value contents					plastic bags, textile and diapers from source to disposal site
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It is noted that calorific value items correspondingly decreases with the recyclable content however diapers / nappies which are not initially accounted in the weight measures and kept segregated during the waste compositional studies remained included in as inert material would substantially add to the heat / calorific value content of waste ultimately arising at the landfill. The quantitative assessment shows that almost 8% of waste is added to the landfill waste as specific disposal diapers waste which is a material of high heat content. The other components imparting significant calorific / heat content to the waste arising at landfill is 12% of plastic bags and 7.5% of textile waste.

Organic Materials

The landfill site is receiving almost 2/3rd of MSW collected as organic waste content which can be further divided into two streams. Stream one constitutes of fresh organic waste; remains of vegetables and fruits which accounts up to 17% is rich in organic content that can be subsequently processed or directly used as fodder for cattle. Such quality organic waste is obtained when it is transferred and transported without contamination within a day to the disposal site. It is further estimated that almost 50% of that is fairly digestible material however due to contamination with plastics and paper its quality gets deteriorated despite that the organic fraction available at the landfill site is substantially significant. [9]

2.6 Chemical Analysis Results of Waste from Generation Source to Landfill Site

Services of one of the most reputable and reliable analytical laboratory services were hired to undertake the sampling and analyses of the waste chemical composition and heat / calorific content estimation. Samples were collected as per defined methodology and sampling regime and transferred / transferred to the laboratory premises. It is to be noted that the waste samples analyzed do not have diapers included i.e. values are to be adjusted on higher side / increased considering the quantum of diapers if as included at landfill site by 8% by weight content.

Table IV: Summary of Chemical Analysis Results by SGS Laboratory see appendix C

Sample No.	Waste Collected From	Total Moisture (%)	Gross Calorific Values (K.cal/kg)	Organic Carbon Total (TOC) %	Carbon (%)	Hydrogen (%)	Nitrogen (%)
Sample No. 1	Door to Door Clifton Block 7 Saddar Town	94.08	3644	Not Tested	37.21	5.28	1.331
Sample No. 2	Fresh Discharged at Gulshan GTS	61.65	4056	Not Tested	38.17	5.25	1.456
Sample No. 3	Fresh Discharged at Gulshan GTS	60.44	4274	Not Tested	41.15	6.09	1.437
Sample No. 4	Door to Door medium income Block 16 F.B Area	91.13	Not Tested	35.78	42.88	6.12	1.444
Sample No. 5	Door to Door High income Block 6, F.B Area	90.74	Not Tested	40.77	45.1	6.26	1.397
Sample No. 6	Sample from Baloch GTS	61.39	3566	Not Tested	35.72	4.86	1.339
Sample No. 7	Door to Door High Income Gulberg Town	62.98	4505	Not Tested	44.35	6.05	1.403
Sample No. 8 Landfill Site	Nazimabad Block B (Board Office, Liaquatabad UC#02, -Gulshan Gulistane Jauher Cantonment Area, Gulberg GTS	70.66	3363	26.94	34.26	4.44	1.75
Sample No. 9 Landfill Site	Nazimabad Block B (Board Office, Liaquatabad UC#02, -Gulshan Gulistane Jauher Cantonment Area, Gulberg GTS	85.7	4508	33.61	45.57	6.05	1.871
Sample No. 5 (A) Landfill Site	Gulshan Iqbal UC05 GTS, CBF-Model Colony Katchra Kundi	93.34	4386	34.48	43.89	6.25	1.42
Sample No. 5 (B) Landfill Site	Gulshan Iqbal UC05 GTS, CBF-Model Colony Katchra Kundi	95.76	4450	34.56	44.76	6.64	1.561
Sample No. 6 (A) Landfill Site	New Karachi, CBF-Jauhar, Vehicle 03 N.Nazimabad	85.54	4473	29.85	40.29	5.92	0.264
Sample No. 6 (B) Landfill Site	New Karachi, CBF-Jauhar, Vehicle 03 N.Nazimabad	91.35	4107	41.23	44.56	6.5	0.265
Sample No. 8 (A) Landfill Site	Gulberg Town n, Saddar Cant Station	73.92	3970	35.72	39.75	5.47	6.098
Sample No. 8 (B) Landfill Site	Gulberg Town n, Saddar Cant Station	69.38	3805	36.62	39.62	5.3	7.738
Sample No. 11 Landfill Site	Saddar Town n Eid Gah UC#06, Gulberg Town n UC#08, Liaquatabad UC#02	70.82	4090	36.85	40.9	5.85	1.92

3 CONCLUSION

It is established that Karachi's municipal solid waste undergoes segregation, sorting and itemized separation of recyclable items from the very source i.e. household level. Individuals are involved in direct selling of recyclable/resalable materials directly to the waste collectors who pay visit to homes. The informal collectors and middle dealers sell these recyclables as 'commodity' to recyclers for recycling. Another stream of recyclable material is separating out from MSW waste stream is at the transfer stage from household to community bin and street level where much of the recyclables are being removed by the waste collection service providers, street scavengers who sell them to recycling industry through middle dealers. Finally, least separation of some of the waste items mostly metals takes place at the dump sites through open burning which is a cause of environmental deterioration and degrading air and water quality particularly at the dumping grounds.

The variation in waste (generation rate and composition) is a highly variable characteristic observed depending upon the waste producer income and living life style as well as waste management; collection, handling (segregation, sorting, separation) practices at source, and different transfer levels; community bins, garbage transfer station and disposal sites by formal and informal sector (in-house, private collection, street scavenging, middle dealers). The three main components of the municipal solid waste branching out and showing variations at different transfer stages are; organic fractions, recyclables and inert. The waste stream originating from the sources mainly;

households / dwelling units, shops & markets, streets & roads, institutional and public places, open places, etc. experience significant variation in composition of waste composition particularly in terms of recyclables which get substantially reduced as it reaches to the final dumping place. Organic fractions are also reduced and inert are increased. Comparison of previous data of Karachi with the present finding indicates that waste composition has remained more or less similar and the variations are in conformity following the previous trends observed as in socioeconomic levels as well as across the transfer stages of waste from source (generation) to the disposal. Waste generation rates have however increased to some noticeable extent which is a sign of affluence and shift in life style of the citizens of Karachi. In context to waste to energy option for Karachi, it may be suggested that feasibility lies both at establishing Waste to Energy plant at GTS or Landfill with the current waste management practices, however if the collection mechanism is improved and the number of recovery of unaccounted calorific / heat value items such as diapers, tetra-pack containers, etc. is contributed in the waste fed into the waste to energy system then a substantial / feasible operation of the system on sustainable grounds is envisaged.

Recommendations An independent Waste to Energy study for Karachi should be undertaken to investigate under the feasibility of power generation from waste and the prospects of how much energy can be derived (potential) from MSW waste. Also other option of converting waste into other forms of fuel (RDF – Refuse Derived Fuel) should also be investigated (Pyrolytic Conversion, etc.).

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The Impact of Artificial Intelligence in the Development of Textile and Fashion Industry

Basem Kamal Abasakhiroun Farag

Abstract— Fashion, like many other areas of design, has undergone numerous developments over the centuries. The aim of the article is to recognize and evaluate the importance of advanced technologies in fashion design and to examine how they are transforming the role of contemporary fashion designers by transforming the creative process. It also discusses how contemporary culture is involved in such developments and how it influences fashion design in terms of conceptualization and production. The methodology used is based on examining various examples of the use of technology in fashion design and drawing parallels between what was feasible then and what is feasible today. Comparison of case studies, examples of existing fashion designs and experiences with craft methods; We therefore observe patterns that help us predict the direction of future developments in this area. Discussing the technological elements in fashion design helps us understand the driving force behind the trend. The research presented in the article shows that there is a trend towards significantly increasing interest and progress in the field of fashion technology, leading to the emergence of hybrid artisanal methods. In summary, as fashion technologies advance, their role in clothing production is becoming increasingly important, extending far beyond the humble sewing machine.

Keywords— fashion, identity, such, textiles ambient intelligence, proximity sensors, shape memory materials, sound sensing garments, wearable technology bio textiles, fashion trends, nano textiles, new materials, smart textiles, techno textiles fashion design, functional aesthetics, 3D printing.

An Approach to Establish a Design-Development Model for the Bangladeshi Handloom Fashion Industry

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Abstract: This study attempts to uphold a report on an approach to establish a design-development model for the Bangladeshi handloom fashion industry. This paper uses quantitative research to develop the Bangladesh handloom sector to follow the Indian fashion industry. Moreover, the study will also consider primary and secondary sources of information to analyze the handloom sector's development. It is motivated by the fact that, over this period, India's fashion industry has developed and become well-positioned in the international market. The Indian handloom-based fashion industry includes brands such as Jigmat Couture, Raw Mango, Bharatsthal and Southloom, Fabindia, Heirloom Naga, the Calico Guild, and REHWA society; their new techniques are also already catching the international market's attention. Based on that formula, handloom sector development is a strategic decision for the Bangladeshi handloom sector. In fact, implementation of CAD (computer-aided design) techniques will help to develop this sector, which will be briefly discussed in the result and discussion of this part paper. On the other hand, old motifs and concepts have been used for a long time; there is no development in the handloom products. This paper is prepared to improve the handloom sector through CAD-based design, and the effective thing is that it is a creative sector as the second employment after agriculture. So, if we take initiative to improve them, we can do it because brands like Aarong, Aranya, Bibiana, Bibi Russell, Bishwo Rang, Kay Kraft, Anjan, and Sadakalo already use handloom fabric. So, if we apply the latest techniques in our fashion brands, we hope that from the local market to the international market will spread its popularity.

Based on this analysis, developing the handloom sector is a strategic decision for Bangladesh. Implementing CAD (Computer-Aided Design) techniques can significantly enhance this sector, as will be discussed in the results and discussion section of this paper. Currently, the handloom sector relies on old motifs and concepts, with little innovation in product design. This paper aims to rejuvenate the handloom industry through CAD-based design. The handloom sector is the second-largest source of employment after agriculture in Bangladesh, highlighting its potential for development. Brands like Aarong, Aranya, Bibiana, Bibi Russell, Bishwo Rang, Kay Kraft, Anjan, and Sadakalo already use handloom fabrics. By integrating modern techniques into our fashion brands, we can increase their appeal, expanding their popularity from the local market to the international stage.

Keywords: handloom product, development in handloom, design-development model, CAD, photoshop, fashion industry

1. Introduction

This study is focused on establishing design-development models for the Bangladeshi handloom fashion industry. This study aims to promote handloom among foreign buyers through a design-development model. This report is prepared to improve the handloom sector through some design-development models using CAD concepts so that it is easy to represent it in the international market. This paper describes some techniques to establish a design-development model

with handloom-based fashion products. This study focuses on the Indian handloom-based fashion house so that we can get concepts from them, and our fashion house can start in a new way. Some people are still very interested in purchasing handloom-based products [4]. As a result, this research paper is researched to develop the handloom sector; it is necessary to create the handloom industry because it faces enormous challenges to sustain itself for the technological advancement

and digitalization of the apparel sector lacking development. This is why we have to keep up with the times and CAD implementation in the handloom sector, which is the main aim of this study. Development is a procedure that creates progress, positive change, economic, and social [3]. On the other hand, when development is progressed, sustainability in this sector also happens. Sustainability is social equity, environmental safeguard, economic fairness, and cultural accuracy [9]. Following those terms, this study also tries to find solutions to develop the handloom sector so that this sector can lead not only in the international market and at the grassroots level. So, this paper finds Computer-aided handloom Design for weavers' time saving because most weavers try to ready handloom motif design on graph paper, which is time-wasting. But if the procedure is done in Photoshop (CAD), time will be saved for the weavers [11].

As a result, the latest unique design will be prepared, and if we succeed, we can reach a great position. If we want to take the initiative, we should focus on technical knowledge to implement in the handloom sector. For that reason, nowadays, CAD is a great opportunity that saves time and helps to find out the latest trends and new design varieties of our traditional motif [11]. On the other hand, India has taken a great position to export their products to the international market; their economic sector is growing gradually. Some designers in that country guide the handloom industry; for that reason, their fabric has been made in creative concept and can adapt to the latest trends. The latest trends are implemented in the handloom fabric; consequently, international buyers are attracted to their products. Raghavendra Rathore, Ritu Kumar, Manish Malhotra, Ritu Beri, and Neeta Lulla are Indian designers, and they are using these handmade fabrics with a new concept [10]. Moreover, those designers have helped to guide new techniques for local weavers before weaving fabrics [6]. The handloom products are exported from India to the world in more than 20 countries, such as the USA, UK, Spain, Australia, Germany, Italy, France, and others [5]. Because of their initiative, they are doing great on the products of weaving fabric. However, brands in our country are not as active as Indian brands. Bibi Russell, Aranya, Bibiana, Mayasir Ltd, Rang, Aarong, Kaykraft, Anjans, Sadakalo, and Afsana Ferdousi those are working on weaving fabrics. Still, it is very effective to increase those percentage for use in that fashion house. Moreover, proper implementation of the latest trend should give knowledge to the weavers with CAD; accordingly, the different types of dresses will be made in a creative way from handloom-based fabric [15]. After that, we can be able to represent our product in the international market. Computer-aided Design (CAD) helps a lot if they learn about this. After that, this handloom sector develops day by day, and we can take a significant position in the international market.

1.1. Significance of the Study

The overview of this research first discusses that the cumulative study of the Bangladeshi handloom sector and the development of the handloom sector is the main aim to follow the Indian fashion industry. They use highly valued

raw materials, which are matched with input material values and by the high costs of handloom production in order to produce just value addition products, the diversification of handloom products, product development to increase the value-added, adapt fair trade practices, handloom weaving as a modern profession, such as fine arts, photography, music, etc., and encourage young people to enter the handloom industry [9]. Furthermore, Indian designers make significant contributions to the handloom industry along with government cooperation. Apart from this, the literature shows that various new techniques are great for turning around. If Bangladesh follows the Indian fashion industry, we can quickly reach a great position because we can reach a significant place better than India. So, we should take the initiative to spread our popularity in the international market. That's why we need trained technical knowledge among our weavers to discover new fashion knowledge. As a result, CAD is the primary technique to implement in our handloom industry in this research paper [11]. For that technique, the weavers can weave very quickly various fabrics with new design concepts; as a result, our fashion brand is encouraged to use those fabrics [15].

1.2. Research Objectives

This study is to collect new techniques for developing the handloom sector. In addition, this paper tries to come across the present conditions of Bangladesh and Indian handloom-based products to find significant obstacles to development in this sector. Another objective of this study is to determine how many products are developed in the handloom industry. This research is about how to improve this position from the previous and present conditions. The weavers in this country have created a unique niche in weaving excellence through the acquisition of skills passed down from generation to generation. However, design techniques are not changing; for that reason, developing this sector through new digital techniques (CAD) implementation is effective. As a result, the artisans and designers can improve the unique designs on the handloom-based products with artisans. Various types of colors, textures, motifs, and designs can be implemented in different ways. This study tries to design some Photoshop (CAD) models for developing the handloom sector and how to save time [15]. The specific objectives are to:

- 1) A cumulative study on the Bangladeshi handloom industry.
- 2) Finding opportunities for handloom products by studying the Indian fashion industry.
- 3) Designing a model for the fashion industry focusing development of handloom-based products through CAD implementation.

2. Literature Review

Faria Sharmin has found out the handloom industry's role in Bangladesh's national economy is immense. The indigenous handloom industry occupied a special place at home and abroad. The latest design concept is for handlooms, which is effective, and evens the latest

techniques to inspire people to purchase handloom products [12].

Annapurna says that jamdani is a sophisticated and labor-intensive technique that allows shaped motifs to weaving of finely. Moreover, the innovative capacity for handloom weaving creates sustainability among the weaving communities through phone technology, and the innovation techniques can get a great response from the handloom sector [1].

CAD allows for a faster pace of work to reduce the cost of products and to improve competitiveness in 2008. Furthermore, special drafting methods can be applied, and the planning calculations are quicker and more accurate [15].

The handloom sector is one of the most important sectors of the Indian textile industry. The handloom sector has significantly contributed to the Indian economy for a long time. Furthermore, the author tries to say that if the designer, researcher, and marketer focus on the handloom sector, this sector will revive as well as take a position in the international market [10].

Dwivedi explains that nowadays how important CAD and 3D technology are in the fashion industry. To address these challenges, it is also possible to combine solutions such as CAD and 3D technology with Internet tools so that optimum solutions can be developed in all areas [2].

3. Research Methodology

The study will consider primary and secondary sources of information in order to analyze the development of the handloom sector. Furthermore, this research article is done for the development of handloom-based products in our country to follow the products of the Indian fashion industry. For preparing this report, there is also needed to study various publications of the handloom industry and websites. The study is prepared depending on the quantitative research. In order to improve the handloom sector, secondary data is used from 2012 to 2023. The motivation for choosing this span of time is that most of the handloom industries gradually developed during this period within this time in the Indian fashion industry and have taken a great position in the international market. So, following their industry, this paper is discussed about design progress of the handloom sector. To develop the handloom sector, the CAD concept will be implemented, for that reason; CAD-based knowledge is taken from different authors' study papers [14].

3.1. Sampling Method

A researcher should choose an accurate sampling method for selecting the population, setting, and time although the research situations are limited. Interviewing everyone or observe on different matters, is usually not easy too. Quantitative researchers' works are with a large number of sources for different experimental work according to results. There is a great opportunity to get strong data from quantitative research, and this research report is worked on the basis of quantitative. Therefore, there is collected

information from secondary research.

3.2. Data Collection and Analysis

Observations are conducted for acquiring data on the handloom sector from different fashion brand of Bangladeshi and India. My friend and I went to collect data and I conducted quantitative research through interviews, observation, and secondary research. I interviewed the 120 people who helped me a lot to give me information. I collected information over 10 weeks and then got very effective data. Also more, it was necessary to do a field survey among designers for collecting some opinions, and then that was done by a Likert scale questionnaire (3 point scale) survey on 30 designers (academic and another). That was effective for this paper to complete and be authentic, as well this paper contained accurate data which has done field survey.

3.3. Data Storage

All collected data and documents will be stored according to data management process of University. In line with University's requirements, all data will be retained for five years.

4. Result & Discussion

This chapter is comprised of four parts, and the first part discusses the analysis of various types of products about various types of handloom products of Bangladeshi brands. The second part describes an analysis of various types of product motifs about different types of traditional motifs and new motifs strategies on graph paper; those are used on handloom products through fashion brands. The Third part is discussed handloom-based products' materials; the last one is following an Indian handloom-based fashion brand for finding techniques to develop the handloom-based design-development model. Therefore, the findings are exactly the solution that helps to complete this research report.

- 1) Analysis of collected handloom based different types of ladies' products. For the example -
- 2) Analysis on variety types of product
- 3) Analysis on variety types of products motif
- 4) Analysis on variety types of products materials
- 5) Analysis on Indian handloom products
- 6) Analysis on Bangladeshi handloom products export condition & destination

4.1. Analysis on Variety Types of Product

Findings are handloom-based various types of products, cultural art, and motif are applied to different types of dresses in a variety of contexts to develop Bangladeshi handloom-based clothing. Handloom-based different types of products are found in the market. There are various types of handloom products; those are in the category of women, men, kids' girls, and kids' boys in aarong such as handloom cotton Panjabi, men's handloom lungi, men's cotton shirts, cotton tops, viscose shirts, men's cotton Panjabi, viscose shawl, viscose muffler, men cotton Panjabi pajama set, maternity

top, kids boy cotton Panjabi, men cotton coat, cotton scarf, maternity sleepwear, viscose jacket, cotton shalwar kameez, saree, dupatta and so on. From the primary survey, Aarong collects these types of products (Fig. 1) with various types of traditional work.



Fig. 1. Handloom Based Products Aarong Collection 2023.

fabric is made of cotton, and that is made with hardworking labor. The handloom, an artistic fabric of Bangladesh weavers, is one of the most beautiful textiles in the world. This fabric is designed fabulously with traditional motifs which is the most popular to all from old age to modern age.



Fig. 4. Handloom Based Products' Motif Aarong Collection 2023.



Fig. 2. Handloom Based Products Aranya Collection 2023.

However, Aranya decided to re-establish the lost traditions and they decide to promote unique products (Fig. 2) by individual craftsmen and artisans so that indigenous crafts become available in the market.

The weaving techniques of this fabric are the most notable part, which is drawn on lucid graph paper and placed beneath the wrap instead of sketched on the fabric. There is some motif, these are so popular such as the Dana motif, nakshi kantha motif, Kolka (Paisley), Pakhi (birds), palki (palanquin), Ghora (horse), Moyur (peacock), Nortoki (dancer), Roth (chariot), shonko (conch), hathi (elephant), Dhaki (drummer), dora (stripes), phool (flower), Aansh (fish), Buti (polka), Lota-pata (twigs) and so on. From the primary survey, Aarong uses those motifs for developing new products (Fig. 4) and, they are trying to improve the handloom sector.



Fig. 3. Handloom-Based Product with New Concept Bibir Bason Collection 2023.

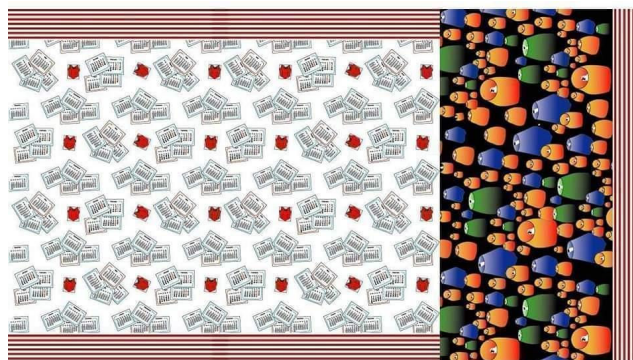


Fig. 5. Handloom Based Products' Motif Graph Paper Design Bibir Bason Collection 2023.

On the other contrary, Bibir Bason is applying on the dress traditional techniques with contemporary print designs (Fig. 3). Moreover, they decide to promote the sustainable development of lost traditions and even improve Bangladeshi cultural arts and crafts.

Moreover, graph paper (Fig. 5) is also used before weaving the fabric with different motifs. Already, Bibir Bason is a new fashion brand, and they try to develop a unique fashion product with handloom fabric. As well, they are already focusing on Indian techniques as a result our local people is gradually catching attention. If we want to make them effective, we need to take initiative. We hope that we will have a bright future in the handloom sector.

4.2. Analysis on Variety Types of Products' Motif

4.3. Analysis on Variety Types of Products' Materials

Findings handloom-based various types of cultural art and motif are applied to different types of dresses in a variety of contexts to develop Bangladeshi culture. Handloom woven

Findings handloom-based various types of products and various types of products materials are applied on different types of dresses in a variety of contexts to develop Bangladeshi handloom based products. Most of the handloom products of the Aarong brand are made with

handloom cotton, handloom viscose, handloom rayon, Textured handloom viscose cotton, embroidered handloom cotton, printed and embroidered handloom cotton, handloom cotton - rayon, handloom tie-dyed viscose cotton and so on. The aesthetics of products are very eye-catching with hand embroidery work, block print, machine embroidery, screen print, dobby texture, as well as tie and dye (Fig. 6).



Fig. 6. Handloom Based Products' Materials Aarong Collection 2023.

4.4. Analysis on Indian Handloom Products

India is the source of a wide variety of rich and nice handlooms and textiles. In fact, this country is universally known for awesome printing, weaving, and hand-spinning. With 23.77 lakh looms, the handloom industry is the largest cottage industry. Several traditional products are produced for example shawls, lungies, sarees, ghagra cholis, bedspreads, kurtas, bed sheets, fashion accessories, and so on. Not only that there are western dresses, fashion fabrics, drapes, bed linens, kitchen linen, rug durries, and decorative furnishings, and those are produced as well they export those items in the international market [5]. Moreover, India takes some initiatives such as having less power consumption, being capable to adapt to market conditions, having less capital intensive, and being eco-friendly.

4.4.1. Exported Items and Destination

Mat products, carpets, rugs, bed sheets, cushion covers, and other textiles are the main exports of handlooms from India. The export of mats and rugs from this country is accounted for 29.60% of overall exports in the period from 2021 to 2022. In total, home textiles compose over 60% of India's handloom exports. The export of carpets, rugs, and carpets accounted for US\$ 124.89 million in value between 2021 and 2022 amounting to INR 930.78 billion. The export of cotton durries amounted to US\$ 190.47 million in INR 1,419.10 cores over the period between 2021 and 2022 [5]. In the period from 2020 to 2021, the total textile products produced from handlooms, for the example: bed linen, toilet linen, kitchen linen, bed sheets, pillowcases, cushions, table cloths, etc., accounted for approximately 23.5% of the total exports [13].

Karur, Panipat, Varanasi, and Kannur are the main centers for exporting handloom products such as bed sheets, table cloth, kitchen rugs, toilet stains, floor coverings, embroidered textile materials, curtains or anything else that is produced in export markets. From January to June 2022, Indian exported

cotton yarn/fabrics/made-ups, handloom products etc. worth US\$ 7.17 billion. Over 20 countries in the world are exporting handmade cloth products from India. The United States, United Kingdom, Spain, Australia, Italy, Germany, France, South African, Netherlands and United Arab Emirates are some of the most important importers. The US is the largest importer of Indian handloom products, and it has continuously been the most important consumer over the last eight years. During 2021 to 2022 (April to September 2022), the country importer handloom products are worth US\$ 33.75 million. Exports to the United Kingdom, which was India is the second largest exporter of handloom in the same period, rose to US\$ 6.50 million. European Union constituted a total of 18% India's export during 2021 to 2022, Bangladesh accounts for 12%, and UAE stood at 6% of total Indian handloom exports [5].

4.4.2. Design Concept in India

The majority of the weavers at Single Ikat Craft had been developing new and unusual designs, but some were working with both traditional and modern patterns. A single Ikat boat of Gujarat with a distinctive feature in its design, the Grid based pattern. In order to obtain a grid pattern, it was necessary to split the motif into smaller units that were as small as those on the graph sheet. When it was tied up a bunch of yarns was named bhagwat and they had been represented as the smallest square on the graph sheet. The bunch used to be called a ribbon while they were on the loom. The 61 divide formed one repeating unit and the same border was a 31 x 61 divide. The new designs are that they have come up with themselves. Embroidered books, newspapers, puzzle images, magazines, periodicals, and all sorts of other textiles and prints have been the inspiration for the new designs [11].

4.5. Analysis on Bangladeshi Handloom Products Export Condition & Destination

In terms of demands for its advanced handloom around the world, Bangladesh is on track to become one of the most required after countries. For centuries before the creating of this country, these fabrics have been completely connected to culture and heritage. Everywhere in the world, there is an increasing demand for fabric, with every passing day it passes through its own borders. In ancient times, the handlooms produced in Bengal had been exported to almost every wealthy nation of the world [8]. The export began about 10 years ago, and has so far received acceptance from a number of countries in the world. There are 1 million weavers producing more than 0.50 million handlooms, 59% of which are active. We get 620 million square meters of garment, accounting for 40% of the country's overall annual demand from these 0.3 million shed looms. The Bangladesh handloom board showed (table 1) a piece of the amount where Bangladesh earned 1.6 billion USD in exports of handloom during the period from FY 2009 - 2010 to FY 2019 - 2020.

TABLE 1. HANDLOOM PRODUCTS EXPORT COLLECTED FROM TEXTILE FOCUS.

Fiscal Year	Type of products	Price of the products (in USD)	Country's
2015 - 16	Tangail tant saree, Tant cotton saree, Lungi,	95,76,875.00	India, Japan, Germany, UK, Sweden, Switzerland
2016 - 17	Scarf, Handloom check fabrics, Kitchen towel, Table cloth	115,10,060.00	India and Japan
2017 - 18	Tangail tant saree, Tant cotton saree, Lungi, Scarf	133,05,174.68	India, Japan and UK
2018 - 19	Tangail tant saree, Tant cotton saree, Lungi, Scarf	127,87,328.20	India, Japan and UK
2019 - 20	Tangail tant saree, Tant cotton saree, Lungi	13,25,182.50	India, Japan and UK

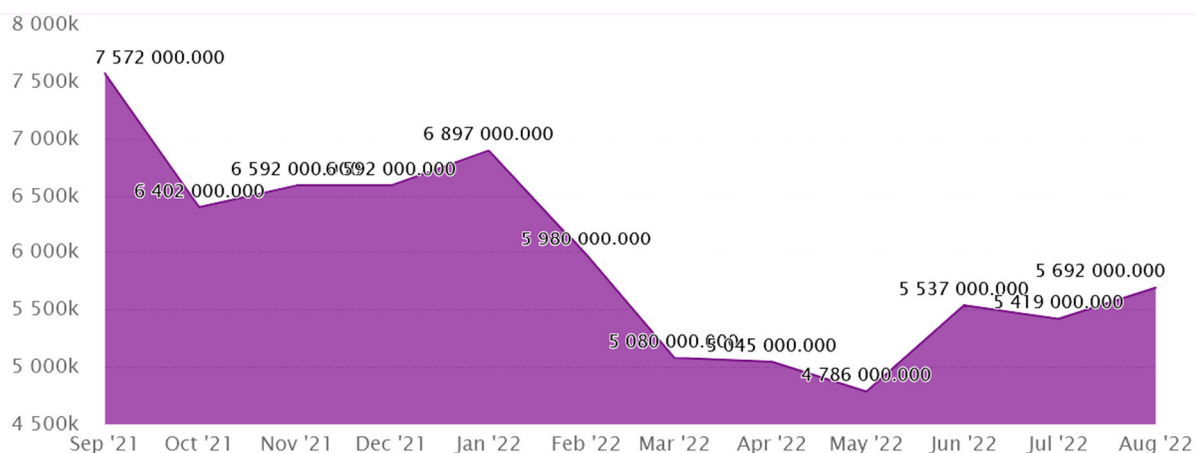


Fig. 7. Handloom Textile (Oct 2015 - Aug 2022) Collected from ceicdata.

From October 2015 to August 2022, here (Fig. 7) are the statistics of Bangladeshi handloom product conditions, which is really surprising for our country. The condition of handloom textiles was 7,572,000.000 in September 2021, 881,000.000 in July 2016, 5,419,000.000 in July 2022 and 5,692,000.000 in August 2022. To increase our handloom products internationally demand, it is necessary to take a decision for developing this sector in a new way so that we can reach a high position in the international market.

4.5.1. Analysis on Weaving Items

By visiting the craftsmen, the need analysis was carried out. The researcher has learned that the craftsman used traditional techniques to develop their designs while she visited there. It has checked that, apart from the weaving, the craftsman would record the patterns on graph paper locally available to them with pencil, pen, color pencil, or pen on graph paper, as well, as someone trying to design on the handloom items, which would be a time consuming activity.

It took a lot of time to develop the traditional method of design. Without the help of computer programs, it was hard to create a layout [11]. The handloom weavers wanted to learn to make the designs layouts, so that the color combination, which they had to imagine (Fig. 8) and was only possible while weaving of the fabric.

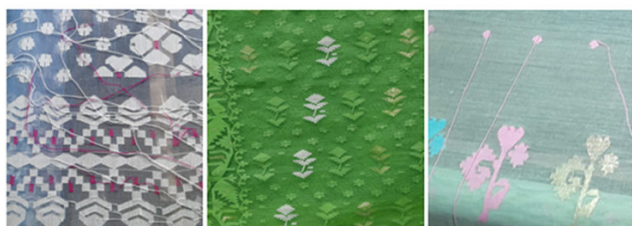


Fig. 8. Handloom Design Samples from Weavers House.

With the help of Computer-aided Design (CAD) without the loom process, it would be easy to see. When designing a layout using CAD, there would be the possibility to place motifs as well. The weavers did not have a catalogue for clients to look at. The transmission process can be improved by a catalogue or swatch file. Before production, consumers and weavers can look at the final product rather than visualize it. When the researcher visits the weavers of Narayanganj, she found that they develop designs for a long time.

For that reason, there is an essential computer-aided design so that those will be in the catalogue. As a result, time will be solved, and it will be easy to follow the latest trend and order quantity will be increased, then we will also get a good reputation worldwide. Furthermore, some of the newest design concepts have been developed (Fig. 9) in Photoshop in computer-aided design. Old motives have been used for a long time; that is why digital-based design with new motifs, new color concepts, and unique designs are effective in developing the handloom design to reach a great place.



Fig. 9. Handloom Design on CAD (Photoshop).

4.5.2. Design-Development Based on CAD

Consequently, a catalogue of different designs will be prepared, and as a result, the visitors and company owners can also check all designs [11]. The digital technique is actually a very time-saving, which helps to easy productivity and speedy process for developing any product. If we want to represent handloom-based products in the international market, we need to implement a new market strategy. After that, the CAD-based concept will help a lot to designers, artisans, and weavers for improving the product. The following designs are prepared in Photoshop; there are some processes to develop any design. Thus, there is firstly a need to take a "new file", need to set the width and length with 60 pixels and 65 resolutions, after then, there is necessary to go to edit with preferences, grid and by pixels. After taking the grid option, then there is needed to take a pencil and color, and then draw a variety type of designs.

4.5.3. Design-Development Process Based on CAD

The design analysis process has illustrated what has come out of thinking. In fact, the thinking concept has been expressed from diverse platforms, and they have tried to represent their local concepts in the international market. Moreover, the flow chart (Fig. 10) states from the designing process to the last stage, which represents the world.

4.5.4. Inspiration Board

An inspiration board expresses a huge concept, and it helps a designer to provide new ideas for making newly designed dresses. Nowadays, there are various types of devices, and we can acquire different latest techniques. Same as, if our designers decide to help with their new concept, the handloom is also possible to sustain. Therefore, from that point of view, there has been created an inspiration board (Fig. 11) from our local concept so that something new or special can come out.

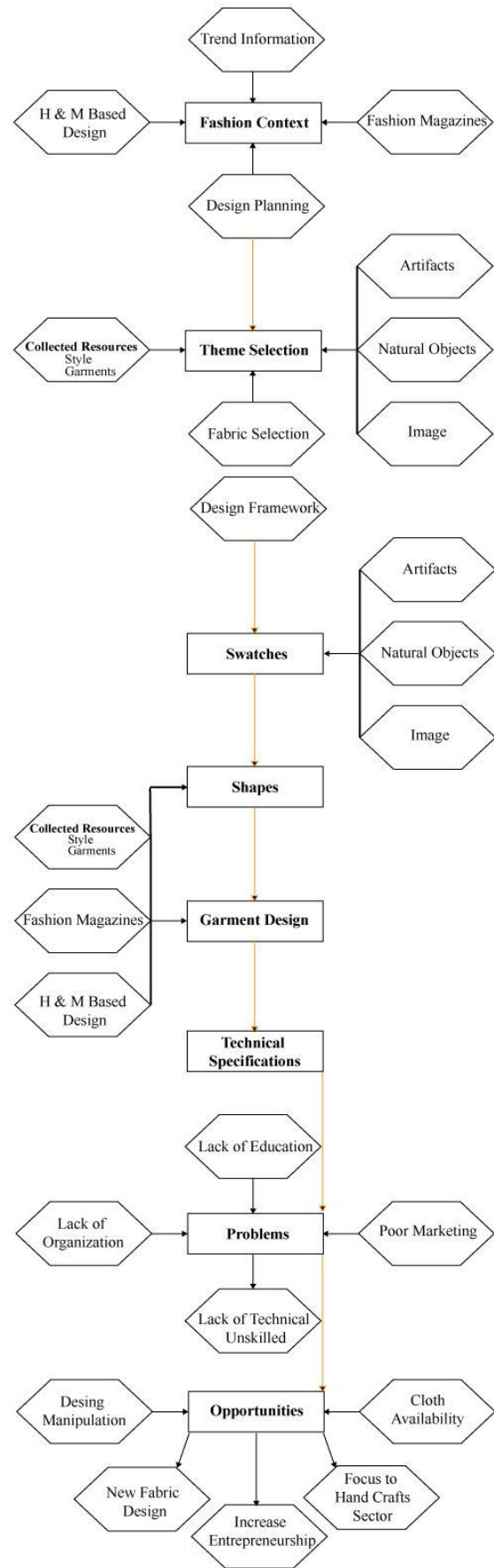


Fig. 10. Flowchart of Design-Development Process.



Fig. 11. Inspiration Board.

4.5.5. Mood Board



Fig. 12. Mood Board.

The design process becomes fulfilled from the mood board (Fig. 12), the new design is very easy to create when the

mood board completes perfectly according to inspiration. The board helps to provide details concepts for making different new designs. Creativity is the most effective thing, and then the creative idea generates from the mood board. If we would like to complete design work, this is mandatory. Otherwise, the design work will be incomplete, and it helps to do great in working methodologies and problem-solving theories.

4.5.6. Color Board

Color is the symbol of attention to people if that is eye-catching; it ensures that people are impressed with any item and this color board (Fig. 13) expresses for handloom different products concept. Same as, color is very necessary to forecast because we should not create any design based on guessing. For that reason, a color board is very important and the designer should analysis on color. There are different colors' analyses in the board of color for predicting upcoming products.



Fig. 13. Color Board.

4.5.7. Design Board 01

This design (Fig. 14) is inspired to folk motif and latest design concept, as well that will be made on handloom fabric. Flower petals concept will be in Applique work, which implemented on this dress.



Fig. 14. Design Board 01.

4.5.8. Design Board 02

This design (Fig. 15) is inspired to folk motif and latest design concept, as well that will be made on handloom fabric. Flower petals concept will be in Applique work, which implemented on this dress.



Fig. 15. Design Board 02.

4.5.9. Design Board 03

This design (Fig. 16) is inspired to jamdani motif and latest design concept, as well that will be made on handloom fabric. This concept will be in Applique work, which implemented on this dress.



Fig. 16. Design Board 03.

4.5.10. Design Board 04

This design (Fig. 17) is inspired to jamdani motif and

latest design concept, as well that will be made on handloom fabric. This concept will be in Applique work, which implemented on this dress.



Fig. 17. Design Board 04.

4.6. Design Board 05

This design (Fig. 18) is inspired to flower motif and latest design concept, as well that will be made on handloom fabric. This concept will be in Applique work, which implemented on this dress.



Fig. 18. Design Board 05.

4.7. Design Board 06



Fig. 19. Design Board 06.

This design (Fig. 19) is inspired to folk motif and latest design concept, as well that will be made on handloom fabric. This concept will be in Applique work, which implemented on this dress.

4.8. Discussion

Nowadays, Computer Aided Design (CAD) is used to perform the specialized design functions with quick pace and reliability. With regard to color, design and style, this makes it an excellent opportunity for experimentation in weaving. A key role to play in facilitating the creation of new designs, with an infinite number of possibilities, can be played by CAD on handloom. Woven designs for Handloom items were developed using CAD, and CAD designing aid in gaining accuracy for weaving. So, the Photoshop of CAD software will be great supportive for weavers, as a result the designer also can help them. CAD based design will be unique, and there is too possible to attention to worldwide customers [14]. On the other hand, at present, some showrooms are decided to collect handloom-based items for developing that tradition. Accordingly, some examples are aarong, aranya, bibiana, bibi russell, rang, kaykraft, anjan, and sadakalo. For CAD based updating new design, our local brands will be more interested to use handloom fabric, along with, we can be able to gather attention from international market. As a result, using of our handloom fabric will be increased. Bangladeshi is one of the great countries for colorful celebrations. Many types of cultural festivals have happened in our country; those are celebrated happily by people. Thus, Pohela Boishakh is the first day of the Bengali calendar, which is one of the most popular festivals in our country. This day is celebrated with so much joy, and most of the young generation wears handmade fabrics item.

Moreover, that is changing day by day in the evolution of time. Nowadays, foreign fabrics and dresses are used by most Bangladeshi people. They think that foreign cultures are

smarter than local cultures. Again some peoples are wore saree, salwar kameez, Panjabi, and traditional based dress, even though most of the items are made with handloom cotton fabric, but their quantity is very low at present [7]. If CAD handloom is ready to develop latest unique design, our young generation will be encouraged to wear handloom based dress. In fact, that was one of the old fabrics of handmade and that was so popular contemporary. Not only in pohela Baisakhi but also on other occasions should wear traditional cloth by weaving based products. The young generation is the main expedient to save from plaguing the handloom sector. If they encourage using those items, we can improve it. We have many cultural occasions, for which people are interested to decorate them in a colorful way so that they can spend a good day. If that occasion becomes the main approach to wearing traditional clothing of handmade fabric, then we will not be needed to import foreign fabrics and clothing. All in one, now, in the final judgment, Photoshop in CAD helps to do design different types of motif, and then the handloom fabric will be favorite to the designers.

5. Conclusion and Recommendations

The findings from this study suggest that the handloom sector is a big traditional sector that helps to strong of our economic sector. As well, the economic growth will be also stronger if our fashion brand in our country decides to create handloom-based products with creative concepts, and we can represent our products in the international market. Handloom means handmade fabric by spinning a machine with creative ideas and motif which expresses our traditional culture.

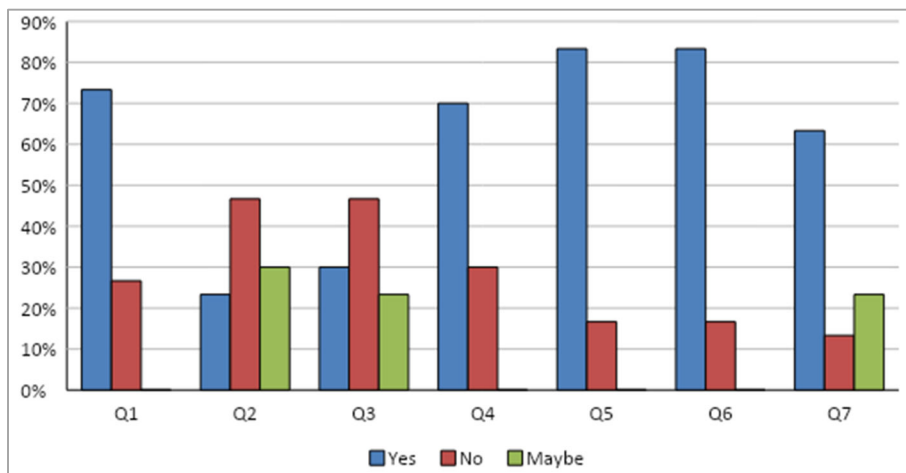


Fig. 20. Questionnaires Result on Bar Graph from Field Survey 2023.

The traditional handloom industry in Bangladesh, which has been the most significant industry for a long past, was well-popular in Asia and Europe. Muslin was the finest quality of handloom used by emperors, families, and nobles, in addition to being one of the most crucial export goods during Britain's period from 1757 to 1947. From Dhaka to Europe, about 6 million pounds of muslin were exported at a time. But that popularity decreased during COVID-19; as a result, the handloom sector has recently faced enormous challenges, and our economic growth from the handloom sector is declining day by day. After COVID-19, India's handloom sector has taken a significant position in the international market because of its fantastic initiative. Some of their endeavors are the latest concepts in the motif of handloom, unique concepts in the handloom-based dress, and the newest techniques in the weaving fabric. By following their initiative, this paper is trying to implement the handloom-based products so that we can reach at our previous level. But can we arrive at a high level by following them at all? I think we can do it because we have an excellent reputation for handloom better than India. From that report, we can reach internationally at a high position. The researcher surveyed designers to determine their opinion on how much they are supporting the developing handloom-based products. The survey was done among 30 designers who participated, which is shown in the bar graph (Fig. 5).

Fig. 20 has shown on survey result from participated designers how effective to improve our handloom products.

From the data analysis, we might have a clear view of the handloom-based design-development where designers shared their opinions regarding improvement in this sector. Most handloom-based products were widely recognized and well-known worldwide at the time, but in the evolution of time, we have lost so many popular items from our country. Again, we can overcome those problems if we take the initiative, we and develop our sector. From the data analysis, some designers want to improve this sector according to the latest design concept, which Indian designers already do. Besides, some designers also believe that many people purchase previous concept designs of handloom products, so we should keep previous motifs. In addition, they also suggest that how people will prefer according to the latest concept design for experimentation. If they agree, we can step ahead in developing this sector. Moreover, some designers want to build on the handloom sector in a new way by implementing different designs.

Additionally, a few designers said that if the nakshi

kantha concept is implemented on various design concepts, handloom-based products can also be designed according to the new concept. Other designers are saying we should target fancy-type dresses from handloom fabric; we can also gain outstanding international achievement. Some designers give their opinion regarding traditional motifs to implement motifs on the different types of clothing diversely; then, we should keep our traditional motif even which will be with the new concept. Because our traditional motif is our main element in presenting our country internationally, there will be a smooth process to update the handloom sector. On the other hand, CAD-based concept which is appreciated from most of the designers because they think that those are an entirely new concept for doing unique work; then the variety of types of better work is possible very quickly, and even CAD (Photoshop) based work helps to find out new design.

Thus, most of the designers share their opinions with positive opinions and suggestions so that we can try to improve our handloom sector better than the previous situation. The finding of this report is that the cultural values and weaving products influence some designers recently which are a positive point for our country. The scope of this study is also to increase using the handloom fabric in our fashion brand; as a result, the international market will get a response to our unique design [14]. Photoshop CAD can help to do easy work. If this technique can be implemented, some bright hopes can see in this sector in a new way.

Conflicts of Interest

The authors declare no conflicts of interest.

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The Impact of Artificial Intelligence on Textiles Technology

Ramy Kamel Fekrey Gadelrab

Abstract— Textile sensors have gained a lot of interest in recent years as it is instrumental in monitoring physiological and environmental changes, for a better diagnosis that can be useful in various fields like medical textiles, sports textiles, protective textiles, agro textiles, and geo-textiles. Moreover, with the development of flexible textile-based wearable sensors, the functionality of smart clothing is augmented for a more improved user experience when it comes to technical textiles. In this context, conductive textiles using new composites and nanomaterials are being developed while considering its compatibility with the textile manufacturing processes. This review aims to provide a comprehensive and detailed overview of the contemporary advancements in textile-based wearable physical sensors, used in the field of medical, security, surveillance, and protection, from a global perspective. The methodology used is through analysing various examples of integration of wearable textile-based sensors with clothing for daily use, keeping in mind the technological advances in the same. By comparing various case studies, it come across various challenges textile sensors, in terms of stability, the comfort of movement, and reliable sensing components to enable accurate measurements, in spite of progress in the engineering of the wearable. Addressing such concerns is critical for the future success of wearable sensors.

Keywords— nanoparticles, enzymes, immobilization, textilesconductive yarn, e-textiles, smart textiles, thermal analysisflexible textile-based wearable sensors, contemporary advancements, conductive textiles, body conformal design.

Archaeoseismological Evidence for a Possible Destructive Earthquake in the 7th Century AD at the Ancient Sites of Bulla Regia and Chemtou (NW Tunisia): Seismotectonic and Structural Implications

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Abstract

The historic sites of Bulla Regia and Chemtou are among the most important archaeological monuments in northwestern Tunisia, which flourished as large, wealthy settlements during the Roman and Byzantine periods (2nd to 7th centuries AD). A new archaeoseismological study provides the first indications about the impact of a possible ancient strong earthquake in the destruction of these cities. Based on previous archaeological excavation results, including numismatic evidence, pottery, economic meltdown and urban transformation, the abrupt ruin and destruction of the cities of Bulla Regia and Chemtou can be bracketed between 613 and 647 AD. In this study, we carried out the first attempt to use the analysis of earthquake archaeological effects (EAEs) that were observed during our field investigations in these two historic cities. The damage includes different types of EAEs: folds on regular pavements, displaced and deformed vaults, folded walls, tilted walls, collapsed keystones in arches, dipping broken corners, displaced-fallen columns, block extrusions in walls, penetrative fractures in brick-made walls and open fractures on regular pavements. These deformations are spread over 10 different sectors or buildings and include 56 measured EAEs. The structural analysis of the identified EAEs can indicate an ancient destructive earthquake that probably destroyed the Bulla Regia and Chemtou archaeological sites. We then analyzed these measurements using structural geological analysis to obtain the maximum horizontal strain of the ground (e.g., S_{Hmax}) on each building oriented damage. After the collection and analysis of these strain datasets, we proceed to plot the orientation of S_{Hmax} trajectories on the map of the archaeological site (Bulla Regia). We concluded that the obtained S_{Hmax} trajectories within this site can then be related to the mean direction of ground motion (oscillatory movement of the ground) triggered by a seismic event, as documented for some historical earthquakes across the world. These S_{Hmax} orientations closely match the current active stress field, as highlighted by some instrumental events in northern Tunisia.

In terms of the seismic source, we strongly suggest that the reactivation of a neotectonic strike-slip fault trending N50E must be responsible for this probable historic earthquake and the recent instrumental seismicity in this area. This fault segment, affecting the folded quaternary deposits south of Jebel Rebia, passes through the monument of Bulla Regia. Stress inversion of the observed and measured data along this fault shows a N150 - 160 trend of S_{Hmax} under a transpressional tectonic regime, which is quite consistent with the GPS data and the state of the current stress field in this region.

Keywords— NW Tunisia, archaeoseismology, earthquake archaeological effect, bulla regia - Chemtou, seismotectonic, neotectonic fault.

Structural Analysis of Archaeoseismic Records Linked to the 5 July 408 - 410 AD Utica Strong Earthquake (NE Tunisia)

Noureddine Ben Ayed, Abdelkader Soumaya, Saïd Maouche, Ali Kadri, Mongi Gueddiche, Hayet Khayati-Ammar, Ahmed Braham

Abstract— The archaeological monument of Utica, located in north-eastern Tunisia, was founded (8th century BC) By the Phoenicians as a port installed on the trade route connecting Phoenicia and the Straits of Gibraltar in the Mediterranean Sea. The flourishing of this city as an important settlement during the Roman period was followed by a sudden abandonment, disuse and progressive oblivion in the first half of the fifth century AD. This decadence can be attributed to the destructive earthquake of 5 July 408 - 410 AD, affecting this historic city as documented in 1906 by the seismologist Fernand De Montessus De Ballore. The magnitude of the Utica earthquake was estimated at 6.8 by the Tunisian National Institute of Meteorology (INM). In order to highlight the damage caused by this earthquake, a field survey was carried out at the Utica ruins to detect and analyse the earthquake archaeological effects (EAEs) using structural geology methods. This approach allowed us to highlight several structural damages, including: (1) folded mortar pavements, (2) cracks affecting the mosaic and walls of a water basin in the "House of the Grand Oecus", (3) displaced columns, (4) block extrusion in masonry walls, (5) undulations in mosaic pavements, (6) tilted walls. The structural analysis of these EAEs and data measurements reveal a seismic cause for all evidence of deformation in the Utica monument. The maximum horizontal strain of the ground (e.g. SHmax) inferred from the building oriented damage in Utica shows a NNW-SSE direction under a compressive tectonic regime. For the seismogenic source of this earthquake, we propose the active E-W to NE-SW trending Utique - Ghar El Melh reverse fault, passing through the Utica Monument and extending towards the Ghar El Melh Lake, as the causative tectonic structure. The active fault trace is well supported by instrumental seismicity, geophysical data (e.g., gravity, seismic profiles) and geomorphological analyses. In summary, we find that the archaeoseismic records detected at Utica are similar to those observed at many other archaeological sites affected by destructive ancient earthquakes around the world. Furthermore, the calculated orientation of the average maximum horizontal stress (SHmax) closely match the state of the actual stress field, as highlighted by some earthquake focal mechanisms in this region.

Keywords— Tunisia, utica, seimogenic fault, archaeological earthquake effects.

Tectonic Movements & Ecosystems

Arvind. K. Trivedi

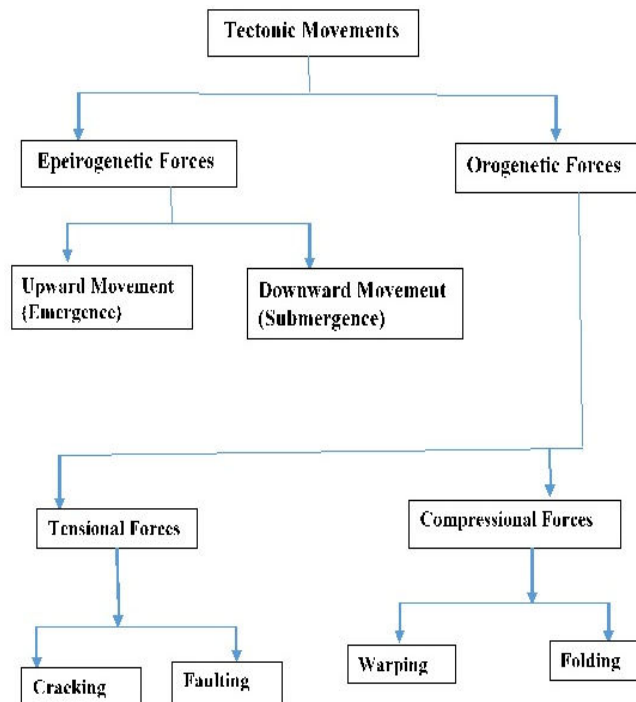
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Our Earth is dynamic in nature and its structure behaves like a puzzle because the interior of the Earth is in both gaseous as well as molten (liquid) form and the crust i.e. the outermost surface is in solid form. This Earth was one landmass known as 'Pangaea' in the beginning. With time due to complex phenomena of tectonic movements, it was broken into various landmasses along with water bodies. This Pangaea was in direct contact with the atmosphere playing dominant role in creating various ecosystems on the Earth. Ecosystems mean: Eco (environment body) and systems (interdependent complex of all the organisms interacting with each other). This paper provides an in depth discussion on tectonic movements as well as ecosystems & how these two effect each other and in the end we will enlist various methods on how to preserve our 'Mother Earth'.

TECTONIC MOVEMENTS

The Earth's interior is divided into three layers on the basis of variation in physical and chemical properties. The uppermost layer is thin i.e. 'crust' (Sial) varies from a few kilometers to 40 kilometers and extendable to 70 kilometers. The 'mantle' (Sima) is the second layer and is much thicker than the crust and contains 83% of Earth's volume and continues upto depth of 2900 kilometers. Beneath the mantle is the 'core' (Nife) layer which extends to the centre of Earth up to 6370 kilometers below the surface. Geologists maintain that the 'core' is made up of primarily metallic iron along with nickel, cobalt etc.

Tectonic movements occur in the interior of the Earth and their formation is caused by the natural forces. These forces are active within the Earth and are responsible for uplifting, faulting or folding etc. as well as over the surface of the Earth as shown in the diagram below:



Tectonic forces are dynamic in nature and are responsible for various features on the surface of the Earth like mountain building etc. It is observed due to the high pressure beneath the surface of the Earth severe faulting is created which results in the formation of passage for gas/oil to travel along the fault.

ROLE OF PLATE TECTONICS:

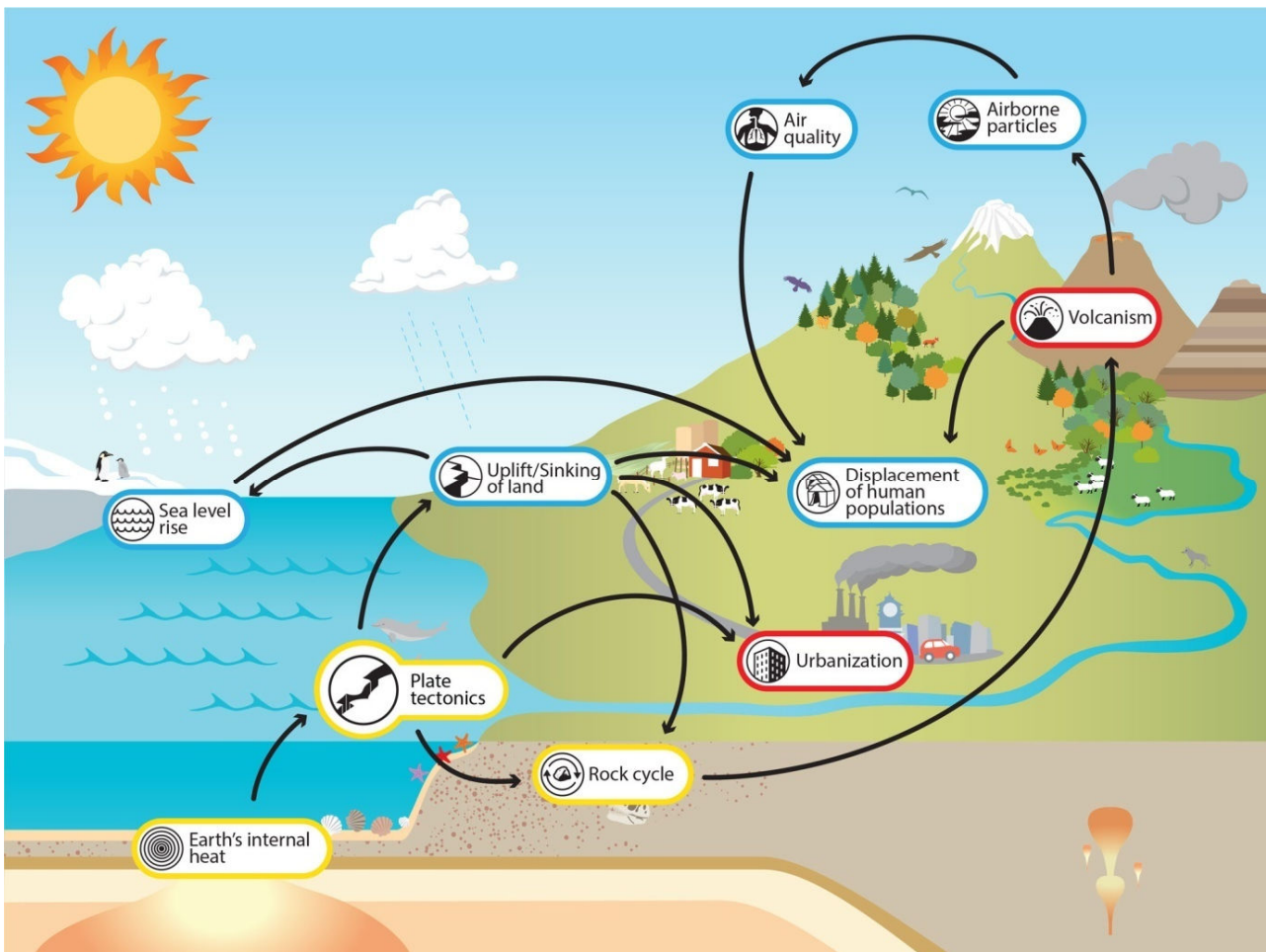
Plate tectonics is the recent concept to explain the role of tectonic movements. This theory was formulated in the 1960's and according to this theory: Our Earth has a rigid outer layer (crust) about 100 kilometers (60 miles) thick and overlies a plastic (moldable, molten) layer called the asthenosphere. Due to tectonic movements the lithosphere was broken into seven large continental and ocean-sized plates side by side, medium-sized regional plates and several small ones. These plates move relative to each other at the rate of 5-6 centimeters per year and interact with each other along their boundaries where they converge, diverge or slip past over one another. Such interactions are thought to be responsible for most of the Earth's seismic and volcanic activity. Also there are changes on the terrestrial surface like orogeny (formation of mountain ranges) due to such interactions between the plates.

The theory of plate tectonics is based on a broad synthesis of geology and geophysical data. It is now almost universally accepted and its adoption represents a true scientific revolution and incorporating the much older idea of continental drift as well as the concept of Sea Floor spreading. In other words, this theory describe the past geography of continents and oceans, the processes controlling creation and destruction of landforms and the evolution of Earth's crust (Lithosphere), hydrosphere, atmosphere. During the late 20th and early 21st century, it became apparent that the process of plate-tectonics influence the composition of Earth's atmosphere and oceans, serve as a prime cause of long-term climate change and develop physical environment in which life evolves.

The plate movement is possible because the lithosphere-asthenosphere boundary is a zone of detachment and the interiors of the plates are presumed to remain essentially unstable. Plate boundaries are the sites of many of the principal processes like earthquakes and volcanoes which occur in plate interiors. Therefore, these plate motions cause mountains to rise where plates push together or converge and cause continents to fracture where plates fall apart or diverge which result in significant changes in the Earth's Geography.

Plate tectonics is one of the key characteristics of the earth that is believed to have played a major role in the evolution of complex life. These movements can be uplifting, faulting or folding etc. The uplift can generate abnormal pressure accompanied by other geological processes which reduce the relief between the buried rock and surface. Subsurface movement can create severe faulting and allow gas/oil/water to travel along the fault and change shallower formations.

In contrast, the rocks in the asthenosphere are weaker because they are close to their melting temperatures. As a result, seismic waves are slow as they enter the asthenosphere. With increasing depth, pressure is high because weight of the rocks above causes the mantle to become gradually stronger and seismic waves increase in velocity. The studies reveal that the deep mantle is highly heterogeneous and this layer may play a fundamental role in driving the Earth's plates.



The theory of plate tectonics explains processes in the geosphere that are fueled by Earth's internal heat that have operated over billions of years. As the earth cooled, layers formed and the densest materials (primarily iron) sank to the middle (the core) of the Earth. Around the core formed the less dense layer called mantle and top thin layer called the crust. Here, are present two kinds of crust i.e. oceanic crust which is found in ocean basins and the continental crust we live on that is made of lighter material than oceanic crust. The crust is attached to the uppermost part of the mantle, together forming the solid lithosphere. The lithosphere is broken up into huge sections called plates that include both oceanic and continental crust. Below the lithosphere is a layer called the asthenosphere. This lithosphere moves on the asthenosphere both horizontally and vertically. Plates are constantly in motion and move about 3 cm per year because of slow convection currents in the mantle due to earth's internal heat and pulling and pushing of the plates. Afterwards they cool and sink back into the mantle. It is a continuous system of these plates.

ECOSYSTEMS OF THE WORLD

Ecosystem is defined as a functional unit of the biosphere comprising of the living communities as well as non-living environment in a given area. It can also be explained as any unit that includes the living organisms in a given area and their interaction with the physical environment, so that a flow of energy leads to clearly defined tropical structure, biotic diversity and material cycles within the system. Therefore major characteristics of any ecosystem are: unit, functional with no limits of boundaries, interaction of all organisms with their environment that is capable of energy transformation, circulation etc.

The structure of an ecosystem can be divided into two main components namely:

- Biotic components
- Abiotic components

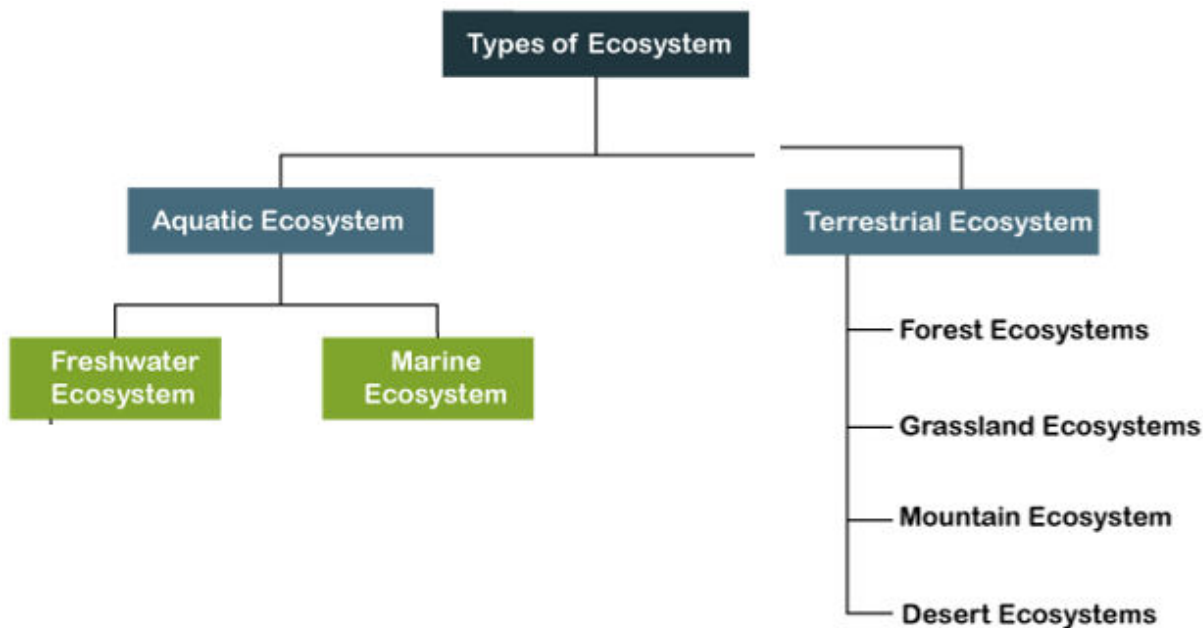
These two components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries.

Biotic components refer to all living where as abiotic components are air, water, soil, minerals, sunlight, temperature, wind, altitude, turbidity etc.

TYPES OF ECOSYSTEMS:

An ecosystem can be small as an oasis in a desert or as big as an ocean. Therefore, ecosystem is of two types:

- Terrestrial ecosystem
- Aquatic ecosystem



Terrestrial Ecosystem:

These are exclusively land based ecosystems and are quite common around various geological zones and can be broadly subdivided into:

- Forest ecosystem
- Grassland ecosystem
- Mountain ecosystem
- Desert ecosystem



Forest ecosystem: A forest ecosystem consists of several plants, trees, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink and also supply maximum oxygen.

Grassland ecosystem: In this ecosystem grasses and herbs are dominating. Temperate grasslands (Prairies) and Tropical Savanna grasslands are examples of this ecosystem.

Mountain ecosystem: These ecosystems are devoid of trees and are found in cold climate where rainfall is scarce. These are covered with snow for most of the year. They are common in the Arctic or mountain tops like Himalayas.

Desert ecosystem: Deserts are found throughout the world but quite common on the western side of the continents. These ecosystems receive little rainfall and scarce vegetation. These deserts are hot because of sand and nights are cold.

Aquatic ecosystems: This ecosystem is present in body of water and is divided into two types mainly:

- **Freshwater ecosystem:** This ecosystem includes lakes, ponds, rivers, canals, streams and wetlands. These have very little salt content in contrast to marine ecosystem
- **Marine ecosystem:** It includes seas and oceans. They have more salt content and greater biodiversity in comparison to the freshwater ecosystem.

These are the natural ecosystems and have no role of man in its formation. Therefore, these ecosystems have the ability to operate and maintain themselves without any human interference.

Another ecosystem i.e. artificial ecosystem refers to a man-made ecosystem which is created and maintained by human beings e.g. crop fields, aquarium, dams, parks etc.

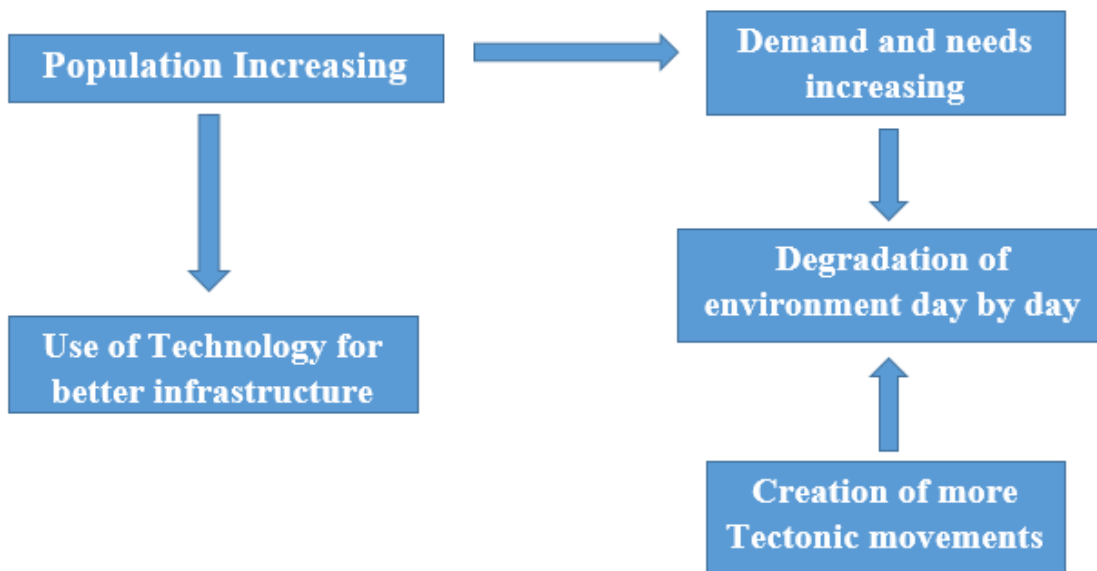
Impact of Tectonic movements on the Ecosystems

Tectonic movements are responsible for the creation of the Earth's physical features such as mountains, valleys and ocean basins. Therefore, these tectonic movements within the earth are disturbing our ecosystems i.e. on the surface of the earth and are responsible for creating imbalance that cause disasters everyday in one corner of the world or the other in the form of earthquakes, volcanoes, cyclones, floods, landslides, tsunami etc.

Sometimes, there is creation of new landmasses in various ecosystems e.g. volcanic eruption can create new islands and new landmasses. These new habitats can become home to a new variety of plant and animal species.

These tectonic movements can also destroy existing ones e.g. earthquakes can cause landslides and rock falls which can destroy forest ecosystems. These destructions can have long lasting effect on the ecosystems and can take years and decades to recover.

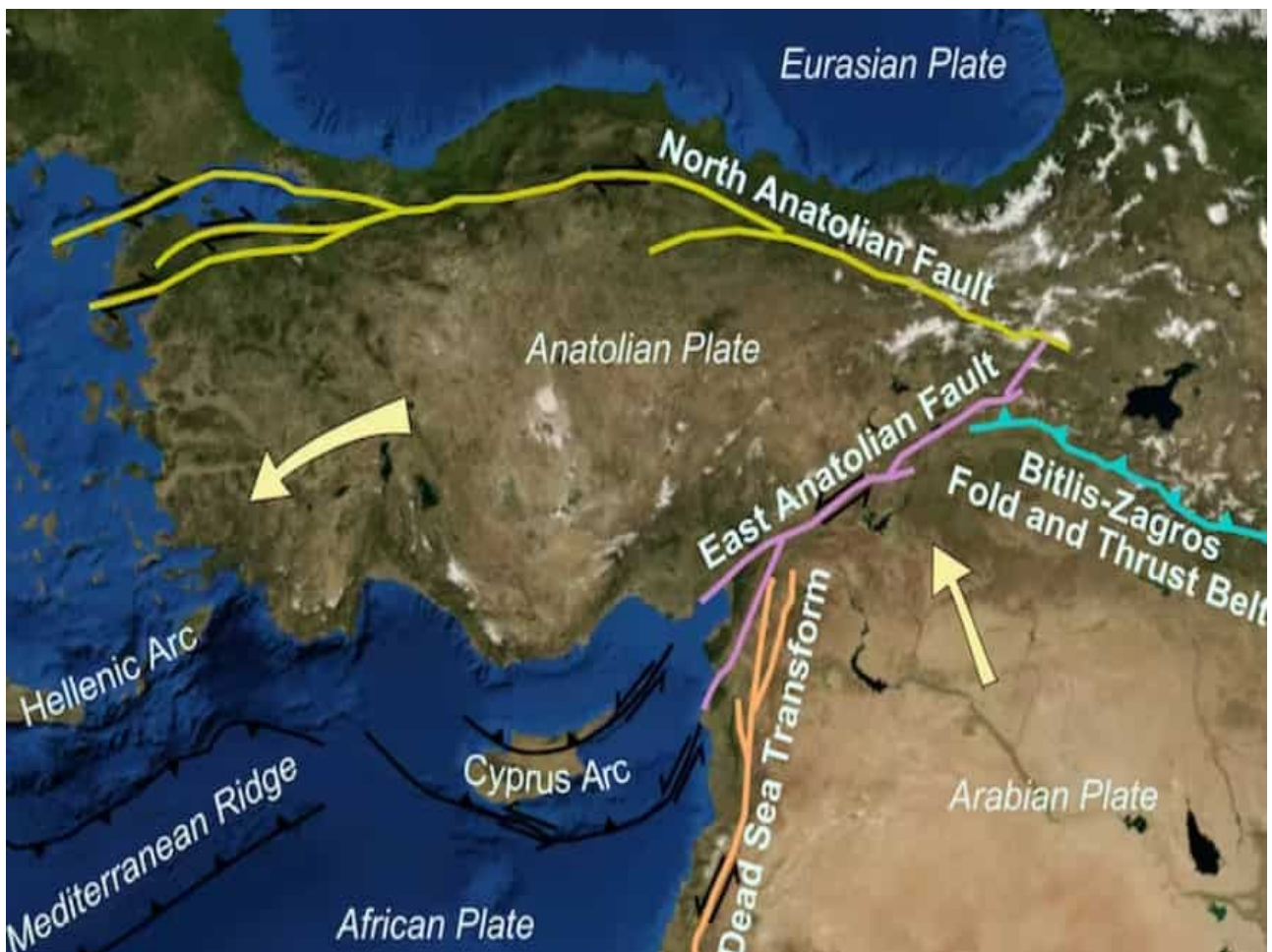
In the present scenario humans are also responsible for the change in these ecosystems as the population is increasing there is demand for settlement (urban-rural), better infrastructure which makes the human life easy at the cost of environmental health. This table explains how tectonic movements and human technology affect our ecosystems:



Humans use advanced technology for socio-economic development which is responsible for imbalance in these ecosystems e.g. blasting in the mountains to have hydroelectricity, mining, digging, drilling etc. and removing the upper layers to develop big buildings and infrastructure. These activities of man are creating passage for tectonic movements and their effects are noticed at various places e.g. Turkey, Syria (earthquake) etc.

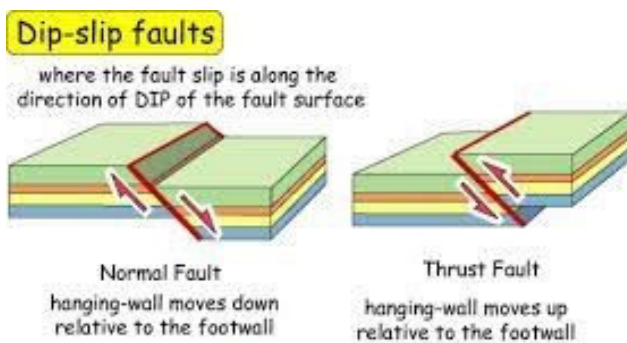
Turkey earthquake

It is noticed that Turkey is one of the most seismically active nation in the world. The Arabian tectonic plates are clashing with the Eurasian plate, while moving northward. These two plates are moving in the same direction and Turkey is falling in the middle. While crust readjusts to the changes in tension, there were numerous aftershocks following big earthquake. The magnitude of more than 6.0 was registered in the latest earthquake after the initial tremor and there was a major loss of human beings, animals etc.



Morocco earthquake

Another recent earthquake occurred in Morocco and its magnitude recorded was 6.8. This earthquake’s epicenter was in the Atlas Mountains and it resulted from a geological phenomenon known as “reverse fault”. This country is situated in an area where the Eurasian and African tectonic plates converge due to the compression of the tectonic plates. It is interesting to note that this country has not experienced major earthquakes earlier. This earthquake was due to the slow movement of tectonic plates as shown in the diagram below:



Remedies

- Since the impact of ecosystems is observed in every corner of the earth it is required to implement conservation and management methods to protect and preserve the ecosystems. These methods include efforts to protect habitats as well as species and also managing human activities like extraction of resources & tourism. In addition to this, there is a need to understand ways through which tectonic movements affect the environment so that efforts can be ensured that are effective in the long term.

- Collaboration & research: tectonic movements are complex phenomena and collaboration and research are essential to understand and manage these impacts. These efforts involve sharing knowledge and resources across international borders. Side by side new research methods to be invented to prevent the impact of tectonic movements
- International cooperation: this method is essential to effectively manage the effect of tectonic movement on the environment such as climate change, natural disasters and protection of biodiversity etc. These are the global environmental challenges
- Education & awareness: here efforts can be made to educate the public about the impacts of tectonic movements on the environment and raise awareness about it through social media platforms and other forms of media.
- Monitoring tectonic activity using equipment may help predict and identify major events. In addition to this, setting up evacuation zones and hazard mapping are helpful techniques to reduce the impact of disaster.

Summary

It is clear, tectonic movements have a wide range of impact on the world's ecosystems in the form of climate change, formation of new habitats, extinction of biodiversity, natural disasters etc. To ensure the long term health and sustainability of these ecosystems effective strategies as well as management is required. This can be achieved through education, awareness, cooperation, collaboration (micro to macro level) and man has to play a significant role in this.

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Standard Essential Patents for Artificial Intelligence Hardware and the Implications For Intellectual Property Rights

Wendy de Gomez

Abstract— Standardization is a critical element in the ability of a society to reduce uncertainty, subjectivity, misrepresentation, and interpretation while simultaneously contributing to innovation. Technological standardization is critical to codify specific operationalization through legal instruments that provide rules of development, expectation, and use. In the current emerging technology landscape Artificial Intelligence (AI) hardware as a general use technology has seen incredible growth as evidenced from AI technology patents between 2012 and 2018 in the United States Patent Trademark Office (USPTO) AI dataset. However, as outlined in the 2023 United States Government National Standards Strategy for Critical and Emerging Technology the codification through standardization of emerging technologies such as AI has not kept pace with its actual technological proliferation. This gap has the potential to cause significant divergent possibilities for the downstream outcomes of AI in both the short and long term. This original empirical research provides an overview of the standardization efforts around AI in different geographies and provides a background to standardization law. It quantifies the longitudinal trend of Artificial Intelligence hardware patents through the USPTO AI dataset. It seeks evidence of existing Standard Essential Patents from these AI hardware patents through a text analysis of the Statement of patent history and the Field of the invention of these patents in Patent Vector and examines their determination as a Standard Essential Patent and their inclusion in existing AI technology standards across the four main AI standards bodies- European Telecommunications Standards Institute (ETSI); International Telecommunication Union (ITU)/ Telecommunication Standardization Sector (-T); Institute of Electrical and Electronics Engineers (IEEE); and the International Organization for Standardization (ISO). Once the analysis is complete the paper will discuss both the theoretical and operational implications of F/Rand Licensing Agreements for the owners of these Standard Essential Patents in the United States Court and Administrative system. It will conclude with an evaluation of how Standard Setting Organizations (SSOs) can work with SEP owners more effectively through various forms of Intellectual Property mechanisms such as patent pools.

Keywords— patents, artificial intelligence, standards, F/Rand agreements.

Exploring the Impact of Additive Manufacturing on Supply Chains: A Game-Theoretic Analysis of Manufacturer-Retailer Dynamics

Mohammad Ebrahim Arbabian

Abstract— This paper investigates the impact of 3D printing, also known as additive manufacturing, on a multi-item supply chain comprising a manufacturer and retailer. Operating under a wholesale-price contract and catering to stochastic customer demand, this study delves into the largely unexplored realm of how 3D printing technology reshapes supply chain dynamics. A distinguishing aspect of 3D printing is its versatility in producing various product types, yet its slower production pace compared to traditional methods poses a challenge. We analyze the trade-off between 3D printing's limited capacity and its enhancement of production flexibility. By delineating the economic circumstances favoring 3D printing adoption by the manufacturer, we establish the Stackelberg equilibrium in the retailer-manufacturer game. Additionally, we determine optimal order quantities for the retailer considering 3D printing as an option for the manufacturer, ascertain optimal wholesale prices in the presence of 3D printing, and compute optimal profits for both parties involved in the supply chain.

Keywords— additive manufacturing, supply chain management, contract theory, Stackelberg game, optimization.

Liquid Waste Management in Cluster Development

Abheyjit Singh, Kulwant Singh

Abstract— There is a gradual depletion of the water table in the earth's crust, and it is required to converse and reduce the scarcity of water. This is only done by rainwater harvesting, recycling of water and by judicious consumption/utilization of water and adopting unique treatment measures. Domestic waste is generated in residential areas, commercial settings, and institutions. Waste, in general, is unwanted, undesirable, and nevertheless an inevitable and inherent product of social, economic, and cultural life. In a cluster, a need-based system is formed where the project is designed for systematic analysis, collection of sewage from the cluster, treating it and then recycling it for multifarious work. The liquid waste may consist of Sanitary sewage/ Domestic waste, Industrial waste, Storm waste, or Mixed Waste. The sewage contains both suspended and dissolved particles, and the total amount of organic material is related to the strength of the sewage. The untreated domestic sanitary sewage has a BOD (Biochemical Oxygen Demand) of 200 mg/l. TSS (Total Suspended Solids) about 240 mg/l. Industrial Waste may have BOD and TSS values much higher than those of sanitary sewage. Another type of impurities of wastewater is plant nutrients, especially when there are compounds of nitrogen N phosphorus P in the sewage; raw sanitary contains approx. 35 mg/l Nitrogen and 10 mg/l of Phosphorus. Finally, the pathogen in the waste is expected to be proportional to the concentration of faecal coliform bacteria. The coliform concentration in raw sanitary sewage is roughly 1 billion per liter. The system of sewage disposal technique has been universally applied to all conditions, which are the nature of soil formation, Availability of land, Quantity of Sewage to be disposed of, The degree of treatment and the relative cost of disposal technique. The adopted Thappar Model (India) has the following designed parameters consisting of a Screen Chamber, a Digestion Tank, a Skimming Tank, a Stabilization Tank, an Oxidation Pond and a Water Storage Pond. The screening Chamber is used to remove plastic and other solids, The Digestion Tank is designed as an anaerobic tank having a retention period of 8 hours, The Skimming Tank has an outlet that is kept 1 meter below the surface anaerobic condition at the bottom and also help in organic solid remover, Stabilization Tank is designed as primary settling tank, Oxidation Pond is a facultative pond having a depth of 1.5 meter, Storage Pond is designed as per the requirement. The cost of the Thappar model is Rs. 185 Lakh per 3,000 to 4,000 population, and the Area required is 1.5 Acre. The complete structure will lining as per the requirement. The annual maintenance will be Rs. 5 lakh per year. The project is useful for water conservation, silage water for irrigation, decrease of BOD and there will be no longer damage to community assets and economic loss to the farmer community by inundation. There will be a healthy and clean environment in the community.

Keywords— collection, treatment, utilization, economic.

Evaluating Construction Project Outcomes: Synergy through the Evolution of Digital Innovation and Strategic Management

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Abstract: The ongoing high rate of construction project failures worldwide is often blamed on the difficulties of managing stakeholders. This highlights the crucial role of strategic management (SM) in achieving project success. This study investigates how integrating digital tools into the SM framework can effectively address stakeholder-related challenges. This work specifically focuses on the impact of evolving digital tools, such as Project Management Software (PMS) (e.g., Basecamp and Wrike), Building Information Modeling (BIM) (e.g., Tekla BIMsight and Autodesk Navisworks), Virtual and Augmented Reality (VR/AR) (e.g., Microsoft HoloLens), drones and remote monitoring, and social media and Web-Based platforms, in improving stakeholder engagement and project outcomes. Through existing literature with examples of failed projects, the study highlights how the evolution of digital tools will serve as facilitators within the strategic management process. These tools offer benefits such as real-time data access, enhanced visualization, and more efficient workflows to mitigate stakeholder challenges in construction projects. The findings indicate that integrating digital tools with SM principles effectively addresses stakeholder challenges, resulting in improved project outcomes and stakeholder satisfaction. The research advocates for a combined approach that embraces both strategic management and digital innovation to navigate the complex stakeholder landscape in construction projects.

Keywords: Strategic Management, Digital Tools, Virtual and Augmented Reality, Stakeholder Management, Building Information Modeling, Project Management Software

1. Introduction

The construction industry is in a constant state of flux, with successful project outcomes hinging on the adept management of stakeholder challenges. These complexities, if mismanaged, can precipitate delays, cost overruns, and project failures. The Boston Big Dig project exemplifies the repercussions of poor stakeholder management (Greiman & Sclar, 2019), where initial cost projections of \$2.8 billion ballooned to an excess of \$14.6 billion, spurred by stakeholder disputes, environmental issues, and political strife. This case demonstrates the criticality of strategic management (SM) in steering stakeholder expectations and interests towards the fruition of construction endeavours (Aecis, 2024; Haynes, 2008).

Recognizing the critical role of strategic management (SM), it is considered essential for project success (Sinnaiah et al., 2023). It provides a systematic approach to address the complex challenges that come with construction projects. However, the construction industry's dynamic nature, characterized by a diverse range of stakeholders and intricate demands, calls for the advancement of traditional strategic management methodologies. In this regard, digital tools emerge as innovative solutions that have the potential to redefine stakeholder engagement and management. Technologies such as Project Management Software (PMS), Building Information Modeling (BIM), Virtual and Augmented Reality (VR/AR), drones, remote monitoring, and social media platforms are leading this transformation by offering improved communication, collaboration, and access to real-time project data (Appelnasa, 2024; Fieldwire, 2024).

In addition, there are various challenges that can cause construction projects to fail. These challenges go beyond just the construction activities and encompass a wide range of issues. Some of these challenges include cultural diversity, environmental concerns, economic fluctuations, technological advancements, legal and regulatory constraints, and political governance issues. An example of such challenges is the "100 jours" project in the Democratic Republic of Congo (DRC), which was poorly managed by the government (Rfi, 2024). The World Bank's decision to suspend \$1 billion in project funding in Congo due to concerns about transparency and accountability highlights the seriousness of these challenges (Reuters, 2024). Furthermore, the "Congo Hold-up" leak exposed widespread corruption, demonstrating how the negligence and lack of due diligence by various actors, including international entities, can lead to the misuse of a country's resources and derail construction projects (Pplaaf, 2024).

The integration of digital tools with strategic management practices in the construction industry is a promising area for research (Duarte-Vidal et al., 2021; Sepasgozar et al., 2022). This study aims to explore the relationship

between digital innovation and strategic management in order to better understand how to effectively manage stakeholders in today's digital landscape. The findings of this study provide valuable insights for construction professionals, project managers, and industry stakeholders. In fact, the study highlights the impact of the digital revolution on stakeholder management in construction projects. BIM is at the core of this digital shift, creating a collaborative environment where stakeholders can visualize and understand project deliverables together. Drones, with their high-definition imaging capabilities, offer real-time project monitoring, enhancing transparency and trust among stakeholders. VR and AR technologies provide stakeholders with tangible previews of construction plans, enabling them to make informed decisions and suggest modifications proactively. PM software plays a crucial role in coordinating project activities and fostering a culture of accountability and collaboration among stakeholders. Social media and web-based platforms have emerged as effective channels for stakeholder dialogue and community involvement, ensuring inclusive and comprehensive engagement (Greiman & Sclar, 2019; Ucd, 2024; Yahaya et al., 2018).

This research proposes a new approach to engaging stakeholders in construction projects, by combining digital tools with strategic management practices. This combination not only improves stakeholder management, but also streamlines project management workflows, resulting in better project outcomes. The aim of this study is to provide construction professionals with guidance on navigating the complex landscape of stakeholders using both strategic management principles and advancements in digital tools for effective project management. Through this research, there is a hope to contribute to the existing body of knowledge on successful stakeholder management in the construction industry, offering practical strategies to address stakeholder-related challenges and enhance project success in this digital era.

2. Stakeholder Management in Construction Projects

Strategic Management (SM) in construction projects is an essential discipline that has evolved significantly since the late 1950s. Originating from the foundational work of scholars like Peter Drucker and Igor H. Ansoff, SM has become crucial in navigating the complexities of construction projects. Defined broadly, strategic management involves specifying an organization's objectives, developing policies and plans to achieve these objectives, and efficiently allocating resources to support their implementation. This process is vital in the construction industry, where managing diverse resources and solving problems are paramount for project success.

The core of strategic management lies in its ability to coordinate human and financial resources to meet organizational goals. This coordination is particularly critical in construction due to the industry's inherent project complexities. Strategic management in this context includes evaluating the current strategic direction, analyzing strengths and weaknesses, formulating and executing action plans, and assessing their success. This ensures that construction projects align with the broader strategic objectives of the organization, enhancing operational efficiency, profitability, and market share.

Moreover, strategic management provides clear direction for organizations, fostering an environment of high performance and productivity. It contributes to operational efficiency and the successful realization of project goals by facilitating consistent planning, monitoring, and evaluation of activities. Additionally, strategic management enables organizations to navigate environmental constraints, identify and pursue objectives, and apply strategic thinking skills effectively. This proactive approach not only increases productivity and profitability but also enhances communication, creativity, and competitiveness within the construction industry.

Innovatively applying strategic management principles to construction projects involves leveraging digital technologies, fostering strategic team building, and emphasizing purpose-driven documentation and communication. Digitalization can optimize project management processes, enhance data-driven decision-making, and improve stakeholder engagement. Strategic team building ensures that all project participants, including suppliers and subcontractors, are aligned with the project's goals and work collaboratively towards their achievement. Purpose-driven documentation and communication facilitate efficient information flow, accountability, and compliance, thereby mitigating risks and enhancing project outcomes.

Stakeholder management is another critical aspect of strategic management in construction projects. The diverse interests and impacts of stakeholders, ranging from clients and suppliers to regulatory agencies and local residents, significantly affect project outcomes. Managing these stakeholders involves addressing conflicting interests, bridging communication gaps, and managing expectations effectively. Strategic management provides the framework for engaging with stakeholders in a manner that aligns with the project's goals and objectives, ensuring the project's success.

3. Stakeholder challenges in construction projects

Stakeholder challenges in construction projects are multifaceted and can significantly impact the success and smooth execution of these projects (Joshi et al., 2021). These challenges arise from the diverse interests,

expectations, and influences of various stakeholders (Figure 1) involved in construction projects, ranging from clients, contractors, and suppliers to local communities, regulatory bodies, and environmental groups.

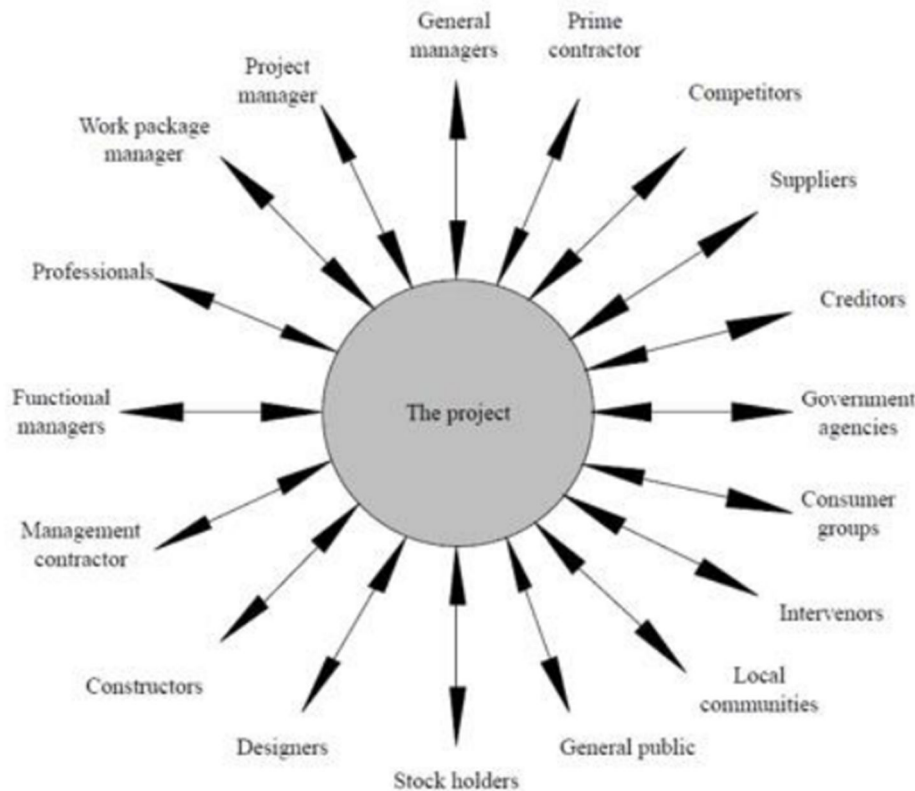


Figure 1: Different Project Stakeholders (Yahaya et al., 2018)

The management of these stakeholders is complex, as it involves balancing economic, legal, environmental, and ethical responsibilities. This often leads to conflicts, delays, and cost overruns. The examples below illustrate some projects that have faced challenges with stakeholders. Table 1 provides details on the initial and final costs, as well as the funding source for these projects.

- I. The High Line, New York City, USA (Figure 2(a)): The transformation of the High Line from an abandoned railway into a public park is a clear example of successfully navigating stakeholder challenges. Initially, property owners raised concerns about privacy and public access near their properties. However, through extensive engagement and collaboration with stakeholders, the project team turned opposition into support. As a result, the project became a highly successful urban renewal initiative, serving as a model for similar projects worldwide (Fennelly, 2024; Hyde, 2024; LaFarge, 2024).
- II. The Sydney Opera House, Sydney, Australia (Figure 2(b)): This iconic project faced significant stakeholder challenges, including political controversies, budget overruns, and design changes. The original architect, Jørn Utzon, eventually resigned due to conflicts with stakeholders, including the government (Drew & Utzon, 1995). Successfully completing the project required effectively managing the complex dynamics among stakeholders to realize the vision of a landmark cultural facility (Greiman, 2023; Landorf, 2019).
- III. The Gautrain Rapid Rail Link, South Africa (Figure 1(c)): The Gautrain project, which connects Johannesburg, Pretoria, and the Oliver Reginald (OR) Tambo International Airport, encountered challenges related to land acquisition, environmental concerns, and community opposition (Bond, 2014; Mthombeni et al., 2022). Stakeholder engagement strategies, such as public consultations and negotiations, played an important role in addressing these challenges and ensuring the project's successful implementation.
- IV. The Three Gorges Dam, China (Figure 1(d)): As one of the world's largest hydroelectric projects, the Three Gorges Dam faced significant stakeholder challenges, including the displacement of over a million people, environmental degradation, and the preservation of cultural heritage (Wilmsen, 2016, 2018). To address these concerns, the project's management had to engage with local communities, environmental groups, and government agencies. This highlights the complexity of managing stakeholders in large-scale infrastructure projects (Ponseti & López-Pujol, 2006).
- V. The "Highway to Nowhere," Baltimore, USA (Figure 1(e)): This project aimed to connect Interstate 70 with downtown Baltimore but was never completed. As a result, hundreds of families were displaced, and a physical and symbolic barrier was created in West Baltimore (Salimbene & Wiggins, 2023). The project

encountered strong opposition from the community and has become a case study on the consequences of not adequately engaging and considering the needs and concerns of local stakeholders (de Lucas, 2020; Eloshway, 2022).

Table 1: Stakeholder challenges in construction projects

Project	Location	Date of Completion	Initial Budget	Final Cost	Funding Sources	Overrun
The High Line	New York City, USA	2009 (First Section)	-	\$152.3 million (Sections 1 and 2)	City, federal government, state, and private funding	-
Sydney Opera House	Sydney, Australia	1973	AUS \$7 million	AUS \$102 million	Primarily funded by a dedicated lottery	Over budget by 1300%
Gautrain Rapid Rail Link	Gauteng, South Africa	2012	R27 billion	R31.8 billion (Capex)	Public-Private Partnership (PPP), federal and provincial funding	R4.8 billion increase due to inflationary pressures
Three Gorges Dam	Hubei Province, China	2006	USD \$8.3 billion	USD \$37.23 billion	State Investment, Power Generation Revenue, Bonds, Loans, Three Gorges Project Construction Fund, International and Private Investment	Over budget by 163 %
Highway to Nowhere	Baltimore, USA	Never completed since 1975, stop in 1979	USD \$2 million	-	City, federal government, state, and private funding	-

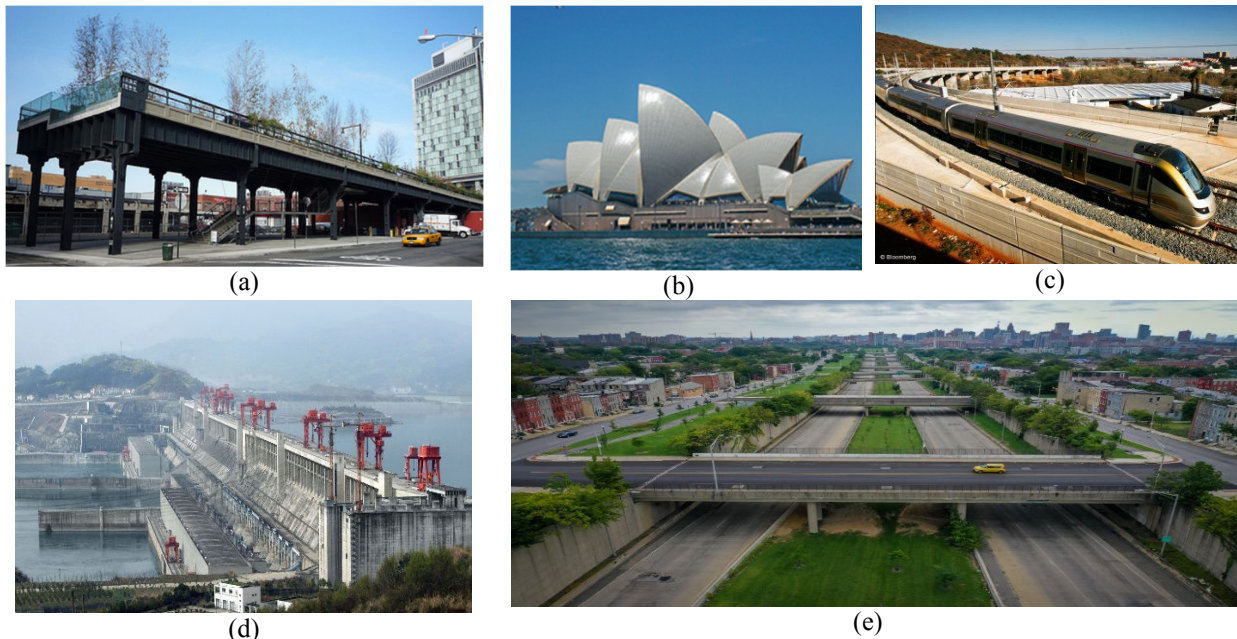


Figure 2: (a) The High Line in New York, USA(Pinjacolada, 2024);(b) Sydney Opera House in Sydney, Australia(Jshoton, 2024);(c) Gautrain Rapid Rail Link in Gauteng, South Africa(Bloomberg, 2024);(d) The Three Gorges Dam in Hubei Province, China(Britannica, 2024);(e) The Highway to Nowhere in Baltimore, USA(Baltimoresun, 2024)

These examples demonstrate the significance of effective stakeholder management in construction projects. When project teams properly understand and address the various needs and concerns of all stakeholders, conflicts can be minimized, risks can be reduced, and the likelihood of project success can be enhanced. The challenges encountered by these projects underscore the importance of adopting a strategic approach to stakeholder engagement, with a focus on communication, collaboration, and consensus-building.

4. Integrating Digital Tools with Strategic Management for Stakeholder Engagement

The integration of digital tools with strategic management practices presents a novel approach to mitigating stakeholder challenges in construction projects. This synergy not only enhances stakeholder engagement but also streamlines project management processes, thereby improving project outcomes. This section explores the innovative strategies for integrating digital tools with strategic management to address stakeholder challenges effectively.

4.1 Building Information Modeling (BIM)

Building Information Modeling (BIM) is a crucial digital tool in the construction industry that promotes collaboration among stakeholders. By integrating BIM with strategic management practices, construction managers can ensure that everyone involved in the project has access to a unified, real-time view (Entrepriseinsights, 2024). This integration allows for early identification of conflicts and discrepancies, enabling stakeholders to address issues proactively. For example, using BIM to conduct virtual stakeholder meetings can enhance understanding of project complexities, leading to informed decision-making and consensus-building in real time. Tekla BIMsight and Autodesk Navisworks are two popular software solutions that enhance collaboration and simulation capabilities, thereby mitigating challenges faced by stakeholders in construction projects. Tekla BIMsight enables effective project review and collaboration by allowing users to combine models, detect conflicts, and share information within an accessible BIM environment, promoting informed decision-making (Figure 3 (a)) (Tekla, 2024). Navisworks is particularly powerful in simulation, offering tools such as 5D analysis and clash detection that integrate with Autodesk BIM 360 Glue to improve project management workflows and stakeholder engagement, ultimately resulting in better project outcomes (Figure 3 (b)) (Helpautodesk, 2024).

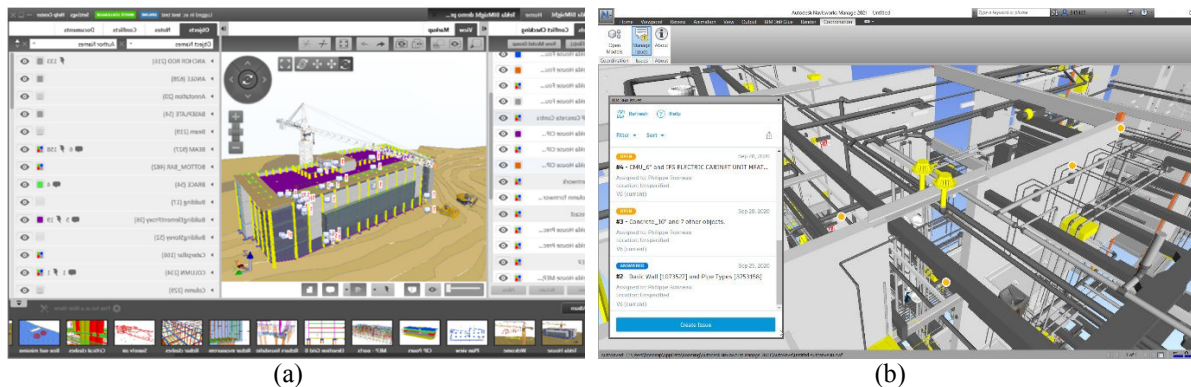


Figure 3: (a) Tekla BIMsight interface (Tekla, 2024); Autodesk Navisworks interface (Autodesk, 2024)

4.2 Utilizing Drones for Real-Time Monitoring and Stakeholder Reporting

Drones offer unparalleled capabilities in monitoring construction progress and identifying potential issues before they escalate. By integrating drone technology with strategic management, construction managers can provide stakeholders with real-time updates and visual progress reports. This approach not only enhances transparency but also builds trust among stakeholders. For example, deploying drones to capture aerial footage of the construction site can be used in stakeholder presentations to demonstrate progress, address concerns, and adjust project plans based on stakeholder feedback. Indeed, drones such as DJI Mavic 3E, particularly with its RTK module, is highlighted for revolutionizing the world of small drones in the construction industry by offering precise data and visuals in real-time using BIM tools (Figure 4) (Entrepriseinsights, 2024). This drone is celebrated for its efficiency, safety, and accuracy in tasks such as surveying, monitoring, and inspection processes. Its ability to provide real-time, precise data and visuals has optimized these processes, reducing both time and cost for construction projects.

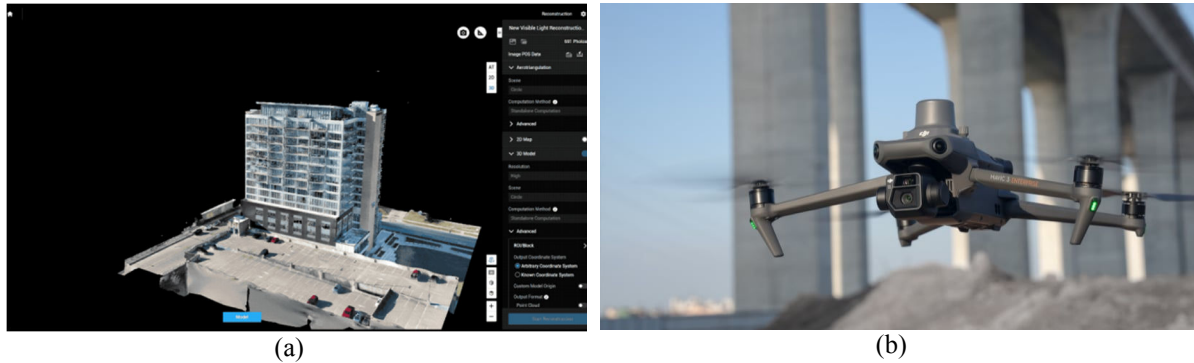


Figure 4: (a) Real-time interface of a building connecting drone to BIM tool; (b) Dji Mavic 3E drone (Entrepriseinsights, 2024)

4.3 Implementing Project Management Software

Project Management Software (PMS) plays a critical role in centralizing project information and facilitating seamless communication among stakeholders. By integrating PMS with strategic management, construction managers can maintain a clear and consistent flow of information (Ferreira & Tereso, 2014). Stakeholders can access project schedules, budgets, and updates in real-time, which reduces misunderstandings and conflicts. Additionally, PMS can create a centralized repository of project documents, making it easier for stakeholders to review plans, contracts, and compliance documents. This ensures that all parties are aligned with project objectives (Sigalov et al., 2021). Using advanced PMS tools like Wrike and Basecamp into strategic management can significantly mitigate stakeholder challenges in construction projects. As depicted Figure 5 (a), Wrike offers a suite of features, including Gantt charts and real-time progress updates, which enhance transparency and coordination among stakeholders (Wrike, 2024). Basecamp facilitates streamlined communication with designated discussion areas and daily updates, ensuring that all stakeholders are informed and engaged throughout the project lifecycle (Figure 5 (b)) (Signalnoise, 2024). These tools centralize project information and foster a collaborative environment, reducing the potential for misunderstandings and aligning stakeholder expectations with project objectives.

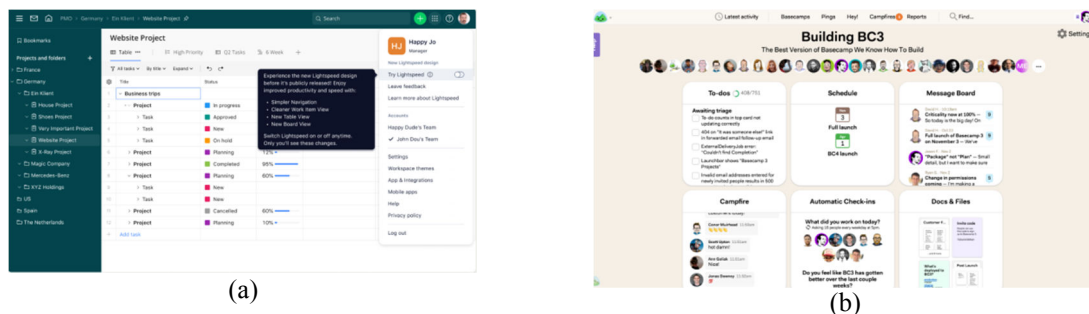


Figure 5: (a) Basecamp interface (Signalnoise, 2024); (b) Wrike interface (Wrike, 2024)

4.4 Adopting Virtual and Augmented Reality (VR/AR) for Stakeholder Engagement

Virtual and Augmented Reality (VR/AR) technologies offer immersive experiences that greatly improve stakeholder engagement (Theguardian, 2024) (Imottesjo & Kain, 2022). Construction managers can use these technologies to provide stakeholders with virtual walkthroughs of the project, allowing them to visualize the final outcome and make informed decisions. This approach is particularly useful for engaging community stakeholders, as it gives them a clear representation of how the project will impact the local environment and infrastructure. One standout VR/AR tool is the Microsoft HoloLens, which offers immersive, mixed-reality experiences (Theguardian, 2024). By integrating Microsoft HoloLens with strategic management, construction managers can provide stakeholders with interactive 3D models of projects, enabling them to explore potential design options and impacts in real-time (Figure 6). This direct engagement with the project through VR/AR technology helps address concerns and align stakeholder expectations, mitigating challenges related to communication and decision-making in construction projects.



Figure 6: Virtual reality headsets (Theguardian, 2024)

4.5 Social Media and Web-Based Platforms for Community Outreach

Social media and Web-Based Platforms have emerged as powerful tools for engaging with the broader community of stakeholders (Burke et al., 2024). Integrating these platforms with strategic management practices enables construction managers to conduct outreach efforts, gather feedback, and address public concerns. Also, construction projects can foster a positive public image, mitigate opposition, and build support for the project by maintaining an active presence on social media. Additionally, web-based platforms can serve as forums for public consultations, allowing stakeholders to voice their opinions and contribute to the project's success. Platforms like Nextdoor have become popular for their ability to connect local communities and stakeholders (Figure 7) (Businessinder, 2024). For projects like the High Line in New York City, using Nextdoor could facilitate direct communication with neighborhood residents, allowing for transparent discussions about privacy and public access concerns. This localized social platform can be instrumental in transforming initial resistance into community support by providing a space for dialogue, feedback, and consensus-building, ultimately contributing to the project's success and acceptance within the community.

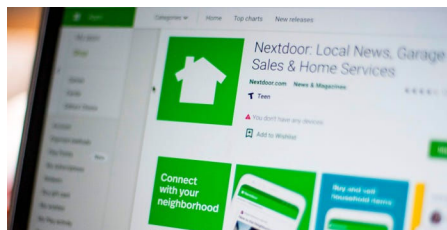


Figure 7: Nextdoor interface (Businessinder, 2024)

5. Conclusion

This study investigates how digital tools can be integrated with strategic management techniques to address stakeholder challenges in construction projects. The research aims to demonstrate how the application of digital innovations and strategic management practices can help mitigate complexities arising from diverse stakeholder interests, which often lead to project delays, budget overruns, and failures. The key findings highlight the transformative potential of digital tools, such as Building Information Modeling (BIM), drones, Virtual and Augmented Reality (VR/AR), Project Management Software (PMS), and social media platforms, in revolutionizing stakeholder engagement and management. These technologies significantly improve communication, collaboration, and access to real-time project information, facilitating informed decision-making and enhancing project outcomes. By integrating these digital tools with strategic management practices, a new approach to navigating the complex stakeholder landscape in construction projects is offered, aligning stakeholder expectations with project objectives and promoting transparency and accountability. These results hold practical implications for construction professionals, project managers, and industry stakeholders. Through the adoption of this integrated strategy, the construction industry can leverage digital innovation to improve operational efficiency, stakeholder satisfaction, and project success. Additionally, the study contributes to the existing body of knowledge and emphasizes the need for widespread adoption of digital tools in strategic management practices, which can inform policy development. However, it is important to acknowledge the limitations of this study, such as the scope of digital tools examined and the geographical context of the research. These limitations suggest areas for future research, particularly in exploring the scalability of integrating digital tools across different construction contexts and assessing their long-term impact on project success. This research reaffirms the crucial role of digital tools in enhancing strategic management practices in the construction industry.

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Improvement of Mechanical Properties and Corrosion Resistance of AA7056 Aluminum Alloys by the Non-Isothermal Aging Process

Tse-An Pan, Sheng-Long Lee

Abstract—The effect of non-isothermal aging on the mechanical properties and corrosion resistance of Al-9Zn-2.3Mg-1.9Cu (AA7056) alloys were investigated. The results revealed that thick materials were limited to retrogression and re-aging treatment (RRA). It could not reach the retrogression temperature in the RRA treatment. Compared with the RRA treatment, the non-isothermal aging (NIA) treatment produced discontinuous precipitates at grain boundaries, while the intragranular precipitates were fine and dense. The strength was similar to that of the RRA treatment; the corrosion resistance of the alloy was significantly improved by NIA aging. NIA treatment was less affected by the thickness of the alloy. The difference between the actual temperature and the setting temperature of the alloy is minimal during the aging process. The combination of properties could overcome the fact that RRA treatment cannot handle thick materials.

Keywords—Al-Zn-Mg-Cu alloy, Corrosion, Retrogression and re-aging, Non-isothermal aging

Enhancing Cellulose Acetate Films: Impact of Glycerol and Ionic Liquid Plasticizers

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Abstract

Plastic packaging is widely used, but its pollution is a major environmental problem. Solutions require new sustainable technologies, environmental management, and the use of bio-based polymers as sustainable packaging.

Cellulose acetate (CA) is a biobased polymer used in a variety of applications such as the manufacture of plastic films, textiles, and filters. However, it has limitations in terms of thermal stability and rigidity, which necessitates the addition of plasticizers to optimize its use in packaging.

Plasticizers are molecules that increase the flexibility of polymers, but their influence on the chemical and physical properties of films (CA) has not been studied in detail. Some studies have focused on mechanical and thermal properties. However, an in-depth analysis is needed to understand the interactions between the additives and the polymer matrix. In this study, the aim is to examine the effect of two types of plasticizers, glycerol (a conventional plasticizer) and an ionic liquid, on the transparency, mechanical, thermal and barrier properties of cellulose acetate (CA) films prepared by the solution-casting method. Various analytical techniques were used to characterize these films, including infrared spectroscopy (FT-IR), X-ray diffraction (XRD), thermogravimetric analysis (TGA), water vapor permeability (WVP), oxygen permeability, scanning electron microscopy (SEM), opacity, transmission analysis and mechanical tests.

Keywords: cellulose acetate, plasticizers, biopolymers, ionic liquid, glycerol.

Using IoT on Single Input Multiple Outputs (SIMO) DC–DC Converter to Control Smart-home

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Abstract— The aim of the energy management system is to monitor and control utilization, access, optimize and manage energy availability. This can be realized through real-time analyses and energy sources and loads data control in a predictive way. Smart-home monitoring and control provide convenience and cost savings by controlling appliances, lights, thermostats and other loads. There may be different categories of loads in the various homes, and the homeowner may wish to control access to solar-generated energy to protect the storage from draining completely. Controlling the power system operation by managing the converter output power and controlling how it feeds the appliances will satisfy the residential load demand. The Internet of Things (IoT) provides an attractive technological platform to connect the two and make home automation and domestic energy utilization easier and more attractive. This paper presents the use of IoT-based control topology to monitor and control power distribution and consumption by DC loads connected to single-input multiple outputs (SIMO) DC-DC converter, thereby reducing leakages, enhancing performance and reducing human efforts. A SIMO converter was first developed and integrated with the IoT/Raspberry Pi control topology, which enables the user to monitor and control power scheduling and load forecasting via an Android app.

Keywords — IoT, DC-DC converter, SIMO, flyback, smarhome.

I. INTRODUCTION

Single input multiple output (SIMO) converter enables various outputs, minimizes components number and production cost [1]. Various electronic devices have different voltage requirement, and a single output converter may not satisfy their requirements satisfactorily [2]. DC fan, television, or laptop may require higher amount of power than mobile phone, and the power required by phones may be too small for laptops, etc. Fig. 1 shows the interconnection of the PV array to the SIMO converter and to the four connected loads.

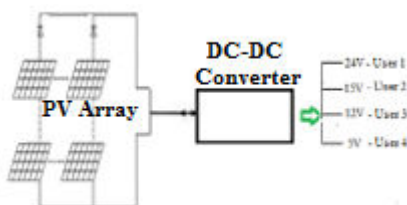


Fig. 1: Interconnection of the PV array to the SIMO converter and to the four connected loads.

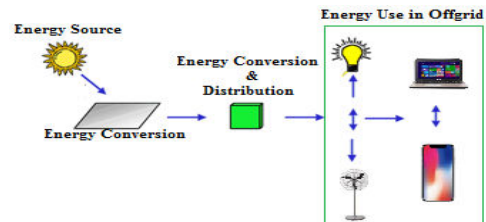


Fig. 2: Illustration of the energy source, energy conversion (based on the proposed SIMO converter) and energy use in off-grid application.

The conversion of solar energy into electrical energy has many application fields. Extensive research has been done on renewable energy conversion into electric energy [3-12] and residential energy management [9, 13]. Many families have a residential stand-alone solar powered system installed in their homes. The direct benefits of such systems at homes goes to the power consumer (user) by reducing the cost of getting electrical energy and also reducing the risk of contracting high-voltage electricity. The main function of a residential renewable energy system is to help the user manage and control consumption of electricity.

Controlling the whole photovoltaic system operation by managing the converter output power and controlling how it feed the appliances will satisfy the residential load demand. And, efficient management, monitoring and control of homes and home appliances automatically is making the home to be a “Smart Home”. The major requirements for making are smart home are [14]: extensibility, heterogeneity, security and privacy protection, self-configurable, context awareness, usability and intelligence.

In the previous years, applications of intelligent systems received significant attention in various fields of power systems, specifically in operations, planning, management and control [15]. Some research publications [16, 17] have shown how intelligent systems applications to power systems and control techniques for solar tracking with fuzzy logic [18] and other intelligent controllers have been realized. Human reasoning and mathematical models were used in conventional designs, planning, operation, control and management of power systems [15] as solutions to power management and control problems. However, these models come with a lot of uncertainties in practical applications of power systems [15]. Those mathematical models mostly use assumptions to provide specific solutions to power systems.

Many recent works have indicated interest in providing combination of simple intelligent technologies that will aid residential energy control and management [19-21]. With fast advancement of Internet Technologies and enormous increase of internet users and networking, control and management of many objects becomes easier and efficient [22]. The proliferation of internet in communications and controls creates the IoT, where sensors and actuators mingle around us, enabling sharing of information across a given platform to develop a common operating ground [23]. IoT are physical items communicating to each other (person – computer, computer – computer, etc.) [24, 25]. Human beings interact in their homes with things like air, light, electronics devices, etc. and regulate them accordingly. So, those home appliances are made to interact and respond to human behavior, and can be made to do that automatically with many advantages. Thus, intelligent home automation, monitoring and control consists of clusters of sensors with computing capabilities to analyze data regarding residents and proper utilization of the energy resources, thereby reducing cost and improving the standard of living at home with much convenience. Many researches focused on the use of IoT for automation and control [26, 27]. Some of the researches discussed management of resource constraints devices and mechanisms of interconnections [28-30]. However, energy management techniques and systems are deployed in homes to monitor, control, manage and schedule the electricity utilization to maximally reduce cost [31].

This paper therefore presents the use of IoT to monitor, control, manage and schedule DC home appliances connected to SIMO DC -DC photovoltaic converter. Raspberry Pi Zero W is used for wireless communications between the appliances connected to the converter, which are operated with a relay. A SIMO DC-DC converter was developed and connected to the solar supply. The multiple outputs are then subjected to connections on various DC loads. Raspberry Pi was implemented to transmit the input and output voltages via Wi-Fi to the IoT cloud, in which the android app of mobile phone has ability to monitor and control.

II. INTERNET OF THINGS (IoT) AND RASPBERRY PI

The IoT is a new paradigm of envisioned as a global machines, systems and devices network capable mutual interaction. The significance of IoT can be explored when devices, systems and machines are connected together via a platform with ability to communicate with each other [32]. It is an interconnection between objects and people with ability to exchange data over a network platform [33]. It offers connectivity from services, devices and systems working with machine-machine communication that cover protocols, domains and applications [34].

Raspberry Pi is a portable, low cost and miniaturized computer. It contains graphic chip, a processor random access memory (RAM) and several connectors and interfaces for external communication with other devices [35]. It is powerful and cheap with low power consumption [36]. It has a built-in software that enables users to design and program

animation, videos, games, etc. [33]. Programmers uses Python programming language, which is its core language to develop programs or scripts. Fig. 3 shows the complete architecture.

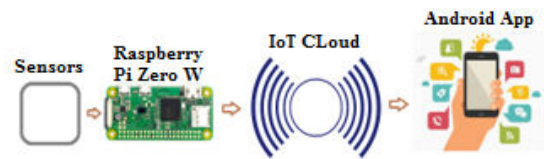


Fig. 3 IoT Architecture with Raspberry Pi W

III. CONTROL, MONITORING AND MANAGEMENT METHOD USING IoT AND RASPBERRY PI ZERO W

III

In controlling and monitoring the converter functions, the following tasks were adopted; Monitoring, Control and Scheduling. The program is designed to monitor the DC power generation by determining the input voltage and current. The user will be able to see the input voltage and current, and can schedule or control the power dissipation based on priority. Also, the user will get alerts when the voltage and current supply is less than the load demand and vice versa. Fig. 4 illustrates the system from generation, distribution, monitoring and control via a Raspberry Pi and Android App. Upon reception of the signal to either activate or deactivate a device, the relays will act according to the commands.

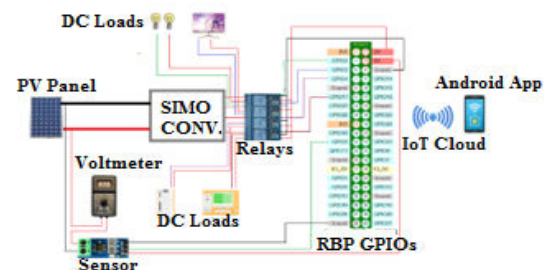


Fig. 4 Monitoring and Control Architecture Connected to the Converter

A. RELAY OPERATION AND CONNECTIONS TO LOADS (ACTUATION)

It is necessary to make the analyses of relay connections in complex electrical systems [37]. Upon reception of signal from the Raspberry Pi based on the instructions from the user, the relay acts. The relay is responsible for connecting or disconnecting supply to the device at any given instruction and time. Set of equations are used to describe any circuit and its operations. The equation terms represent the relay or switch terminals. The terminals of the relay used in this work are represented and denoted, in whatever circumstance, the operation is described as it may correspond to the instruction received from the Raspberry Pi, relay's task is only to execute. Fig. 5 shows the connection of a relay to one of the loads. DC voltage coming to activate the load has to wait the

decision of the user from the mobile app via the Raspberry Pi, and through the relay to activate or deactivate a device. Each of the loads has its own relay; a total of four relays for the four outputs of the converter is used.

For the analyses of the operation of this relay, a simple notation and symbolic logic is adopted. The terminals of a relay need to satisfy some postulates when executing a certain command. Now, for every two terminals; which may either be X and Y, the following postulates holds:

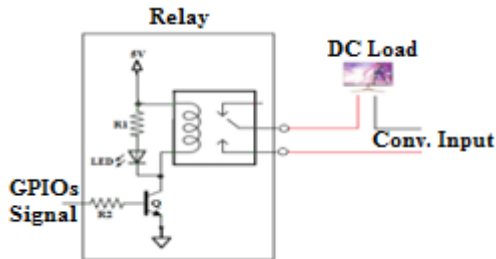


Fig. 5 Relay connection to the load

1. (a) When a closed circuit is connected in parallel with a closed circuit, the resultant circuit is closed;
 $0.0 = 0.$
(b) When an open circuit is connected in series with an open circuit, the resultant circuit is open;
 $1 + 1 = 1.$
2. (a) In either order, when an open circuit is connected in series with a closed circuit, the resultant circuit is an open circuit;
 $0 + 1 = 1 + 0 = 1.$
(b) In either order, when a closed circuit is connected in parallel with an open circuit, the resultant circuit is a closed circuit;
 $1.0 = 0.1 = 0.$
3. (a) When a closed circuit is connected in series with a closed circuit, the resultant circuit is a closed circuit;
 $0 + 0 = 0$
(b) When an open circuit is connected in parallel with an open circuit, the resultant circuit is an open circuit;
 $1.1 = 1.$
4. At any given instance, is either;
 - (a) $X = 1$ or $X = 0$
 - (b) $Y = 1$ or $Y = 0$
 - (c) $X = 1$ or $Y = 1$
 - (d) $X = 0$ or $Y = 0$
 - (e) $X = 0$ or $Y = 1$
 - (f) $X = 1$ or $Y = 0$

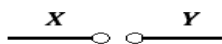


Fig. Two terminals of a relay

Limiting the circuit and logic treatment to relays and switches contacts, the circuit between any two terminals at any given instance must either give zero impedance (when closed) or infinite impedance (when open). Adopting the symbol X with terminals a and b, it is simply denoted as X_{ab} . The relay contact is represented by the symbol in Fig.....

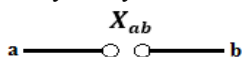


Fig. Symbol of a function between two terminals of a relay

This variable X_{ab} is used to represent a function of time between two terminals a – b. The symbol 0 (zero) represents the function of a closed circuit while the symbol 1 (one) represents the function of an open circuit.

When the circuit a – b is open, $X_{ab} = 1$ and when a – b is closed, $X_{ab} = 0.$

Ordinary algebra is used for these analyses of relay operation. However, other theorems are used for further analyses of the relay operation as in this work:

$$\begin{aligned}
 X + Y &= Y + X \\
 XY &= YX \\
 1. X &= X \\
 0 + X &= X; \text{ duality principle} \\
 1 + X &= 1 \\
 0. X &= 0
 \end{aligned}$$

Note that, X here is either 1 or 0. If it is 1, postulate 3b stands and if it is 0, it follows postulates 2b.

A new operation called *negation* is can be used by the relays during execution of the commands and instructions. A negative of the function X can be X' . It is a variable that is equal to 0 when X is equals to 1 and/or 1 when X is equal to 0. If X is the function assigned to make the relay contact, then X' is the function that will break the contact of the same relay. The following theorems arises from the definition of the negatives of a relay terminal X contact:

$$\begin{aligned}
 X + X' &= 1 \\
 XX' &= 0 \\
 0' &= 1 \\
 1' &= 0 \\
 (X')' &= X
 \end{aligned}$$

With these analogies, any calculus theorem interpreted in terms of relay and switch circuits is true. In negating the operation of the terminal of the relay in this work, *De Morgan's Theorem* gives the negative of the sum of product:

$$\begin{aligned}
 (X + Y)' &= X'.Y' \\
 (X.Y)' &= X' + Y'
 \end{aligned}$$

Fig.illustrates the relay connection to the loads, though a single relay is used here. But total of four relays are used each for each of the converter outputs and each of the loads.

B. CONTROL AND MANAGEMENT PROCEDURE

Starting from the main control topology as in Figures 1 and 2, the system starts by receiving instructions from the user via a mobile app which transmits the signal to the cloud, and subsequently to the Raspberry Pi, which then instruct the relays to execute. The flow chart of Fig. 6 illustrates the monitoring and control procedure.

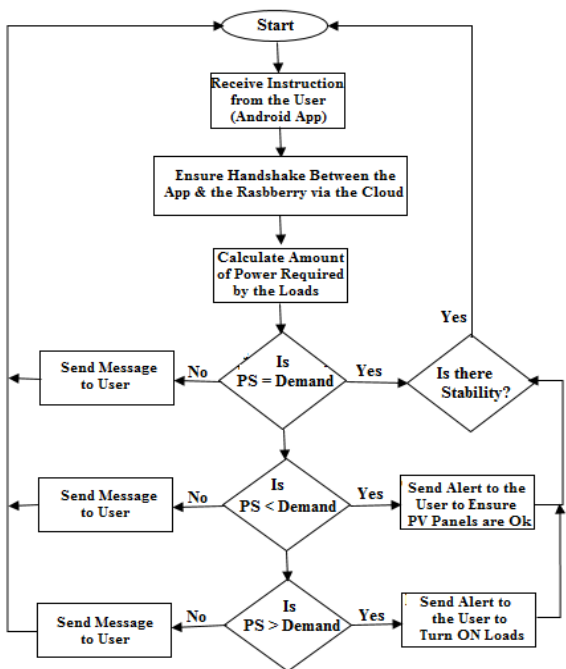


Figure 6: Flowchart of the main Intelligent Control algorithm.

In essence, this IoT/Raspberry based control performs the following functions:

- Load detection and access control.
- Overvoltage detection and alert.
- Under-voltage detection and alert.
- Distribution Control.

A. Load Forecasting

The consumptions of energy by humans in a particular period can be estimated by considering the hourly solar flux incident on the surface of the earth [38]. The load forecasting ability of this intelligent inverter will be able to predict and decide the load configurations according to power demand as follows:

- i. Maximum power demand of the house is estimated and predicted 24 hours before utilization based on weather conditions and forecast. Then the intelligent controller will decide the number of loads to be applied on the inverter.
- ii. The hourly or daily power demand of the house is predicted based on the result of (i).
- iii. The network will then be able to predict the weekly power demand of the house based on the loads applied such as lamps, fridges, televisions, etc.
- iv. Based on the applications and discrimination of the heavy and light appliances, and the time variations, the system will predict the savings and loss.
- v. The system will be able then to estimate the power loss and savings in a week.

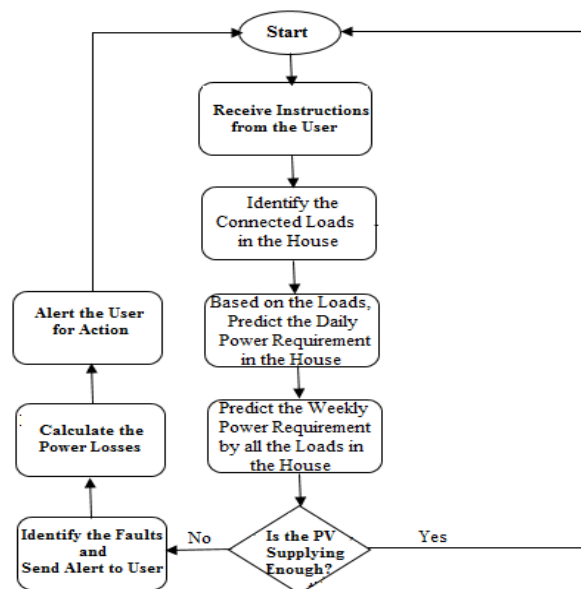


Figure 7 Load forecast, scheduling and prediction flowchart.

IV. RESULTS AND DISCUSSION

Using the algorithm of Fig. 6 and 7 flowcharts for main control, forecast, and prediction and scheduling respectively, the SIMO flyback converter was connected to loads to monitor supply from the PV, demand by the loads and stability and efficiency of the power system. The sensors connected to the supply and those connected at the relay and load terminals sent signals to the mobile app which are recorded for a whole day. Various records of the signals are plotted using R-Package software and the response is shown in Fig. 8.

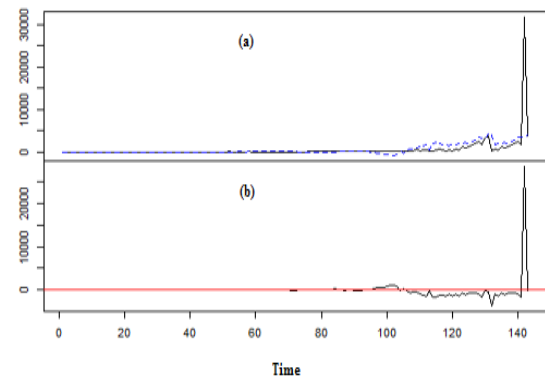


Figure 8: Loads Demand and PV Supply Plots of Recorded Controller Signals I

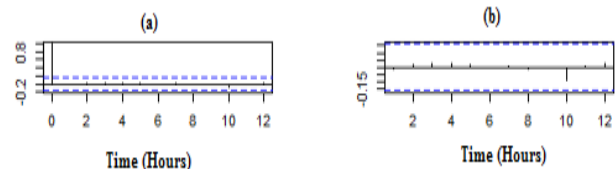


Figure 9: Stability and Risk periods

After careful study of the controller’s response to load demands and generation, the loads were set to match the generation to further study the response. The results are plotted as can be seen in Fig. 10 and 11.

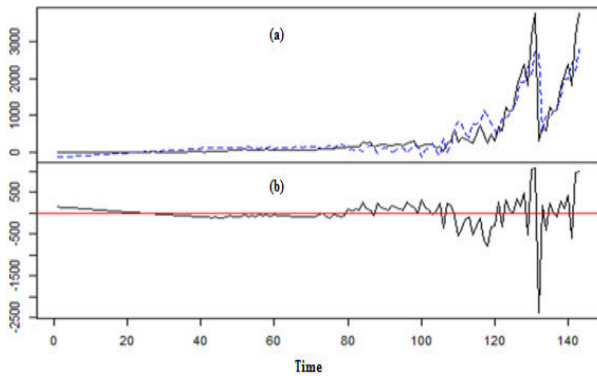


Figure 10: Loads Demand and PV Supply Plots of Recorded Controller Signals II

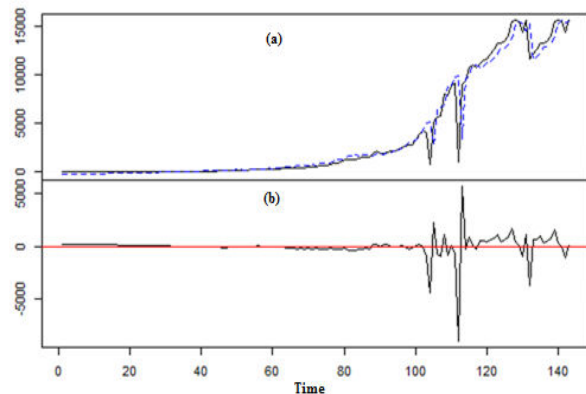


Figure 11: Loads Demand and PV Supply Plots of Recorded Controller Signals III

Fig. 8 is plotted using generated data from the controller via the mobile app. The data were recorded for a whole day while both the SIMO flyback converter and DC-AC inverter were fully connected with loads. The app was able to generate huge data every second, which is used on R-Package software. The response is seen on Fig. 8.

From Fig. 9 (a), there are two plots; blue and black. The blue plot represents generation (supply) while the black represents loads demand (usage). From the onset, there is stationary and stable demand and supply up to some points towards the night (dark) when the generation start dropping at constant demand. It can be seen that while the generation drops, the demand continues to shoot up beyond control. At that point, alert was sent to the user to disconnect or disable some appliances.

On Fig. 9 (b), there are also two plots; red and black. The red plot is a danger (risk) plot while the black plot is a load demand plot. In comparison with the plots of Fig. 9 (a), where the generation drops and the demand plunged to danger. It is reflected on Fig. 9 (b), the danger is seen below the red line (risk) as the generation drops. From there, the demand continues to shoot up after it must have sent alert to the user to act.

Fig. 10 illustrates the areas of stability and danger. Fig. 10 (a) specifically shows the captured stability plots between the demand and generation of Fig. 8 (a) which happened for over

twelve hours. Whereas, Fig. 10 (b) shows the periods in which danger (risk) was recorded.

After careful study of the controller's response to load demands and generation, the loads were set to match the generation to further study the response. The results are plotted as can be seen in Fig. 11.

In Fig. 11, the loads were varied to study the response and efficiency of the controller perform the tasks assigned to it. Fig. 11 (a) specifically shows the stability of both the loads demands and generation maintained at same level after careful study of what the PV could supply for 24 hours, the loads were then maintained to fit the generation. As such, both the blue and black lines for generation and demands respectively are maintained on same path. The demands were set by the controller to at all times match the generation by disabling some appliances. As soon as the generation drops, the demands follows it to drop together and vice versa.

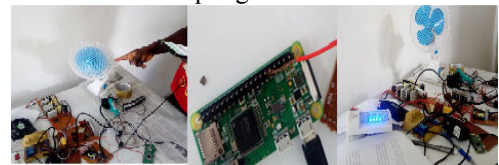


Figure 12: Images of Testing of the Developed System

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Existing a Prime in Interval n^2 and n^2+en

Hashem Sazegar

Abstract— Oppermann's conjecture states that there is a prime number between n^2 and n^2+n for every positive integer n . In this paper we prove generalization of this conjecture i.e there is a prime number in interval n^2 and $n^2 + en$ such that $0 < \epsilon \leq 1$.

Keywords— Bertrand-Chebyshev theorem, Landau's problems, Goldbach conjecture, twin prime, Legendre's conjecture, Oppermann's conjecture.

Hardy Type Inequalities of Two-Dimensional on Time Scales via Steklov Operator

Wedad Albalawi

Abstract— The mathematical inequalities have been the core of mathematical study and used in almost all branches of mathematics as well in various areas of science and engineering. The inequalities by Hardy, Littlewood and Polya were the first significant composition of several science. This work presents fundamental ideas, results and techniques and it has had much influence on research in various branches of analysis. Since 1934, various inequalities have been produced and studied in the literature. Furthermore, some inequalities have been formulated by some operators; in 1989, weighted Hardy inequalities have been obtained for integration operators. Then, they obtained weighted estimates for Steklov operators that were used in the solution of the Cauchy problem for the wave equation. They were improved upon in 2011 to include the boundedness of integral operators from the weighted Sobolev space to the weighted Lebesgue space. Some inequalities have been demonstrated and improved using the Hardy–Steklov operator.

Recently, a lot of integral inequalities have been improved by differential operators. Hardy inequality has been one of the tools that is used to consider integrity solutions of differential equations. Then dynamic inequalities of Hardy and Copson have been extended and improved by various integral operators. These inequalities would be interesting to apply in different fields of mathematics (functional spaces, partial differential equations, mathematical modeling).

Some inequalities have been appeared involving Copson and Hardy inequalities on time scales to obtain new special version of them. A time scale is defined as a closed subset contains real numbers. Then the inequalities of time scales version have received a lot of attention and has had a major field in both pure and applied mathematics. There are many applications of dynamic equations on time scales to quantum mechanics, electrical engineering, neural networks, heat transfer, combinatorics, and population dynamics.

This study focuses on double integrals to obtain new time-scale inequalities of Copson driven by Steklov operator. They will be applied in the solution of the Cauchy problem for the wave equation. The proof can be done by introducing restriction on the operator in several cases. In addition, the obtained inequalities done by using some concepts in time scale version such as time scales calculus, theorem of Fubini and the inequality of Hölder.

Keywords—Time Scales, Inequality of Hardy, Inequality of Copson, Steklov Operator.

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A Data-Driven Optimal Control Model for the Dynamics of Monkeypox in a Variable Population with a Comprehensive Cost-Effectiveness Analysis

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Abstract

Introduction

In the realm of public health, the threat posed by Monkeypox continues to elicit concern, prompting rigorous studies to understand its dynamics and devise effective containment strategies. Particularly significant is its recurrence in variable populations, such as the observed outbreak in Nigeria in 2022. In light of this, our study undertakes a meticulous analysis, employing a data-driven approach to explore, validate, and propose optimized intervention strategies tailored to the distinct dynamics of Monkeypox within varying demographic structures.

Utilizing a deterministic mathematical model, we delved into the intricate dynamics of Monkeypox, with a particular focus on a variable population context. Our qualitative analysis provided insights into the disease-free equilibrium, revealing its stability when R_0 is less than one and discounting the possibility of backward bifurcation, as substantiated by the presence of a single stable endemic equilibrium.

The model was rigorously validated using real-time data from the Nigerian 2022 recorded cases for Epi weeks 1 – 52. Transitioning from qualitative to quantitative, we augmented our deterministic model with optimal control, introducing three time-dependent interventions to scrutinize their efficacy and influence on the epidemic's trajectory.

Numerical simulations unveiled a pronounced impact of the interventions, offering a data-supported blueprint for informed decision-making in containing the disease. A comprehensive cost-effectiveness analysis, employing the Infection Averted Ratio (IAR), Average Cost-Effectiveness Ratio (ACER), and Incremental Cost-Effectiveness Ratio (ICER), facilitated a balanced evaluation of the interventions' economic and health impacts.

In essence, our study epitomizes a holistic approach to understanding and mitigating Monkeypox, intertwining rigorous mathematical modeling, empirical validation, and economic evaluation. The insights derived not only bolster our comprehension of Monkeypox's intricate dynamics but also unveil optimized, cost-effective interventions. This integration of methodologies and findings underscores a pivotal stride towards aligning public health imperatives with economic sustainability, marking a significant contribution to global efforts in combating infectious diseases.

Keywords: Monkeypox, Equilibrium states, Stability, Bifurcation, Optimal control, Cost-effectiveness.

Bayes Estimation for the two Parameters of Burr Type *XII* Distribution

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Abstract:

We consider in this article that identical items have lifetimes X_1, \dots, X_n from the two parameters of Burr-type *XII* distribution. Assuming that the prior pdf of θ to be Gamma and the prior of c to be noninformative and independent of the first, we derived, under squared error loss, the Bayes estimates of θ and c in the following four cases: complete sample, type *I* censoring, partial ordering *I*, and type *II* censoring. We derived the reliability for every case that we derived it. By using simulation methods, we compare the sampling plans mentioned above.

Keywords: Bayes, Estimation, Distribution, Burr Type *XII*.

AMS subject classifications: 62F15, 62G05, 62H10.

Introduction

The Burr system of distribution was introduced by Irving W. Burr (1942). His original motivation for developing the Burr system was to provide a method for fitting cumulative distribution function (cdf) to frequency data. Some applications of Burr system of distribution are in simulation modeling, Reliability, and engineering. These distributions have been used as models in a variety of applied fields such as Business (e.g., Rodriguez and Taniguchi), Economics and Engineering (e.g., McDonald and Richards), and Medicine (Wingo). Burr chose to work with the cumulative distribution function (cdf) $F(x)$ satisfying the differential equation (D.E.)

$$\frac{dy}{dx} = y(1 - y)g(x, y), \quad y = F(x)$$

that generate the Pearson system.

The Pearson system was originated by Pearson between 1880 and 1900. For every member in Pearson's family, the probability density function $p(x)$ satisfies the differential equation

$$\frac{1}{p} \frac{dy}{dx} = \frac{a + x}{c_0 + c_1x + c_2x^2}$$

For Burr families, different choices of $g(x, y)$ generate various solutions of $F(x)$, for example, if $g(x, y) = g(x)$, then

$$F(x) = \frac{1}{1 + \text{EXP}(-\int_{-\infty}^x g(u) du)}.$$

The solution $F(x)$ of Burr *XII* is

$$F_x(x) = 1 - (1 + x^c)^{-\theta}, \quad x > 0.$$

Burr *XII* was studied by many authors, Shah considered the estimation of the parameters of this distribution by several methods. He compared his results through simulation. Also, he derived the maximum likelihood estimator (MLE) of θ and c . Al-Hussiani gave a characterization of the Burr *XII* distribution. Wingo derived a maximum likelihood method for fitting the Burr *XII* distributions to life test data. In [], we studied Bayes estimation for the parameter θ of Burr type *XII* when c is known under several sampling plans: complete sample, type *I* censoring, partial ordering *I*, type *II* censoring, and partial ordering *II*.

Let X_1, \dots, X_n be a random sample from Burr *XII* distribution with probability density function given by

$$f(x|\theta, c) = \frac{c\theta x^{c-1}}{(1+x^c)^{\theta+1}}.$$

Let Y_1, \dots, Y_n be a future sample from the same population but with outlier observation of the type $\theta_0\theta$ where θ_0 known. Assuming conjugate prior on θ , namely $G\left(\alpha, \frac{1}{\beta}\right)$ and noninformative prior of c , they predicted the minimum $Y_{(1)}$ and the maximum $Y_{(n)}$ of the future samples using squared error loss function.

Statement of the problem

Assuming conjugate prior (Gamma prior) and squared error loss function, we computed Bayes estimator of the parameter θ using the following plans:

1. Complete sample, where we observed all lifetimes of the n items.
2. Type *I* censoring, where we observed the failure times in the interval $(0, t_0]$ such that $Y_1 \leq Y_2 \leq \dots \leq Y_r$ where t_0 is fixed.
3. Partial ordering *I*, where we observed the failure times in the interval $(0, t_0]$ such that $Y_1 \leq Y_2 \leq \dots \leq Y_r$ and the number of failures in the interval $(t_0, t_1]$ where t_0, t_1 are fixed.
4. Type *I* censoring, where we observe the first r failure $Y_1 \leq Y_2 \leq \dots \leq Y_r$.

We considered n items from two-parameter Burr type *XII* distribution. Assuming prior pdf of θ to be Gamma and the prior pdf of c to be non-informative and independent of the first. We derived, under squared error loss, the Bayes estimates of θ and c in the following four cases mentioned above.

Bayes Estimation for the Parameters θ and c of Burr Type XII Distribution

Let X_1, \dots, X_n be independent and identically distributed random variables (*iid rv's*) from Burr XII distribution with parameters θ and c where both θ and c are unknown. The probability density function of X is given by

$$f(x|\theta, c) = \frac{c\theta x^{c-1}}{(1+x^c)^{\theta+1}}, \quad x \geq 0, c > 0, \theta > 0 \quad (1)$$

where θ and c are positive parameters.

The distribution function is

$$F_x(x) = 1 - (1+x^c)^{-\theta}, \quad x > 0.$$

We shall derive the Generalized Bayes estimator of θ and c in addition to the Generalized Bayes estimator of the reliability function.

1. The case of complete sample

Let the prior of θ be $G(\alpha, \frac{1}{\beta})$ and prior of c be non-informative prior, *i. e.*,

$$\pi_1(\theta) = \frac{\beta^\alpha}{\Gamma(\alpha)} e^{\alpha-1} e^{-\theta\beta}, \quad \theta, \alpha, \beta > 0$$

$$\pi_2(\theta) = \frac{1}{c}, \quad c > 0$$

then

$$H(c, \theta, \underline{x}) = L(\underline{x}, \theta, c) \pi_1(\theta) \pi_2(c)$$

$$= \frac{c^{n-1} \theta^{n+\alpha-1} \beta^\alpha e^{-\theta\beta} (\prod_{i=1}^n x_i)^{c-1}}{\Gamma(\alpha) [\prod_{i=1}^n (1+x_i^c)]^{\theta+1}}, \quad \theta > 0$$

and the joint posterior pdf of θ and c is given by

$$\pi(\theta, c | \underline{x}) = \frac{H(c, \theta, \underline{x})}{\int_0^\infty \int_0^\infty H(c, \theta, \underline{x}) d\theta dc} \quad (2)$$

$$= \frac{c^{n-1} \theta^{n+\alpha-1} \beta^\alpha e^{-\theta\beta} (\prod_{i=1}^n x_i)^{c-1}}{[\prod_{i=1}^n (1+x_i^c)]^{\theta+1} \int_0^\infty \int_0^\infty \frac{c^{n-1} \theta^{n+\alpha-1} \beta^\alpha e^{-\theta\beta} (\prod_{i=1}^n x_i)^{c-1}}{[\prod_{i=1}^n (1+x_i^c)]^{\theta+1}} d\theta dc}$$

But

$$\int_0^\infty \int_0^\infty \frac{c^{n-1} \theta^{n+\alpha-1} \beta^\alpha e^{-\theta\beta} (\prod_{i=1}^n x_i)^{c-1}}{[\prod_{i=1}^n (1+x_i^c)]^{\theta+1}} d\theta dc$$

$$= \int_0^\infty \left(c^{n-1} \left(\prod x_i \right)^{c-1} \int_0^\infty \frac{\theta^{n+\alpha-1} e^{-\theta \beta}}{\left[\prod_{i=1}^n (1+x_i^c) \right]^{\theta+1}} d\theta \right) dc = \Gamma(n + \alpha) A$$

where $A = \int_0^\infty \frac{c^{n-1} \left(\prod_{i=1}^n x_i \right)^{c-1}}{[\beta + \sum \ln(1+x_i^c)]^{n+\alpha} \prod_{i=1}^n (1+x_i^c)} dc$

therefore, equation (2) becomes

$$\pi(\theta, c | \underline{x}) = \frac{c^{n-1} \theta^{n+\alpha-1} \beta^\alpha e^{-\theta \beta} \left(\prod_{i=1}^n x_i \right)^{c-1}}{A \Gamma(n+\alpha) \left[\prod_{i=1}^n (1+x_i^c) \right]^{\theta+1}}, \theta > 0 \tag{3}$$

integrating the posterior in equation (3) over θ we get the marginal posterior of c as:

$$\pi_1(c | \underline{x}) = \int_0^\infty \pi(\theta, c | \underline{x}) d\theta = \frac{c^{n-1} \left(\prod_{i=1}^n x_i \right)^{c-1}}{A [\beta + \sum \ln(1+x_i^c)]^{n+\alpha} \prod_{i=1}^n (1+x_i^c)}, \quad c > 0$$

Under squared error loss, the generalized Bayes estimator of c is the mean of the marginal posterior of c and is given by

$$\hat{c}_1 = E(c | \underline{x}) = \int_0^\infty c \pi_1(c | \underline{x}) dc = \frac{1}{A} \int_0^\infty \frac{c^n \left(\prod_{i=1}^n x_i \right)^{c-1}}{[\beta + \sum \ln(1+x_i^c)]^{n+\alpha} \prod_{i=1}^n (1+x_i^c)} dc$$

Note: The integrations in this chapter found numerically.

Now, integrating the posterior given in equation (3) over c we get the marginal posterior of θ as

$$\pi_2(\theta | \underline{x}) = \int_0^\infty \pi(\theta, c | \underline{x}) dc = \frac{\theta^{n+\alpha-1} e^{-\theta \beta}}{A \Gamma(n + \alpha)} \int_0^\infty \frac{c^{n-1} \left(\prod_{i=1}^n x_i \right)^{c-1}}{\left[\prod_{i=1}^n (1+x_i^c) \right]^{\theta+1}} dc, \quad \theta > 0$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean of the θ , i. e.,

$$\hat{\theta}_1 = E(\theta | \underline{x}) = \int_0^\infty \theta \pi_2(\theta | \underline{x}) d\theta = \frac{n + \alpha}{A} \int_0^\infty \frac{c^{n-1} \left(\prod_{i=1}^n x_i \right)^{c-1}}{[\beta + \sum \ln(1+x_i^c)]^{n+\alpha+1} \prod_{i=1}^n (1+x_i^c)} dc$$

Estimation of Reliability

Reliability is defined by

$$R = P(X > t) = 1 - P(X \leq t) = 1 - F_X(t)$$

$$= 1 - [1 - (1 + t^c)^{-\theta}] = (1 + t^c)^{-\theta}, \quad t > 0$$

so, the generalized Bayes estimator of R is:

$$\hat{R}_1 = \frac{1}{A} \int_0^\infty \frac{c^{n-1} \left(\prod_{i=1}^n x_i \right)^{c-1}}{[\beta + \sum \ln(1+x_i^c) + \ln(1+t^c)]^{n+\alpha} \prod_{i=1}^n (1+x_i^c)} dc.$$

2. The case of type I censoring

Observe the lifetimes of the units in the interval $(0, t_0]$. Let $Y_1 < \dots < Y_r$ be the lifetimes observed in the interval $(0, t_0]$. The conditional joint probability density function (jpdf) of the observed sample is given by:

$$\begin{aligned} L(\underline{y}|\theta, c) &= \frac{n!}{(n-r)!} \prod_{i=1}^r f(y_i) [1 - F(t_0)]^{n-r} \\ &= \frac{n!}{(n-r)!} \frac{c^r \theta^r (\prod y_i)^{c-1} (1+t_0^c)^{-\theta(n-r)}}{[\prod (1+y_i^c)]^{\theta+1}}. \end{aligned}$$

The posterior pdf of θ and c can be calculated as follows:

Let $\underline{y} = (y_1, \dots, y_r)$, then

$$\begin{aligned} \pi(\theta, c|\underline{y}) &= \frac{L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c)}{\int_0^\infty \int_0^\infty L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c) d\theta dc} \\ &= \frac{\theta^{r+\alpha-1} c^{r-1} e^{-\theta\beta} (\prod y_i)^{c-1}}{\Gamma(r+\alpha) [\prod (1+y_i^c)]^{\theta+1} [1+t_0^c]^{\theta(n-r)} D} \quad (4) \end{aligned}$$

where

$$D = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod (1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c)]^{r+\alpha}} dc$$

Integrating the posterior pdf given in equation (4) with respect to θ we get the marginal posterior pdf of c which is

$$\begin{aligned} \pi_1(c|\underline{y}) &= \int_0^\infty \pi(\theta, c|\underline{y}) d\theta \\ &= \frac{c^{r-1} (\prod y_i)^{c-1}}{D \prod (1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c)]^{r+\alpha}} \end{aligned}$$

Under squared error loss, the generalized Bayes estimator of c is the posterior mean given by:

$$\begin{aligned} \hat{c}_2 = E(c|\underline{y}) &= \int_0^\infty c \pi_1(c|\underline{y}) dc \\ &= \frac{1}{D} \int_0^\infty \frac{c^r (\prod y_i)^{c-1}}{\prod (1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c)]^{r+\alpha}} dc. \end{aligned}$$

Now, integrating the posterior pdf given in equation (4) with respect to c we obtain the marginal posterior pdf of θ , i. e.,

$$\pi_2(\theta|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) dc = \frac{\theta^{r+\alpha-1} e^{-\theta\beta} M(\theta)}{\Gamma(r+\alpha) D}$$

where,

$$D = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c)]^{r+\alpha}} dc$$

$$M(\theta) = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{[\prod(1+y_i^c)]^{\theta+1} [1+t_0^c]^{\theta(n-r)}} dc$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean given by:

$$\hat{\theta}_2 = E(\theta|\underline{y}) = \int_0^\infty \theta \pi_2(\theta|\underline{x}) d\theta$$

$$= \frac{r + \alpha}{D} \int_0^\infty \frac{c^{n-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c)]^{n+\alpha+1}} dc$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_2 = \int_0^\infty \int_0^\infty (1+t^c)^{-\theta} \pi(\theta, c|\underline{y}) d\theta dc$$

$$= \frac{1}{D} \int_0^\infty \frac{c^{n-1} (\prod_{i=1}^n x_i)^{c-1}}{\prod(1+y_i^c) [\beta + \sum \ln(1+y_i^c) + (n-r) \ln(1+t_0^c) + \ln(1+t^c)]^{r+\alpha}} dc.$$

3. The case of partial ordering I

Assume that we observe the lifetime of the units which failed in the interval $(0, t_0]$ and obtain the number of failures in the interval $(t_0, t_1]$. Let $Y_1 < \dots < Y_r$ be the lifetimes observed in the interval $(0, t_0]$ and k be the number of failures observed in the interval $(t_0, t_1]$.

The conditional jpdf of the observed sample is given by:

$$L(\underline{y}|\theta, c) = h(r, k) f(\underline{y}|R = r, K = k)$$

$$= \frac{n! [(1+t_0^c)^{-\theta} - (1+t_1^c)^{-\theta}]^k [1+t_1^c]^{-\theta(n-r-k)} c^r \theta^r [\prod_{i=1}^n y_i]^{c-1}}{k!(n-r-k)! [\prod(1+y_i^c)]^{\theta+1}}$$

Then the pdf of the posterior of θ and c is

$$\pi(\theta, c|\underline{y}) = \frac{L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c)}{\int_0^\infty \int_0^\infty L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c) d\theta dc}$$

$$= \frac{[(1+t_0^c)^{-\theta} - (1+t_1^c)^{-\theta}]^k (1+t_1^c)^{-\theta(n-r-k)} c^{r-1} \theta^{r+\alpha-1} [\prod y_i]^{c-1}}{[\prod(1+y_i^c)]^{\theta+1} G} \tag{5}$$

where

$$G = \int_0^\infty \int_0^\infty \frac{[(1+t_0^c)^{-\theta} - (1+t_1^c)^{-\theta}]^k (1+t_1^c)^{-\theta(n-r-k)} c^{r-1} \theta^{r+\alpha-1} [\prod y_i]^{c-1} e^{-\theta\beta}}{[\prod(1+y_i^c)]^{\theta+1}} d\theta dc$$

$$= \sum_{j=0}^k (-1)^j \int_0^\infty \frac{c^{r-1} [\prod y_i]^{c-1}}{\prod(1+y_i^c)} \frac{\Gamma(r+\alpha)}{A_j^{r+\alpha}} dc$$

where

$$A_j = \beta + (n+j-r-k) \ln(1+t_1^c) + \sum \ln(1+y_i^c) + (k-j) \ln(1+t_0^c)$$

Therefore, equation (5) becomes

$$\pi(\theta, c | \underline{y}) = \frac{\sum_{j=0}^k (-1)^j (1+t_1^c)^{-j\theta} (1+t_0^c)^{-\theta(k-j)} c^{r-1} \theta^{r+\alpha-1} (\prod y_i)^{c-1}}{\Gamma(r+\alpha) [\prod(1+y_i^c)]^{\theta+1} \sum_{j=0}^k (-1)^j \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) A_j^{r+\alpha}} dc} \quad (6)$$

Now, by integrating the posterior given in equation (6) with respect to θ , the marginal posterior of c is

$$\pi_1(c | \underline{y}) = \int_0^\infty \pi(\theta, c | \underline{y}) d\theta = \frac{c^{r-1} (\prod y_i)^{c-1} \sum_{j=0}^k \frac{(-1)^j}{A_j^{r+\alpha}}}{\sum_{j=0}^k (-1)^j F_j}$$

where

$$F_j = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) A_j^{r+\alpha}} dc.$$

Under squared error loss, the generalized Bayes estimator of c is the posterior mean given by:

$$\hat{c}_3 = E(c | \underline{y}) = \int_0^\infty c \pi_1(c | \underline{y}) dc = \frac{\sum_{j=0}^k (-1)^j G_j}{\sum_{j=0}^k (-1)^j F_j}$$

where

$$G_j = \int_0^\infty \frac{c^r (\prod y_i)^{c-1}}{\prod(1+y_i^c) A_j^{r+\alpha}} dc.$$

Now, let us integrate equation (6) over c , we get the marginal posterior of θ as:

$$\pi_2(\theta | \underline{y}) = \int_0^\infty \pi(\theta, c | \underline{y}) dc$$

$$= \frac{\sum_{j=0}^k (-1)^j \theta^{r+\alpha-1} e^{-\theta\beta} u_j(\theta)}{\sum_{j=0}^k (-1)^j F_j \Gamma(r+\alpha)}$$

where

$$u_j(\theta) = \int_0^\infty \frac{(1+t_0^c)^{-\theta(k-j)} (1+t_1^c)^{-\theta(n+j-r-k)} c^{r-1} (\prod y_i)^{c-1}}{(\prod(1+y_i^c))^{\theta+1}} dc.$$

Under squared error loss, the generalized Bayes estimator of the parameter θ is the posterior mean given by

$$\hat{\theta}_3 = E(\theta|\underline{y}) = \int_0^\infty \theta \pi_2(\theta|\underline{y}) d\theta = (r+\alpha) \frac{\sum_{j=0}^k (-1)^j H_j}{\sum_{j=0}^k (-1)^j F_j}$$

where

$$H_j = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) A_j^{r+\alpha+1}} dc.$$

Estimation of Reliability

The generalized Bayes estimator of R is

$$\hat{R}_3 = \int_0^\infty \int_0^\infty [1+t^c]^{-\theta} \pi(\theta, c|\underline{y}) d\theta dc = \frac{\sum_{j=0}^k (-1)^j W_j}{\sum_{j=0}^k (-1)^j F_j}$$

where

$$W_j = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1+y_i^c) B_j^{r+\alpha}} dc$$

where

$$B_j = \beta + (n+j-r-k) \ln(1+t_1^c) + (k-j) \ln(1+t_0^c) + \sum \ln(1+y_i^c) + \ln(1+t^c).$$

4. The Case of type II censoring

Observe the first r failures $Y_1 \leq Y_2 \leq \dots \leq Y_r$. The posterior distribution is

$$\pi(\theta, c|\underline{y}) = \frac{L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c)}{\int_0^\infty \int_0^\infty L(\underline{y}|\theta, c) \pi_1(\theta) \pi_2(c) d\theta dc}$$

$$= \frac{\theta^{r+\alpha-1} c^{r-1} e^{-\theta\beta} (\prod y_i)^{c-1} (1 + y_r^c)^{-\theta(n-r)}}{\Gamma(r + \alpha) [\prod(1 + y_i^c)]^{\theta+1} V} \quad (7)$$

Such that

$$V = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [\beta + \sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^{r+\alpha}} dc$$

Integrating equation (7) over c , we get the marginal posterior pdf of θ as

$$\pi_1(\theta|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) dc = \frac{\theta^{r+\alpha-1} e^{-\theta\beta} h(\theta)}{\Gamma(r + \alpha) V}$$

where

$$h(\theta) = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1} (1 + y_r^c)^{-\theta(n-r)}}{[\prod(1 + y_i^c)]^{\theta+1}} dc$$

Under squared error loss, the generalized Bayes estimator of the parameter θ is the posterior mean and is given by

$$\begin{aligned} \hat{\theta}_4 = E(\theta|\underline{y}) &= \int_0^\infty \theta \pi_1(\theta|\underline{y}) d\theta \\ &= \frac{r + \alpha}{V} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [\beta + \sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^{r+\alpha+1}} dc \end{aligned}$$

If we want to find the marginal posterior of c , we integrate equation (7) with respect to θ

$$\pi_2(c|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) d\theta = \frac{c^{r-1} (\prod y_i)^{c-1}}{V \prod(1 + y_i^c) [\beta + \sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^{r+\alpha}}$$

Under squared error loss, the generalized Bayes estimator of the parameter c is the posterior mean and is given by

$$\begin{aligned} \hat{c}_4 = E(c|\underline{y}) &= \int_0^\infty \theta \pi_2(c|\underline{y}) dc \\ &= \frac{1}{V} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{V \prod(1 + y_i^c) [\beta + \sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^{r+\alpha}} dc. \end{aligned}$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_4 = \int_0^\infty \int_0^\infty [1 + t^c]^{-\theta} \pi(\theta, c|\underline{y}) d\theta dc$$

$$= \frac{1}{V} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{V \prod (1 + y_i^c) [\beta + \sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c) + \ln(1 + t^c)]^{r+\alpha}} dc.$$

5. The case of partial ordering II

Assume that we obtain k_1 be the number of failures observed in the interval $(0, t_0]$ and obtain k_2 be the number of failures observed in the interval $(t_0, t_1]$ i. e.,

$$k_1 = \text{number of observed in } (0, t_0]$$

$$k_2 = \text{number of observed in } (t_0, t_1]$$

$$k_3 = n - k_1 - k_2.$$

Let

$$p_1 = P(x \leq t_0) = F_x(t_0) = 1 - (1 + t_0^c)^{-\theta}$$

$$p_2 = P(t_0 < x \leq t_1) = F_x(t_1) - F_x(t_0) = (1 + t_0^c)^{-\theta} - (1 + t_1^c)^{-\theta}$$

$$p_3 = P(x > t_1) = 1 - P(x \leq t_1) = 1 - F_x(t_1) = (1 + t_1^c)^{-\theta}$$

The conditional jpdf of the observed sample is given by:

$$\begin{aligned} H(\theta, c, \underline{x}) &= L(\underline{x}|\theta, c)\pi_1(\theta)\pi_2(c) \\ &= \frac{n!}{k_1!k_2!k_3!} [1 - (1 + t_0^c)^{-\theta}]^{k_1} [(1 + t_0^c)^{-\theta} - (1 + t_1^c)^{-\theta}]^{k_2} [1 + t_1^c]^{-\theta k_1} \\ &\quad \times \frac{\beta^\alpha}{c \Gamma(\alpha)} \theta^{\alpha-1} e^{-\theta\beta} \end{aligned}$$

Then the joint posterior of θ and c is given by

$$\begin{aligned} \pi(\theta, c|\underline{x}) &= \frac{H(\theta, c, \underline{x})}{\int_0^\infty \int_0^\infty H(\theta, c, \underline{x}) d\theta dc} \\ &= \frac{\theta^{\alpha-1} e^{-\theta\beta} \sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} (1 + t_1^c)^{-\theta(k_1+l)} (1 + t_0^c)^{-\theta(k_2+j-l)}}{\Gamma(\alpha) \sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc} \end{aligned}$$

where

$$B_{jl} = \beta + (k_3 + l) \ln(1 + t_1^c) + (k_2 + j - l) \ln(1 + t_0^c)$$

Integrating the posterior $\pi(\theta, c|\underline{x})$ with respect to θ , we get the marginal posterior of c as

$$\pi_1(c|\underline{x}) = \int_0^\infty \pi(\theta, c|\underline{x})d\theta = \frac{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} \frac{(-1)^{j+l}}{[B_{jl}(c)]^\alpha}}{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc}, \quad c > 0.$$

Under squared error loss, the generalized Bayes estimator of c is the posterior mean of c and it is given by

$$\begin{aligned} \hat{c}_5 &= E(c|\underline{x}) = \int_0^\infty c \pi_1(c|\underline{x})dc \\ &= \int_0^\infty \frac{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} \frac{(-1)^{j+l}}{[B_{jl}(c)]^\alpha} c}{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc} dc. \end{aligned}$$

The marginal posterior of θ is

$$\begin{aligned} \pi_2(\theta|\underline{x}) &= \int_0^\infty \pi(\theta, c|\underline{x})dc \\ &= \frac{\theta^{\alpha-1} e^{-\theta\beta} \sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty (1+t_1^c)^{-\theta(k_1+l)} (1+t_0^c)^{-\theta(k_2+j-l)} dc}{\Gamma(\alpha) \sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc} \end{aligned}$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean of θ and it is given by

$$\hat{\theta}_5 = E(\theta|\underline{x}) = \int_0^\infty \theta \pi_2(\theta|\underline{x})d\theta = \alpha \frac{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty [B_{jl}(c)]^{-(\alpha+1)}}{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc}$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_5 = \int_0^\infty \int_0^\infty [1+t^c]^{-\theta} \pi(\theta, c|\underline{x}) d\theta dc = \frac{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty [D_{jl}(c)]^{-\alpha}}{\sum_{j=0}^{k_1} \sum_{l=0}^{k_2} (-1)^{j+l} \int_0^\infty \frac{1}{c [B_{jl}(c)]^\alpha} dc}$$

where

$$D_{jl}(c) = \beta + \ln(1+t^c) + (k_3+l) \ln(1+t_1^c) + (k_2+j-l) \ln(1+t_0^c).$$

Bayes Estimator using Non-informative Priors

1. The case of complete sample

If we take prior of θ and non-informative prior of c , i.e.,

$$\pi(\theta, c) = \frac{1}{\theta c}, \quad \theta, c > 0$$

Then,

$$H(c, \theta | \underline{x}) = L(\underline{x} | \theta, c) \pi(\theta, c) = \frac{c^{n-1} \theta^{n-1} (\prod x_i)^{c-1}}{[\prod(1 + x_i^c)]^{\theta+1}}$$

Then the joint posterior of θ and c is given by

$$\pi(\theta, c | \underline{x}) = \frac{H(c, \theta | \underline{x})}{\int_0^\infty \int_0^\infty H(c, \theta | \underline{x}) d\theta dc} = \frac{c^{n-1} \theta^{n-1} (\prod x_i)^{c-1}}{[\prod(1 + x_i^c)]^{\theta+1} \Gamma(n) Z} \quad (8)$$

where

$$Z = \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{\prod(1 + x_i^c) [\sum \ln(1 + x_i^c)]^n} dc$$

Integrating the posterior in equation (8) with respect to θ , we get the marginal posterior of c as

$$\pi_1(c | \underline{x}) = \int_0^\infty \pi(c, \theta | \underline{x}) d\theta = \frac{c^{n-1} (\prod x_i)^{c-1}}{Z \prod(1 + x_i^c) [\sum \ln(1 + x_i^c)]^n}$$

Under squared error loss, the generalized Bayes estimator of c is the posterior mean of c and it is given by

$$\hat{c}_1 = E(c | \underline{x}) = \frac{1}{Z} \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{\prod(1 + x_i^c) [\sum \ln(1 + x_i^c)]^n} dc$$

Integrating the posterior in equation (8) with respect to c , we get the marginal posterior of θ as

$$\pi_2(\theta | \underline{x}) = \int_0^\infty \pi(c, \theta | \underline{x}) dc = \frac{\theta^{n-1}}{\Gamma(n)} \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{[\prod(1 + x_i^c)]^{\theta+1}} dc$$

Under squared error, the generalized Bayes estimator of c is the posterior mean of c and is given by

$$\hat{\theta}_1 = E(\theta | \underline{x}) = \frac{n}{Z} \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{\prod(1 + x_i^c) [\sum \ln(1 + x_i^c)]^n} dc.$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_1 = \int_0^\infty \int_0^\infty [1 + t^c]^{-\theta} \pi(\theta, c | \underline{x}) d\theta dc$$

$$= \frac{1}{Z} \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{\prod (1 + x_i^c) [\ln(1 + t^c) + \sum \ln(1 + x_i^c)]^n} dc.$$

2. The case of type I censoring

We observe the lifetime of the units in the interval $(0, t_0]$. Let $Y_1 < \dots < Y_r$ be the lifetimes observed in the interval $(0, t_0]$. Let the conditional jpdf of the observed sample is given by

$$L(\underline{y}|\theta) = \frac{n!}{(n-r)!} \prod f(y_i) [1 - F(t_0)]^{n-r}$$

$$= \frac{n!}{(n-r)!} \frac{c^r \theta^r [\prod_{i=1}^r y_i]^{c-1}}{[\prod_{i=1}^r (1 + y_i^c)]^{\theta+1}} [1 + t_0^c]^{-\theta(n-r)}, 0 \leq y_1 \leq \dots \leq y_r \leq t_0, \theta \geq 0.$$

The posterior pdf is calculated as follows:

Let $\underline{y} = (y_1, \dots, y_r)$, then

$$\pi(\theta, c|\underline{y}) = \frac{L(\underline{y}|\theta, c) \pi(\theta, c)}{\int_0^\infty \int_0^\infty L(\underline{y}|\theta, c) \pi(\theta, c) d\theta dc}$$

$$= \frac{c^{r-1} \theta^{r-1} [\prod_{i=1}^r y_i]^{c-1} [1 + t_0^c]^{-\theta(n-r)}}{\Gamma(r) [\prod (1 + y_i^c)]^{\theta+1} N}, c, \theta > 0. \quad (9)$$

where

$$N = \int_0^\infty \frac{c^{r-1} [\prod_{i=1}^r y_i]^{c-1}}{\prod (1 + y_i^c) [(n-r) \ln(1 + t_0^c) + \sum \ln(1 + y_i^c)]^r} dc.$$

Integrating the posterior pdf given in equation (9) with respect to θ , we get the marginal posterior pdf of c as

$$\pi_1(c|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) d\theta = \frac{c^{r-1} [\prod_{i=1}^r y_i]^{c-1}}{N \prod (1 + y_i^c) [(n-r) \ln(1 + t_0^c) + \sum (1 + y_i^c)]^r}, c > 0.$$

Under squared error, the generalized Bayes estimator of c is the posterior mean given by

$$\hat{c}_2 = E(c|\underline{y}) = \frac{1}{N} \int_0^\infty \frac{c^n (\prod y_i)^{c-1}}{\prod (1 + y_i^c) [(n-r) \ln(1 + t_0^c) + \sum \ln(1 + y_i^c)]^r} dc$$

Integrating the posterior given in equation (9) with respect to c , we get the marginal posterior pdf of θ as

$$\pi_2(\theta|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) dc = \frac{\theta^{r-1}}{\Gamma(r)N} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1} (1 + t_0^c)^{-\theta(n-r)}}{[\prod (1 + y_i^c)]^{\theta+1}} dc.$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean and it is given by

$$\hat{\theta}_2 = E(\theta|\underline{y}) = \frac{r}{N} \int_0^\infty \frac{c^n (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [(n-r) \ln(1 + t_0^c) + \sum \ln(1 + y_i^c)]^{r+1}} dc.$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\begin{aligned} \hat{R}_2 &= \int_0^\infty \int_0^\infty [1 + t^c]^{-\theta} \pi(\theta, c|\underline{y}) d\theta dc \\ &= \frac{1}{N} \int_0^\infty \frac{c^{n-1} (\prod x_i)^{c-1}}{\prod(1 + y_i^c) [(n-r) \ln(1 + t_0^c) + \sum \ln(1 + y_i^c + \ln(1 + t^c))]^r} dc. \end{aligned}$$

3. The case of partial ordering I

Let $Y_1 < \dots < Y_r$ be the lifetimes observed in the interval $(0, t_0]$ and S be the number of failures observed in the interval $(t_0, t_1]$. Let $\underline{y} = (y_1, \dots, y_r)$. The conditional jpdf of the observed sample is given by

$$\begin{aligned} L(\underline{y}|\theta, c) &= f(r, s) f(\underline{y}|R = r, S = s) \\ &= \frac{n! [(1 + t_0^c)^{-\theta} - (1 + t_1^c)^{-\theta}]^s (1 + t_1^c)^{-\theta(n-r-s)} c^r \theta^r (\prod y_i)^{c-1}}{(n-s-r)! s! [\prod(1 + y_i^c)]^{\theta+1}} \end{aligned}$$

Then the pdf of the posterior is given by

$$\begin{aligned} \pi(\theta, c|\underline{y}) &= \frac{L(\underline{y}|\theta, c) \pi(\theta, c)}{\int_0^\infty \int_0^\infty L(\underline{y}|\theta, c) \pi(\theta, c) d\theta} \\ &= \frac{\sum_{j=0}^s (-1)^j (1 + t_1^c)^{-\theta(j+n-r-s)} (1 + t_0^c)^{-\theta(s-j)} c^{r-1} \theta^{r-1} (\prod y_i)^{c-1}}{[\prod(1 + y_i^c)]^{\theta+1} \sum_{j=0}^s (-1)^j \int_0^\infty \frac{c^{n-1} (\prod y_i)^{c-1}}{\prod(1 + y_i^c)} \frac{\Gamma(r)}{[B_{sj}(c)]^r} dc} \end{aligned} \tag{10}$$

where

$$B_{sj}(c) = (j + n - r - s) \ln(1 + t_1^c) + \sum \ln(1 + y_i^c) + (s - j) \ln(1 + t_0^c).$$

Now, by integrating the posterior in equation (10) with respect to θ , the marginal posterior of c is

$$\pi_1(c|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) d\theta$$

$$= \frac{\sum_{j=0}^s (-1)^j c^{r-1} \frac{(\prod y_i)^{c-1}}{[B_{sj}(c)]^r}}{\sum_{j=0}^s (-1)^j F_{js} \prod(1 + y_i^c)}$$

where

$$F_{js} = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [(j + n - r - s) \ln(1 + t_1^c) + \sum \ln(1 + y_i^c) + (s - j) \ln(1 + t_0^c)]^r} dc.$$

Under squared error, the generalized Bayes estimator of c is the posterior mean given by

$$\hat{c}_3 = E(c|\underline{y}) = \frac{\sum_{j=0}^s (-1)^j G_{js}}{\sum_{j=0}^s (-1)^j F_{js}}$$

where

$$G_{js} = \int_0^\infty \frac{c^r (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [B_{sj}(c)]^r} dc.$$

Now, integrating equation (10) w.r.t c , we get the marginal posterior of θ as:

$$\pi_2(\theta|\underline{y}) = \int_0^\infty \pi(\theta, c|\underline{y}) dc = \frac{\theta^{r-1} \sum_{j=0}^s (-1)^j u_j(\theta)}{\Gamma(r) \sum_{j=0}^s (-1)^j F_{js}}$$

where

$$u_j(\theta) = \int_0^\infty \frac{(1 + t_0^c)^{-\theta(s-j)} (1 + t_1^c)^{-\theta(j+n-r-s)} c^{r-1} (\prod y_i)^{c-1}}{[\prod(1 + y_i^c)]^{\theta+1}} dc.$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean and it is given by

$$\hat{\theta}_3 = E(\theta|\underline{y}) = r \frac{\sum_{j=0}^s (-1)^j P_{js}}{\sum_{j=0}^s (-1)^j F_{js}}$$

where

$$P_{js} = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod(1 + y_i^c) [B_{sj}(c)]^{r+1}} dc.$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_3 = \int_0^\infty \int_0^\infty [1 + t^c]^{-\theta} \pi(\theta, c|\underline{y}) d\theta dc$$

$$= \frac{\sum_{j=0}^s (-1)^j \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{[\prod (1 + y_i^c) [\ln(1 + t^c) + B_{sj}(c)]^r]} dc}{\sum_{j=0}^s (-1)^j F_{js}}$$

4. The case of type II censoring

Observe that first r failures $Y_1 < \dots < Y_r$. The posterior distribution is

$$\begin{aligned} \pi(\theta, c | \underline{y}) &= \frac{f(\underline{y} | \theta, c) \pi(\theta, c)}{\int_0^\infty \int_0^\infty f(\underline{y} | \theta, c) \pi(\theta, c) d\theta dc} \\ &= \frac{\theta^{r-1} c^{r-1} (\prod y_i)^{c-1} (1 + y_r^c)^{-\theta(n-r)}}{\Gamma(r) [\prod (1 + y_i^c)]^{\theta+1} I} \end{aligned} \tag{11}$$

where

$$I = \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod (1 + y_i^c) [\sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^r} dc.$$

Now, by integrating the posterior in equation (11) with respect to θ , the marginal posterior of c is

$$\pi_1(c | \underline{y}) = \int_0^\infty \pi(\theta, c | \underline{y}) d\theta = \frac{c^{r-1} (\prod y_i)^{c-1}}{I \prod (1 + y_i^c) [\sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^r}$$

Under squared error, the generalized Bayes estimator of c is the posterior mean given by

$$\hat{c}_4 = E(c | \underline{y}) = \frac{1}{I} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod (1 + y_i^c) [\sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^r} dc.$$

And if we integrate equation (11) w.r.t c , then the marginal posterior of θ as

$$\begin{aligned} \pi_2(\theta | \underline{y}) &= \int_0^\infty \pi(\theta, c | \underline{y}) dc \\ &= \frac{\theta^{r-1}}{\Gamma(r) I} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1} (1 + y_i^c)^{-\theta(n-r)}}{[\prod (1 + y_i^c)]^{\theta+1}} dc. \end{aligned}$$

Under squared error loss, the generalized Bayes estimator of θ is the posterior mean and it is given by

$$\hat{\theta}_4 = E(\theta | \underline{y}) = \frac{r}{I} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod (1 + y_i^c) [\sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c)]^{r+1}} dc.$$

Estimation of Reliability

The generalized Bayes estimator of reliability is

$$\hat{R}_4 = \int_0^\infty \int_0^\infty [1 + t^c]^{-\theta} \pi(\theta, c | \underline{y}) d\theta dc$$

$$= \frac{1}{I} \int_0^\infty \frac{c^{r-1} (\prod y_i)^{c-1}}{\prod (1 + y_i^c) [\sum \ln(1 + y_i^c) + (n - r) \ln(1 + y_r^c) + \ln(1 + t^c)]^r} dc.$$

Simulation and General Results

To compare between the five different sampling plans by MSE we take

Case (1): Complete sample.

Case (2): Type I censoring.

Case (3): Partial ordering I.

Case (4): Type II censoring.

Case (5): Type I censoring.

We compare between the estimators when c and θ are both unknown. To compare the results obtained in each sampling plan, we take (1) $\alpha = 2, \beta = 3$ (2) $\alpha = 2, \beta = 6$ and generate a value of θ from Gamma distribution and then generate random sample of size 10, 20, 40 from Burr XII when $c = 2$ and generated $\theta = 0.6414, 0.3417$. We repeated the simulation 1000 times. For each sampling plan we computed Bayes estimator $\hat{\theta}$ of θ , \hat{R} of R , and MSE for each. Stopping $t_0 = 2, t_1 = 5$, and $t = 3$ for reliability.

The following notation were used

$\bar{\theta}_i \equiv$ mean of Bayes estimator of θ in the i -th sampling plan. *i. e.*,

$$\bar{\theta}_i = \frac{1}{1000} \sum_{j=1}^{1000} \hat{\theta}_{ij}$$

and

$$MSE = \frac{1}{1000} \sum_{j=1}^{1000} (\hat{\theta}_{ij} - \theta_{(given)})^2$$

$\bar{c}_i \equiv$ mean of Bayes estimator of c in the i -th sampling plan. *i. e.*,

$$\bar{c}_i = \frac{1}{1000} \sum_{j=1}^{1000} \hat{c}_{ij}$$

and

$$MSE = \frac{1}{1000} \sum_{j=1}^{1000} (\bar{\hat{c}}_{ij} - c_{(given)})^2$$

$\bar{\hat{R}}_i \equiv$ mean of Bayes estimator of R in the i -th sampling plan. *i. e.*,

$$\bar{\hat{R}}_i = \frac{1}{1000} \sum_{j=1}^{1000} \hat{R}_{ij}$$

and

$$MSE = \frac{1}{1000} \sum_{j=1}^{1000} (\widehat{R}_{ij} - R_{(given)})^2$$

We write $case(i) < case(j)$ to mean MSE of estimator in $case(i) < MSE$ of estimator in $case(j)$.

The results are given in following tables.

Tables (1-6) when c is non-informative and prior of $\theta \sim G\left(\alpha, \frac{1}{\beta}\right)$.

Table (1)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t_0 = 2, \text{ and } t_1 = 5$										
n	$\bar{\hat{c}}_1$	MSE	$\bar{\hat{c}}_2$	MSE	$\bar{\hat{c}}_3$	MSE	$\bar{\hat{c}}_4$	MSE	$\bar{\hat{c}}_5$	MSE
10	2.135	0.996	2.221	0.0501	2.094	0.0089	1.999	0.0051	2.179	0.0431
20	2.189	0.0391	2.228	0.0571	2.190	0.0397	2.035	0.0062	2.059	0.0071
30	2.035	0.0081	2.103	0.0125	2.201	0.0411	2.194	0.0401	1.971	0.0101

$n = 10: case 4 < case 3 < case 5 < case 2 < case 1$

$n = 20: case 4 < case 5 < case 1 < case 3 < case 2$

$n = 30: case 1 < case 5 < case 2 < case 4 < case 3$

Table (2)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t_0 = 2, \text{ and } t_1 = 5$										
n	$\bar{\hat{\theta}}_1$	MSE	$\bar{\hat{\theta}}_2$	MSE	$\bar{\hat{\theta}}_3$	MSE	$\bar{\hat{\theta}}_4$	MSE	$\bar{\hat{\theta}}_5$	MSE
10	0.6378	0.0291	0.6034	0.0599	0.5821	0.0721	0.6068	0.0575	0.6463	0.0125
20	0.6085	0.0301	0.6153	0.0241	0.6060	0.0321	0.6005	0.0335	0.6115	0.0271
30	0.6201	0.0101	0.6084	0.0312	0.6186	0.0201	0.6304	0.0095	0.5952	0.0413

$n = 10: case 5 < case 1 < case 4 < case 2 < case 3$

$n = 20: case 2 < case 5 < case 1 < case 3 < case 4$

$n = 30: case 4 < case 1 < case 3 < case 2 < case 5$

Table (3)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t = 3, R = 0.2283, t_0 = 2, \text{ and } t_1 = 5$										
n	\bar{R}_1	MSE	\bar{R}_2	MSE	\bar{R}_3	MSE	\bar{R}_4	MSE	\bar{R}_5	MSE
10	0.2403	0.0701	0.2457	0.0711	0.2301	0.0531	0.2321	0.0681	0.2330	0.0691
20	0.1998	0.0699	0.2591	0.0801	0.2431	0.0731	0.2433	0.0687	0.2445	0.0750
30	0.2513	0.0815	0.2187	0.0274	0.2199	0.0182	0.2031	0.0341	0.2489	0.0785

$n = 10$: case 3 < case 4 < case 5 < case 1 < case 2

$n = 20$: case 4 < case 1 < case 3 < case 5 < case 2

$n = 30$: case 3 < case 2 < case 4 < case 5 < case 1

Table (4)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$										
n	\bar{c}_1	MSE	\bar{c}_2	MSE	\bar{c}_3	MSE	\bar{c}_4	MSE	\bar{c}_5	MSE
10	2.216	0.0469	1.931	0.0048	2.105	0.0125	2.300	0.0920	2.035	0.0031
20	2.185	0.0381	2.200	0.0510	2.072	0.0053	2.254	0.0681	2.111	0.0129
30	2.031	0.0012	2.213	0.0501	2.041	0.0021	2.230	0.0531	2.180	0.0410

$n = 10$: case 5 < case 2 < case 3 < case 1 < case 4

$n = 20$: case 3 < case 5 < case 1 < case 2 < case 4

$n = 30$: case 1 < case 3 < case 5 < case 2 < case 4

Table (5)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$										
n	$\bar{\theta}_1$	MSE	$\bar{\theta}_2$	MSE	$\bar{\theta}_3$	MSE	$\bar{\theta}_4$	MSE	$\bar{\theta}_5$	MSE
10	0.3562	0.0051	0.3227	0.0285	0.3282	0.0264	0.3081	0.0667	0.3092	0.0651
20	0.3574	0.0081	0.3160	0.0760	0.3567	0.0077	0.3189	0.0534	0.3537	0.0073
30	0.3576	0.0094	0.3092	0.0911	0.3733	0.0401	0.3281	0.0381	0.3429	0.0012

$n = 10$: case 1 < case 3 < case 2 < case 5 < case 4

$n = 20$: case 5 < case 3 < case 1 < case 4 < case 2

$n = 30$: case 5 < case 1 < case 4 < case 3 < case 2

Table (6)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$										
n	\bar{R}_1	MSE	\bar{R}_2	MSE	\bar{R}_3	MSE	\bar{R}_4	MSE	\bar{R}_5	MSE
10	0.4289	0.0101	0.4606	0.0039	0.4957	0.0420	0.4539	0.0021	0.4168	0.0121
20	0.4245	0.0294	0.4571	0.0023	0.4835	0.0283	0.4522	0.0033	0.4150	0.0515
30	0.4239	0.0391	0.4531	0.0021	0.4717	0.0058	0.4328	0.0091	0.7024	0.0515

$n = 10$: case 4 < case 2 < case 1 < case 5 < case 3

$n = 20$: case 2 < case 4 < case 3 < case 1 < case 5

$n = 30$: case 2 < case 3 < case 4 < case 1 < case 5

Tables (7-12) when c is non-informative and prior of θ

Table (7)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t_0 = 2, \text{ and } t_1 = 5$								
n	\hat{c}_1	MSE	\hat{c}_2	MSE	\hat{c}_3	MSE	\hat{c}_4	MSE
10	2.103	0.0109	2.192	0.0311	2.105	0.0144	2.034	0.0023
20	2.054	0.0031	2.079	0.0080	2.202	0.0510	2.047	0.0038
30	2.004	0.0001	2.041	0.0021	2.231	0.0552	2.180	0.0430

$n = 10$: case 4 < case 1 < case 3 < case 2

$n = 20$: case 1 < case 4 < case 2 < case 3

$n = 30$: case 1 < case 2 < case 4 < case 3

Table (8)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t_0 = 2, \text{ and } t_1 = 5$								
n	$\hat{\theta}_1$	MSE	$\hat{\theta}_2$	MSE	$\hat{\theta}_3$	MSE	$\hat{\theta}_4$	MSE
10	0.6841	0.0821	0.6321	0.0452	0.6429	0.0451	0.6728	0.0165
20	0.6541	0.0372	0.6251	0.0103	0.6706	0.0231	0.6614	0.1305
30	0.6351	0.0112	0.5974	0.0304	0.6796	0.0452	0.6575	0.0778

$n = 10$: case 3 < case 2 < case 4 < case 1

$n = 20$: case 1 < case 2 < case 4 < case 3

$n = 30$: case 1 < case 4 < case 3 < case 2

Table (9)

$\alpha = 2, \beta = 3, c = 2, \theta = 0.6414, t_0 = 2, \text{ and } t_1 = 5$								
n	\bar{R}_1	MSE	\bar{R}_2	MSE	\bar{R}_3	MSE	\bar{R}_4	MSE
10	0.2153	0.0013	0.2448	0.0151	0.2401	0.0121	0.2019	0.0093
20	0.2353	0.0242	0.2301	0.0202	0.2443	0.0331	0.1982	0.0192
30	0.2411	0.0452	0.2478	0.0513	0.1937	0.0327	0.2215	0.0083

$n = 10$: case 1 < case 4 < case 3 < case 2

$n = 20$: case 4 < case 2 < case 1 < case 3

$n = 30$: case 4 < case 3 < case 1 < case 2

Table (10)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$								
n	\bar{c}_1	MSE	\bar{c}_2	MSE	\bar{c}_3	MSE	\bar{c}_4	MSE
10	2.166	0.0302	2.276	0.0801	2.131	0.0191	2.054	0.0031
20	2.120	0.0231	2.265	0.0711	2.157	0.0263	1.961	0.0018
30	2.028	0.0009	2.019	0.0042	2.243	0.0607	2.271	0.800

$n = 10$: case 4 < case 3 < case 1 < case 2

$n = 20$: case 4 < case 1 < case 3 < case 2

$n = 30$: case 1 < case 2 < case 3 < case 4

Table (11)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$								
n	$\bar{\theta}_1$	MSE	$\bar{\theta}_2$	MSE	$\bar{\theta}_3$	MSE	$\bar{\theta}_4$	MSE
10	0.3489	0.0015	0.3530	0.0031	0.3103	0.0487	0.3111	0.0409
20	0.3245	0.0325	0.3379	0.0025	0.3221	0.0367	0.3277	0.0305
30	0.3135	0.0478	0.3483	0.0016	0.3296	0.0298	0.3273	0.0311

$n = 10$: case 1 < case 2 < case 4 < case 3

$n = 20$: case 2 < case 4 < case 1 < case 3

$n = 30$: case 2 < case 3 < case 4 < case 1

Table (12)

$\alpha = 2, \beta = 6, c = 2, \theta = 0.3417, t_0 = 2, \text{ and } t_1 = 5$								
n	\widehat{R}_1	MSE	\widehat{R}_2	MSE	\widehat{R}_3	MSE	\widehat{R}_4	MSE
10	0.4427	0.0031	0.4008	0.0381	0.4910	0.0351	0.4835	0.0151
20	0.4299	0.0217	0.4167	0.0352	0.4723	0.0108	0.4801	0.0124
30	0.4252	0.0235	0.4285	0.0229	0.4429	0.0028	0.4583	0.0023

$n = 10$: case 1 < case 4 < case 3 < case 2

$n = 20$: case 3 < case 4 < case 1 < case 2

$n = 30$: case 4 < case 3 < case 2 < case 1

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Long- and Short-Term Impacts of COVID-19 and Gold Price on Price Volatility: A Comparative Study of MIDAS and GARCH-MIDAS Models for USA Crude Oil

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Abstract:

The purpose of this study was to compare the performance of two types of models, namely MIDAS and MIDAS-GARCH, in predicting the volatility of crude oil returns based on gold price returns and the COVID-19 pandemic. The study aimed to identify which model would provide more accurate short-term and long-term predictions, and which model would perform better in handling the increased volatility caused by the pandemic. The findings of the study revealed that the MIDAS model performed better in predicting short-term and long-term volatility before the pandemic, while the MIDAS-GARCH model performed significantly better in handling the increased volatility caused by the pandemic. The study highlights the importance of selecting appropriate models to handle the complexities of real-world data and shows that the choice of model can significantly impact the accuracy of predictions. The practical implications of model selection and explore potential methodological adjustments for future research will be highlighted and discussed.

Keywords: GARCH-MIDAS, MIDAS, Crude Oil, Gold, Covid-19, Volatility.

Modeling of a Stewart Platform for Analyzing One Directional Dynamics for Spacecraft Docking Operations

Leonardo Herrera, Shield B. Lin, Stephen J. Montgomery-Smith

Abstract— A one-directional dynamic model of a Stewart Platform was developed to assist NASA in analyzing the dynamic response in spacecraft docking operations. A simplified mechanical drawing was created, capturing the physical structure's main features. A simplified schematic diagram was developed in a lumped mass model from the mechanical drawing. Three differential equations were derived according to the schematic diagram. A Simulink diagram was created using MATLAB to represent the three equations. System parameters, including spring constants and masses, are derived in detail from the physical system. The model can be used for further analysis via computer simulation in predicting dynamic response in its main docking direction, i.e., up-and-down motion.

Keywords— Stewart platform, docking operation, spacecraft, spring constant.

I. INTRODUCTION

A Stewart platform is a type of parallel manipulator that has six prismatic actuators attached in pairs to three positions on the platform's baseplate. All connections between actuators and baseplate are made of universal joints. Devices placed on the top plate can be moved in six degrees of freedom in which it is possible for a freely-suspended body to move in three linear directions, i.e., lateral, longitudinal, and vertical, and in three rotations, i.e., roll, pitch, and yaw.

The specialized layout was first used by V. Eric Gough, the design was later published in a 1965 paper by D. Stewart on the United Kingdom Institution of Mechanical Engineers [1]. Stewart platform are also known by other names. It is sometimes called a six-axis platform or six-degree-of-freedom platform. It may also be referred to as a synergistic motion platform due to the mutual interaction between the way that the actuators are programmed.

Hardware simulators has been used to simulate docking operations for spacecraft for the past sixty years. In 1964, Langley Research Center in the USA established a docking simulator [2]. In 1971, former USSR designed a docking

simulator that has been employed to the test of APAS-89 docking mechanism [3]. Europe Space Bureau began to research and develop a docking mechanism for unmanned spacecraft in the 1980's. About the same time, Japan developed a docking operation test system in the on-orbit docking of ETS-7 unmanned spacecraft [4]. China began manned space program in 1990's and developed an integrated testing system for docking mechanism by Harbin Institute of Technology and Shanghai Space Bureau in 2000's [5].

NASA Johnson Space Center (JSC) in Houston, Texas, USA built a Stewart Platform in its lab as shown in Fig. 1. It is a parallel manipulator that has six actuators, three pairs attached on its base crossing over to three mounting points on the top plate. With six actuators, the platform can move in six degrees of freedom: back/forward, left/right, up/down, pitch, yaw, and roll. Due to its capabilities, it has many applications on the field with one being docking for spacecraft.

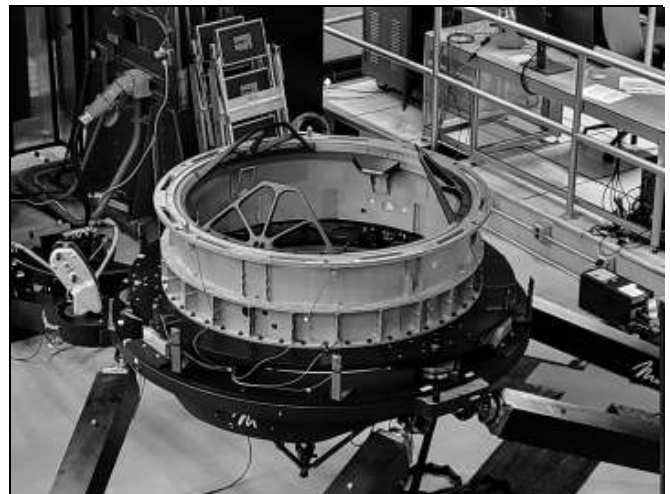


Fig. 1 A Stewart Platform Setup at NASA Johnson Space Center

II. MECHANICAL MODEL OF STEWART PLATFORM

Based on the physical structure of the Stewart Platform, a simplified mechanical drawing was created to capture the main

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figure along with major masses and joint mechanisms as shown in Fig. 2.



Fig. 2 Simplified Stewart Platform Mechanical Drawing

The goal of this task is to derive and study a one directional dynamic motion, in up-and-down direction, of the Stewart Platform to investigate its response for docking tests. A further simplified schematic diagram is drawn in Fig. 3 to represent the Stewart Platform’s motion in up-and-down direction. Lumped mass model is implemented into the schematic diagram as shown in Fig. 3. Flexible mechanical components were identified as spring elements and rigid mechanical components were identified as masses provided, they do carry significant quantity of masses. For those spring elements which have non-negligible masses, since not all of the spring’s length moves at the same velocity, its kinetic energy is not equal to $\frac{1}{2}mv^2$. As such, m cannot be simply added to the adjacent mass to determine the dynamic behavior. An effective mass of the spring element is calculated that needs to be added to the adjacent mass to correctly predict the behavior of the system [6].

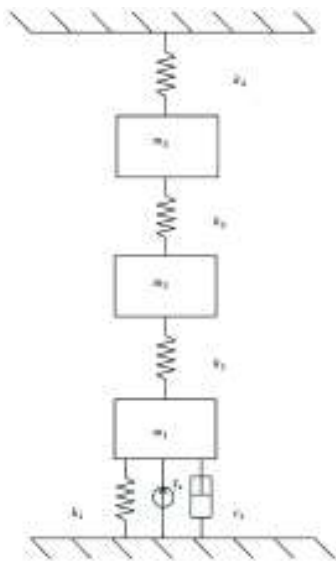


Fig. 3 Schematic Diagram of Lumped Mass Model

Table 1 summarizes the definitions of the parameters used

in the schematic diagram in Fig. 3.

TABLE I
DEFINITIONS OF PARAMETERS IN SCHEMATIC DIAGRAM

Variable	Definition
m_1	Combined mass of actuators, platform, and force-moment sensors.
m_2	Combined mass of load Ring, short I-beam, and long I-beam.
m_3	Combined mass of crossbeam and coil spring.
k_1	Combined lumped parameter stiffness of actuators (bending and compression)
k_2	Force-Moment sensors vertical stiffness.
k_3	Lumped parameter stiffness of crossbeam (bending)
k_4	Coil spring stiffness
c_1	Combined viscous damping coefficient from upper and lower ball joints and lead screw.
F_a	Combined force (vertical component) from linear actuators

Three differential equations were derived from the schematic diagram as shown in the following:

$$\begin{aligned} m_1 \ddot{x}_1 + c_1 \dot{x}_1 + k_1 x_1 + k_2(x_1 - x_2) &= F_a \\ m_2 \ddot{x}_2 + k_2(x_2 - x_1) + k_3(x_2 - x_3) &= 0 \\ m_3 \ddot{x}_3 + k_3(x_3 - x_2) + k_4 x_3 &= 0 \end{aligned}$$

Its state space representation can be shown as:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -a/m_1 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} -b/m_1 & c/m_1 & 0 \\ d/m_2 & -e/m_2 & f/m_2 \\ 0 & g/m_3 & -h/m_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} F_a/m_1 \\ 0 \\ 0 \end{bmatrix}$$

Using the set of equations, a Simulink Diagram in MATLAB was constructed in Fig.4.

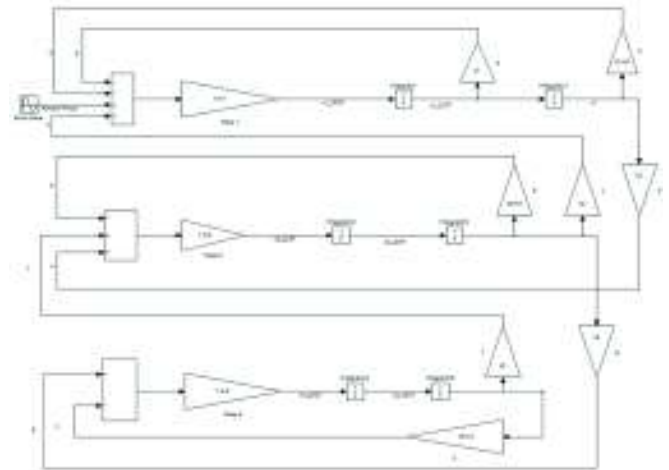


Fig. 4 Simulink Diagram of the Lumped Mass Model

III. CALCULATION OF STIFFNESS VALUES

The six “legs” of the Stewart Platform are called actuators since they contain an AC motor in each of the legs. When in contact, Actuator lower sphere center to upper sphere center

distance is 4199.43 mm. Angle with respect to horizontal, θ , is 51.70° as shown in Fig. 5. The material of all the parts mention in this section is SAE 6150 Alloy Steel which has a Young's Modulus of 200 GPa.



Fig. 5 Actuator Configuration

The actuator consists of several components as shown in Fig. 6, which can be analyzed individually.

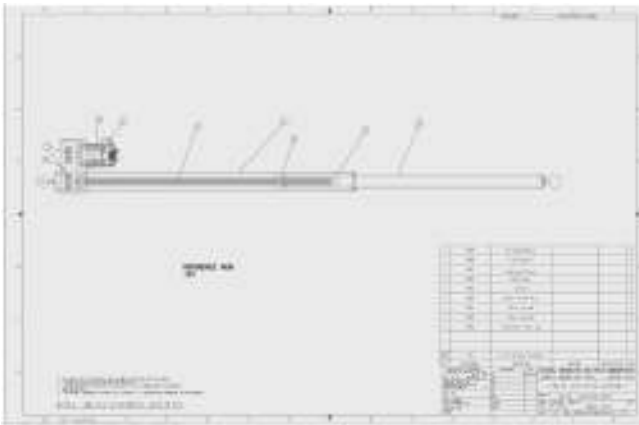


Fig. 6 Components in the Actuator

Actuator Spring Constant in Axial Direction

The spring constant of the right portion in the actuator, called "top cylinder" is calculated as:

$$k_{TopCyl,comp} = \frac{EA}{L} = \frac{200 \times 10^9 Pa \times \pi \times (0.0316 m)^2}{4 \times 0.0277 m} = 5.66 \times 10^9 N/m$$

The shaft is a circular tube; thus, the spring constant can be calculated as:

$$k_{shaft,comp} = \frac{EA}{L} = \frac{200 \times 10^9 Pa \times \pi \times [(0.1016 m)^2 - (0.0762 m)^2]}{4 \times 2.064 m} = 3.44 \times 10^8 N/m$$

The spring constant of the lead screw was calculated using the outer diameter of the threads in the cross-sectional area:

$$k_{ls,comp} = \frac{EA}{L} = \frac{200 \times 10^9 Pa \times \pi \times (0.063 m)^2}{4 \times 0.0944 m} = 6.60 \times 10^9 N/m$$

The spring constant of the connecting cylinder for the ball joint and its housing is calculated as:

$$k_{BottomCyl,comp} = \frac{EA}{L} = \frac{200 \times 10^9 Pa \times \pi \times (0.0316 m)^2}{4 \times 0.0277 m} = 5.66 \times 10^9 N/m$$

Several components in the actuator are considered as rigid, such as ball joints, nuts, etc. Their spring effects are neglected from the spring constant calculations. The four spring constants calculated in the actuator are connected in series; thus the equivalent lumped stiffness, k_{eq} , can be obtained by the equation:

$$\frac{1}{k_{eq}} = \frac{1}{k_1} + \frac{1}{k_2} + \dots + \frac{1}{k_n}$$

Use the four spring constants obtained earlier, we yielded the equivalent spring constant along the actuator axis direction:

$$k_{eq,comp} = 2.93 \times 10^8 \frac{N}{m}$$

Actuator Spring Constant in Bending Direction

The lumped parameter stiffness of the cylinder in between the upper ball joint and the shaft is calculated as:

$$k_{TopCyl,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{\pi d^4}{64}$$

$$k_{TopCyl,bend} = \frac{12 \times 200 \times 10^9 Pa \times \pi \times (0.0316 m)^4}{64 \times (0.0277 m)^3} = 5.513 \times 10^9 N/m$$

The length of the shaft where it is hollow, no nut, is 2.035m.

$$k_{shaft,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{1}{2} \pi (R_2^2 - R_1^2) (R_2^2 + R_1^2)$$

$$I_z = \frac{1}{2} \pi [(0.0508 m)^2 - (0.0381 m)^2] [(0.0508 m)^2 + (0.0381 m)^2]$$

$$I_z = 7.1511 \times 10^{-6} m^4$$

$$k_{shaft,bend} = \frac{12 \times 200 \times 10^9 Pa \times (7.1511 \times 10^{-6} m^4)}{(2.035 m)^3} = 2.03653 \times 10^6 N/m$$

The section where the nut is inside the shaft is can be approximated as a solid cylinder with the diameter of the shaft.

$$k_{NutShaft,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{\pi d^4}{64}$$

$$k_{NutShaft,bend} = \frac{12 \times 200 \times 10^9 Pa \times \pi \times (0.1016 m)^4}{64 \times (0.029 m)^3} = 5.147 \times 10^{11} N/m$$

The part where the nut is on the lead screw can also be approximated as a solid cylinder with diameter of the nut.

$$k_{LS/Nut,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{\pi d^4}{64}$$

$$k_{LS/Nut,bend} = \frac{12 \times 200 \times 10^9 Pa \times \pi \times (0.092 m)^4}{64 \times (0.089 m)^3} = 1.197188 \times 10^{10} N/m$$

The lead screw itself would have a lumped parameter stiffness as:

$$k_{LS,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{\pi d^4}{64}$$

$$k_{LS,bend} = \frac{12 \times 200 \times 10^9 Pa \times \pi \times (0.063 m)^4}{64 \times (1.477158 m)^3} = 5.75788 \times 10^5 N/m$$

The housing can be assumed as rigid.

The stiffness of the cylinder where it connects the housing to the lower sphere is the same as the upper cylinder:

$$k_{BottomCyl,bend} = \frac{12EI_z}{L^3}$$

$$I_z = \frac{\pi d^4}{64}$$

$$k_{BottomCyl,bend} = \frac{12 \times 200 \times 10^9 Pa \times \pi \times (0.0316 m)^4}{64 \times (0.0277 m)^3} = 5.513 \times 10^9 N/m$$

Since the components are connected in series, the equivalent bending spring constant for the actuator can also be calculated using series equation which yielded:

$$k_{eq,bend} = 4.48786 \times 10^5 \frac{N}{m}$$

Combined Actuator Spring Constant in Y-Direction

The springs can be separated into their y-components using the angle θ since the force is being applied vertically. Figure 7 illustrates how the springs can be converted to their y-components.

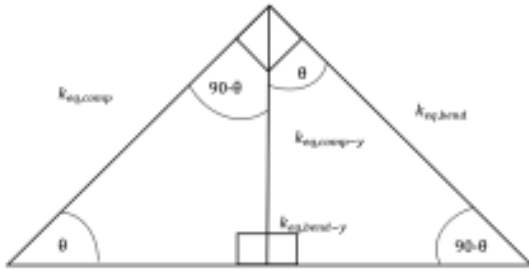


Fig. 7 angle relation between bending and compression

The spring effect projects to the vertical, i.e., y direction, can be calculated as:

$$k_{eq,comp-y} = k_{eq,comp} \times \sin(\theta) = 2.9288 \times 10^8 \frac{N}{m} \times \sin(51.7^\circ)$$

$$k_{eq,comp-y} = 2.2984 \times 10^8 \frac{N}{m}$$

Likewise,

$$k_{eq,bend-y} = k_{eq,bend} \times \cos(\theta) = 4.48786 \times 10^5 \frac{N}{m} \times \cos(51.7^\circ)$$

$$k_{eq,bend-y} = 2.78148 \times 10^5 \frac{N}{m}$$

Finally, the spring effects in bending and compression can be combined in series to obtain the stiffness for a single actuator in y-direction as shown in Fig. 8.

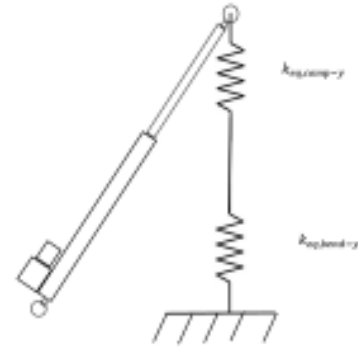


Fig. 8 Stiffness of an actuator in y-direction

$$\frac{1}{k_{1-single}} = \frac{1}{k_{eq,comp-y}} + \frac{1}{k_{eq,bend-y}}$$

$$\frac{1}{k_{1-single}} = \frac{1}{2.2984 \times 10^8 \frac{N}{m}} + \frac{1}{2.78148 \times 10^5 \frac{N}{m}}$$

$$k_{1-single} = 2.77812 \times 10^5 \frac{N}{m}$$

This is for one actuator, since all six actuators are parallel to each other and assumed to be equivalent, they can be combined by simply multiplying by a factor of six.

$$k_1 = k_{1-single} \times 6 = 2.77812 \times 10^5 \frac{N}{m} \times 6 = 1.667 \times 10^6 \frac{N}{m}$$

Spring Constant of Force Sensors

The force moment sensors from ATI are the Omega160 F/T Sensors. From the manufacturer's web page, the stiffness in the vertical axis is $1.2 \times 10^8 \frac{N}{m}$. Since the three F/T sensors are mounted on the same plane, parallel, they can be combined additively.

$$k_2 = 3 \times 1.2 \times 10^8 \frac{N}{m} = 3.6 \times 10^8 \frac{N}{m}$$

Spring Constant of Crossbeam

The material of the I-beam is AL 6061, thus $E = 69 \text{ GPa}$. For a bridge-like system (fixed-fixed beam), the stiffness is as follows:

$$k_t = \frac{192EI_z}{L^3}$$

For an I-Beam, segmenting the I-beam into three rectangles will be the first step in finding the moment of inertia. Next to find the neutral axis (centroid of the beam),

$$\bar{y} = \frac{\sum Y_i A_i}{\sum A_i}$$

Where Y_i is the center of mass of the individual rectangle and A_i is the area of the individual rectangle.

$$A_1 = b_1 \times h_1 = 3.332 \text{ in} \times 0.359 \text{ in} = 1.196188 \text{ in}^2$$

$$A_2 = b_2 \times h_2 = 0.232 \text{ in} \times 5.282 \text{ in} = 1.225424 \text{ in}^2$$

$$A_3 = b_3 \times h_3 = 3.332 \text{ in} \times 0.359 \text{ in} = 1.196188 \text{ in}^2$$

$$\sum A_i = 2 \times 1.196188 \text{ in}^2 + 1.225424 \text{ in}^2 = 3.6178 \text{ in}^2$$

$$Y_1 = h_3 + h_2 + \frac{h_1}{2} = 0.359 \text{ in} + 5.282 \text{ in} + \frac{0.359 \text{ in}}{2} = 5.8205 \text{ in}$$

$$Y_2 = h_3 + \frac{h_2}{2} = 0.359 \text{ in} + \frac{5.282 \text{ in}}{2} = 3 \text{ in}$$

$$Y_3 = \frac{h_3}{2} = \frac{0.359 \text{ in}}{2} = 0.1795 \text{ in}$$

$$\bar{y} = \frac{Y_1 A_1 + Y_2 A_2 + Y_3 A_3}{\sum A_i} =$$

$$\frac{5.8205 \text{ in} \times 1.196188 \text{ in}^2 + 3 \text{ in} \times 1.225424 \text{ in}^2 + 0.1795 \text{ in} \times 1.196188 \text{ in}^2}{3.6178 \text{ in}^2}$$

$$= 3 \text{ in}$$

$$\bar{y} = 3 \text{ in}$$

The parallel axis theorem states:

$$I_{total} = \Sigma(\bar{I}_i + A_i d_i^2)$$

Where \bar{I}_i is the moment of inertia for each rectangle and d_i is the distance from the centroid of an individual rectangle to the centroid of the beam.

Next step is to calculate the moment of inertias for each rectangle,

$$\bar{I} = \frac{1}{12} b h^3$$

$$\bar{I}_1 = \frac{1}{12} b_1 h_1^3 = \frac{1}{12} 3.332 \text{ in} \times (0.359 \text{ in})^3 = 0.012847 \text{ in}^4$$

$$\bar{I}_2 = \frac{1}{12} b_2 h_2^3 = \frac{1}{12} 0.232 \text{ in} \times (5.282 \text{ in})^3 = 2.849062 \text{ in}^4$$

$$\bar{I}_3 = \frac{1}{12} b_3 h_3^3 = \frac{1}{12} 3.332 \text{ in} \times (0.359 \text{ in})^3 = 0.012847 \text{ in}^4$$

The distance in between the centroids is simply:

$$d_1 = |Y_1 - \bar{y}| = |5.8205 \text{ in} - 3 \text{ in}| = 2.8205 \text{ in}$$

$$d_2 = |Y_2 - \bar{y}| = |3 \text{ in} - 3 \text{ in}| = 0 \text{ in}$$

$$d_3 = |Y_3 - \bar{y}| = |0.1795 \text{ in} - 3 \text{ in}| = 2.8205 \text{ in}$$

$$\begin{aligned} I_{total} &= \bar{I}_1 + A_1 d_1^2 + \bar{I}_2 + A_2 d_2^2 + \bar{I}_3 + A_3 d_3^2 \\ &= 0.012847 \text{ in}^4 + 1.196188 \text{ in}^2 \times (2.8205 \text{ in})^2 \\ &\quad + 2.849062 \text{ in}^4 + 1.225424 \text{ in}^2 \times (0 \text{ in})^2 \\ &\quad + 0.012847 \text{ in}^4 + 1.196188 \text{ in}^2 \times (2.8205 \text{ in})^2 \\ &= 21.9066 \text{ in}^4 = 9.1182 \times 10^{-6} \text{ m}^4 \end{aligned}$$

The length of the I-beam is 1.172 m.

$$k_t = \frac{192EI_z}{l^3} = \frac{192 \times 6.9 \times 10^{10} \text{ Pa} \times 9.1182 \times 10^{-6} \text{ m}^4}{(1.172 \text{ m})^3} = 7.5037 \times 10^7 \text{ N/m}$$

Since k_3 was defined as the crossbeam,

$$k_3 = 7.5037 \times 10^7 \text{ N/m}$$

Spring Constant of Coil Spring

The coil spring, which is an adjustable component of the system, for most cases, the spring constant is selected as:

$$k_4 = 50,787 \text{ N/m}$$

IV. MASS VALUES

Mass values were calculated by the CAD software system. After entering material density and component geometry, mass values were obtained in Table II. Noted that Mass 3 included effective mass of Coil Spring k_4 . The mass values of ATI sensors were given by its manufacturer.

TABLE II
MASS VALUES IN SCHEMATIC DIAGRAM

Group	Name	Mass (kg)	Total (kg)
Mass 3	Crossbeam	7.829166	$m_3 = m_{ATI} + m_{Crossbeam} + m_{Coil Spring} = 9.822637933 \text{ kg}$
	Coil Spring	4.82657	
Mass 2	Long I-Beam	8.44277	$m_2 = 221.62487 \text{ kg}$
	Short I-Beam	3.5238	
	Load Ring	209.4599	
Mass 1	3 x ATIs	8.36	$m_1 = 2167.879 \text{ kg}$
	Platform	801.419	
	6 x Actuators	1357.5	

V. MOTOR TRANSFER FUNCTION

The electrical motor in each of the six actuators had unknown characteristics to us. A system identification process was used to obtain its input output relation, i.e., transfer function. Chirp tests allow the user to test a wide range of speed changes of a motor system [7, 8]. The input of our test, a chirp waveform, was a sinusoidal wave with a commanded torque within +/-10 Nm that increased in frequency over time

shown in Fig. 9. The output of the test resulted measured position at the motor encoder as shown in Fig. 10.



Fig. 9 Chirp Test Commanded Torque

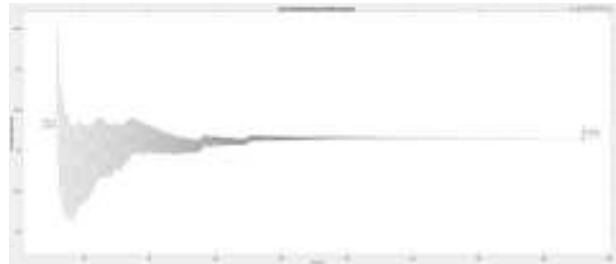


Fig. 10 Chirp Test Motor Encoder Position

Vector Fitting has since its first introduction in 1999 become a widely applied tool for fitting a rational model to frequency domain data [9]. The `vecfit3.m` function, a fast, relaxed vector fitting method, in MATLAB [10] was used to process the motor input/output data. The function computed a rational approximation from the input data in the frequency domain. The resulting model can be expressed in either pole-residue form or state-space form. The pole-residue form of the motor is shown in the following with the coefficients shown in Table III.

$$T(s) = \frac{a_3 s^3 + a_2 s^2 + a_1 s + a_0}{(b_3 s^3 + b_2 s^2 + b_1 s + b_0) s}$$

TABLE III
TRANSFER FUNCTION COEFFICIENTS

Coefficient	Value
a_0	3.789479e+05
a_1	8.5989e+03
a_2	-17.6187
a_3	1.87467e-02
b_0	4.17849e+04
b_1	3.34462e+04
b_2	788.3805
b_3	1

VI. CONCLUSIONS AND RECOMMENDATIONS

A hardware model of the Stewart Platform in a lab at NASA Johnson Space Center was developed. The task resulted a one-directional dynamic model for the purpose of analyzing the up-and-down motions in docking operations. Detailed calculations of spring constants and masses were derived. A system identification process was used to obtain the characteristics of the motor used in the actuators. Damping coefficients in the system can vary due to changes of temperature, surface cleanliness, lubrication condition, force level, etc., and are very

difficult to obtain from calculations. Experimental methods are recommended to obtain suitable damping coefficients. For the future computer simulation tasks, we will assume an initial damping coefficient at the ball joints. The actual value is to be determined through system validation via experimental data.

ACKNOWLEDGMENTS

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Isolation and Characterization of Effective Bacteriophage and Its Endolysin-1252 in Controlling Multiple Serovars of Salmonella Enterica

Debabrata Biswas

Abstract— Salmonella is the most common foodborne pathogen worldwide that causes a large number of hospitalizations, death as well as significant economic loss. Further, due to the overuse of antibiotics, the percentage of antibiotic-resistant Salmonella has been growing rapidly and that warns as a serious healthcare threat specifically effectiveness of antibiotic therapy in gastrointestinal infection. Recent studies show that bacteriophage (phage) could be a promising alternative therapy to replace antibiotics used in animal farming as it can only infect a specific bacteria strain instead of animal cells. This study focuses on discovering novel bacteriophages and expressed its endolysin by which infection with multiple serovars of Salmonella enterica (SE) can be controlled without interfering host gut health and growth. Bacteriophages were isolated and characterized from collected samples from dairy/poultry farms. The lytic ability of isolated phages was evaluated against various serovars of SE using biphasic culture and spot test. The selected phage genomic DNAs were purified and used for next-generation genome sequencing (NGS). The bioinformatics of phages was compared and analyzed by the BLAST and relative analysis software tools. To generate a recombinant beneficial bacterial strain by expressing endolysin, which showed a lytic effect against multiple serovars of SE, specifically Typhimurium and Enteritidis. A new Salmonella bacteriophage SE/1252 was confirmed, which belongs to the genus Duplodnaviria in the order Myoviridae family. The complete genome of phage SE/1252 consists of dsDNA of 244,421 bp in size, with G+C content 48.51% and is 97% to relate to Salmonella bacteriophage SPN3US, Enterobacteria phage SEG1, and Proteus phage 7. The lytic ability of this phage showed highly effective against several SE serovars, including Typhimurium, Enteritidis, Newport, Pullorum, and Gallinarum. A broad-spectrum endolysin-1252 was successfully expressed in BL21 (DE3) E. coli. The qRT-PCR assays confirmed the expression (1.6 folds) of this gene. Using Ni-NTA chromatography, we also verified the molecular weight of Ni-NTA chromatography of the endolysin. These findings indicate that this novel bacteriophage SE/1252 and its endolysin could be a promising antimicrobial for controlling Salmonella colonization in animals.

Keywords— Salmonella, bacteriophage, lytic cycle, lysogenic, food safety.

Synergy and Complementarity in Technology-Intensive Manufacturing Networks

Daidai Shen, Jean Claude Thill, Wenjia Zhang

Abstract— This study explores the dynamics of synergy and complementarity within city networks, specifically focusing on the headquarters-subsidiary relations of firms. We begin by defining these two types of networks and establishing their pivotal roles in shaping city network structures. Utilizing the meso-scale analytic approach of weighted stochastic block modeling, we discern relational patterns between city pairs and determine connection strengths through statistical inference. Furthermore, we introduce a novel community detection approach to uncover the underlying structure of these networks using advanced statistical methods.

Our analysis, based on comprehensive network data up to 2017, reveals the coexistence of both complementarity and synergy networks within China's technology-intensive manufacturing cities. Notably, firms in technology hardware and office & computing machinery predominantly contribute to the complementarity city networks. In contrast, a distinct synergy city network, underpinned by the cities of Suzhou and Dongguan, emerges amidst the expansive complementarity structures in technology hardware and equipment. These findings provide new insights into the relational dynamics and structural configurations of city networks in the context of technology-intensive manufacturing, highlighting the nuanced interplay between synergy and complementarity.

Keywords— City system; complementarity; synergy network.

Financial Modeling for Net Present Benefit Analysis of Electric Bus and Diesel Bus and Applications to NYC, LA, and Chicago

Jollen Dai, Truman You, Xinyun Du, Katrina Liu

Keywords—Financial Modeling, Total Cost Ownership, Net Present Benefits, Electric Bus, Diesel bus, NYC, LA, Chicago.

Abstract— Transportation is one of the leading sources of greenhouse gas emissions (GHG). Thus, to meet the Paris Agreement 2015, all countries must adopt a different and more sustainable transportation system. From bikes to Maglev, the world is slowly shifting to sustainable transportation. To develop a utility public transit system, a sustainable web of buses must be implemented. As of now, only a handful of cities have adopted a detailed plan to implement a full fleet of e-buses by the 2030s with Shenzhen in the lead. Every change requires a detailed plan and a focused analysis of the impacts of the change. In this report, the economic implications and financial implications have been taken into consideration to develop a well-rounded 10-year plan for New York City. We also apply the same financial model to the other cities, LA and Chicago. We picked NYC, Chicago, and LA to conduct the comparative NPB analysis since they all are big metropolitan cities and have complex transportation systems. All three cities have started an action plan to achieve a full fleet of e-bus in the decades. Plus, their energy carbon footprint and their energy price are very different which are the key factors to the benefits from electric buses.

Using TCO (Total Cost Ownership) financial analysis, we developed a model to calculate NPB (Net Present Benefit) /and compare EBS (electric buses) to DBS (diesel buses). We have considered all essential aspects in our model: initial investment, including the cost of a bus, charger, and installation, government fund (federal, state, local), labor cost, energy (electricity or diesel) cost, maintenance cost, insurance cost, health and environment benefit, and V2G (vehicle to grid) benefit. We see about \$1,400,000 in benefits for a 12-year lifetime of an EBS compared to DBS provided the government fund to offset 50% of EBS purchase cost. With the government subsidy, an EBS starts to make positive cash flow in 5th year and can pay back its investment in 5 years. Please remember that in our model, we consider environmental and health benefits, and every year, \$50,000 is counted as health benefits per bus. Besides health benefits, the significant benefits come from the energy cost savings and maintenance savings, which are about \$600,000 and \$200,000 in 12-year life cycle. Using linear regression, given certain budget limitations, we then designed an optimal three-phase process to replace all NYC electric buses in 10 years, i.e., by 2033. The linear regression process is to minimize the total cost over the years and have the lowest environmental cost. The overall benefits to replace all DBS with EBS for NYC is over \$2.1 billion by the year of 2033. For LA, and Chicago, the benefits for electrification of the current bus fleet are \$1.04 billion and \$634 million by 2033. All NPB analyses and the algorithm to optimize the electrification phase process are implemented in Python code and can be shared.

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The Impact of Artificial Intelligence on Sustainable Architecture and Urban Design

Alfons Aziz Asaad Hozain

Abstract— The goal of sustainable architecture is to design buildings that have the least negative impact on the environment and provide better conditions for people. What forms of development enhance the area? This question was asked at the Center for the Study of Spatial Development and Building Forms in Cambridge in the late 1960s. This has resulted in many influential articles that have had a profound impact on the practice of urban planning. This article focuses on the sustainability outcomes caused by the climatic conditions of traditional Iranian architecture in hot and dry regions. Since people spend a lot of time at home, it is very important that these homes meet their physical and spiritual needs as well as the cultural and religious aspects of their lifestyle. In a country as large as Iran with different climates, traditional builders have put forward a number of logical solutions to ensure human comfort. With these solutions, the environmental problems of the have long been solved. Taking into account the experiences of traditional architecture in Iran's hot and dry climate, sustainable architecture can be achieved.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

Impact Load Assessment of Reinforced Concrete

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Abstract

Recently, studying the effect of impact loading has become important in structural design. This is partly due to the impact duration is very short, smaller than a target response time of a structure affecting the integrity and safety of structures under impact loading. Experimental or field test of a structure under impact load is not always an option rather advances in finite element analysis and availability of computational resources make a numerical investigation of a structure under extreme loading such as impact and blast viable and cost-saving.

Keywords: Impact load, Reinforced Concrete, Pole, Transformer seat

Specific Objectives

- Investigate the effect of impacting speed, impacting weight, and concrete strength against impact loading response of RC transformer seater.
- To assess failure mode of the transformer seat, damage, and crack propagation of reinforced concrete pole-mounted transformer seater.
- Offer recommendations to Ethiopian Electric Utility Authority about impact loading performance of pole-mounted RC transformer seater

Significance

1. Structural engineers and designers update their knowledge by showing the effect of impact load on RC pole-mounted transformer seats.
2. To have better attention given for RC pole-mounted transformer seat its performance under impact load.
3. It will increase the knowledge of researchers about RC pole-mounted transformer seat its response and failure mechanism due to impact load

Methodology

The following section outlines the process and results of the finite element modeling of the impact load RC transformer seat simulations. These simulations are an efficient and cost-effective way of studying the impact response of RC transformer seats. In numerical

finite element analysis investigation, both the structure and the properties of the materials have to be idealized for numerical analysis. Assessment procedures can be model-based assessments. To evaluate the impact of different parameters, such as impact weight, impact speed, and concrete compressive strength, and LS DYNA analysis has been conducted.

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The Microstructural Properties of Expansive Soil

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Abstract

The purpose of this study was to determine the experimental investigation on the microstructural properties of expansive soil stabilized with corncob ash expansive soil at providing experimental in sights on the engineering properties of expansive soils stabilized with corncob ash (CCA) to ascertain its suitability varying ratio and UCS, considering CCA contents, varying from 0%,4%,8%,12%, 16% and 20% were carried out by dry weight of the soil. CCA have been frequently employed to reduce the swelling potential of expansive soil, Laboratory experiments scanning electron microscopy(SEM), and X-ray diffraction (XRD). were used in this study to investigate the stabilizing corncob ash on expansive soil.

Keywords: Expansive soil, Corncob Ash, scanning electron microscopy and X-ray diffraction.

Objectives

- .To determine the characterization of corncob ash
- To determine Atterberg limits ,Hydrometer indices, free swell, Linear shrinkage and specific gravity.
- To determine the compaction characteristics OMC and MDD.
- To determine the strength UCS and CBR.

Significance of the study

The presence of expansive clays causes in adequate strength for the building and pavement construction it encourage the use of locally available material for road construction having low plasticity and higher CBR value for effective utilization of material without wasting the original material . The study investigates of microstructural and strength of clayey soil to examine the strength characteristics were determined control the shrink-swell of soil, increasing the bearing capacity of a sub-grade to support pavements and foundation, reduce free swell index and minimize the waste disposal problem.

Metodology

Experimental investigation on the microstructural properties of expansive soil stabilized with corncob Ash. This research aims at providing experimental in sights on the engineering properties of expansive soil stabilized with corncob ash

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Finite Element Analysis of Reinforced Structural Walls

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Abstract

Reinforced concrete structural walls are provided in structures to decrease horizontal displacements under seismic loads. Cyclic lateral load resistance capacity of structural wall is controlled by two parameters, the strength and the ductility; it is better to have the shear strength somewhat greater than the compression to prevent shear failure, which is brittle, sudden and of serious consequence. Due to the architectural and functionality reasons, small openings are providing in this important structural part. The main objective of this study is to investigate the finite element of RC structural walls with small openings subjected to cyclic load using finite element approach. The experimental results in terms of load capacity, failure mode, crack pattern, flexural strength, shear strength, deformation capacity.

Keywords: *ABAQUS, Finite Element Method, Small Openings, Reinforced Concrete Structural Walls.*

Objectives

- To assess the effect of small opening size, location and pattern on the load-carrying capacity of reinforced concrete structural wall in as-built condition
- To verify load capacity, failure mode, crack pattern, flexural strength, shear strength, deformation capacity, strain distribution and lateral displacement of structural wall with and without openings
- To investigate the stress-distribution of structural wall around the opening in order to identify the points of higher stress accumulation and stress pattern in structural walls.

Significance

- Structural engineers and designers by showing the effects of small opening and location of openings on the seismic performance of RC structural walls.

- Useful for improving existing design models and to be applied practice, as it satisfies both architectural and structural requirements.
- It will increase the knowledge of researchers about the seismic performance of RC structural wall with different location and small opening.

Research Methodology

Numerical simulations are important to validate with test results. In this study, the numerical simulations are presented by making F.E models of walls under cyclic load and axial load conditions through the commercial software ABAQUS. The F.E models take the non-linear inelastic response of the walls into account, and applied displacement controls to the wall specimens to find the failure stages of the walls under specified load conditions.

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Water Temperature on Early Age Concrete Property

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Abstract

The long-term performance of concrete structures is affected by the properties and behavior of concrete at an early age. However, the fundamental mechanisms affecting the early-age behavior of concrete have not yet been fully studied. The effect of water temperature on concrete is not sufficiently studied and at the same time majority of studies focused on mixing water temperature on workability and mechanical properties of concrete, however, the researchers showed that the effect of mixing water temperature on plastic shrinkage cracking of concrete is not studied yet

Keywords: Water Temperature, Early Age Concrete Strength, Mechanical Properties of Concrete

Specific Objectives

To investigate the optimum degree of water temperature used to make concrete mix.

- To study the effect of water temperature on plastic shrinkage cracking.
- To study the effect of water temperature on early age mechanical properties of concrete.
- To study the effect of water temperature on the workability of concrete.

Significance of the Study

Researchers and practitioners can potentially benefit from the output of this research work. Among other things,

- It will increase awareness of practicing in the field of material engineering on the importance of mixing water temperature on concrete properties.
- To know the optimum water temperature used to mix concrete without affect workability.
- To have better attention given for mechanical properties of early age concrete that may affect long term strength and durability due to mixing water temperature.
- To gain an understanding of the maximum effect of water temperature on plastic shrinkage cracking.

Methodology

The materials used in the study are aggregates, cement, and water. Major physical tests of concrete at fresh and hardened states were done to study the effect of water temperature on early age concrete properties.

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Public Transport Assignment at Adama City

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Abstract

Adama city having an area of 29.86km² is one of the main cities in Ethiopia experiencing rapid growth in the business and construction activities which in turn with an increasing number of vehicles with an alarming rate. For this reason, currently there is an attempt to develop public transport assignment modelling in the city. Still there is a huge gap in developing public transport assignment along the road segments of the city with operational and safety performance due to high traffic volume. Thus, the introduction of public transport assignment modelling in Adama city can have a massive impact on the road safety and capacity problem in the city. The city transport modelling is important in a city transportation planning particularly to overcome the existing transportation problems such as traffic congestion. In this study, Adama City transportation model developed using the PTV VISUM software whose transportation modelling is based on the four-step model of transportation. Based on the traffic volume data fed and simulated, the result of the study shows that the developed model has better reliability in representing the traffic congestion conditions in Adama city and the simulation clearly indicates the level of congestion of each route selected and thus, the city road administrative office can take managerial decisions on public transport assignment so as to overcome traffic congestion executed along the selected routes.

Keywords: Trip modelling, PTV VISUM, public transport assignment, Congestion.

Objectives

The main objective of the study is to model public transport assignment in Adama city using PTV VISUM along the selected major routes.

Specific Objective

The Specific objectives of the study are:

- To analyse the public transport along the selected routes;
- To evaluate the quantitative performance parameters of the selected routes and
- To evaluate the qualitative performance parameters of the selected routes

Significance of the Study

Nowadays public modes of transport users in Adama city are increasing from time to time, even though public modes of transport allocated so far for the city is low associated with poor infrastructures such as road standards, drainage facilities, walkways and the like. Adama city is also a hub of transportation for the surrounding zones to east shoa like Hararghe zones, Arsi zone, West Arsi zone, Bale zone and

neighbouring town and cities like chiro town, Asella town, Zuway city, Shashemane city and Bishoftu city.

Research Methodology

The approach in this research involves inspection of the study area at the office and field level and various methods and techniques used for data collection and analysis. The study's methodology also required various materials and methods to achieve the specified goals. In order to resolve the research issue, this section of the thesis, therefore, addresses the methodology followed and the rationale for choosing the methods.

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Coupled Field Formulation – A Unified Method for Formulating Structural Mechanics Problems

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Abstract

Engineers create inventions and put their ideas in concrete terms to design new products. Design drivers must be established, which requires, among other things, a complete understanding of the product design, load paths, etc. For Aerospace Vehicles, weight/strength ratio, strength, stiffness and stability are the important design drivers. A complex built-up structure is made up of an assemblage of primitive structural forms of arbitrary shape, which include 1D structures like beams and frames, 2D structures like membranes, plate and shell structures, and 3D solid structures. Justification through simulation involves a check for all the quantities of interest, namely stresses, deformation, frequencies, and buckling loads and is normally achieved through the finite element (FE) method. Over the past few decades, Fiber-reinforced composites are fast replacing the traditional metallic structures in the weight-sensitive aerospace and aircraft industries due to their high specific strength, high specific stiffness, anisotropic properties, design freedom for tailoring etc. Composite panel constructions are used in aircraft to design primary structure components like wings, empennage, ailerons, etc., while thin-walled composite beams (TWCB) are used to model slender structures like stiffened panels, helicopter, and wind turbine rotor blades, etc. The TWCB demonstrates many non-classical effects like torsional and constrained warping, transverse shear, coupling effects, heterogeneity, etc., which makes the analysis of composite structures far more complex. Conventional FE formulations to model 1D structures suffer from many limitations like shear locking, particularly in slender beams, lower convergence rates due to material coupling in composites, inability to satisfy, equilibrium in the domain and natural boundary conditions (NBC) etc. For 2D structures, the limitations of conventional displacement-based FE formulations include the inability to satisfy NBC explicitly and many pathological problems such as shear and membrane locking, spurious modes, stress oscillations, lower convergence due to mesh distortion etc. This mandates frequent re-meshing to even achieve an acceptable mesh (satisfy stringent quality metrics) for analysis leading to significant cycle time. Besides, currently, there is a need for separate formulations (u/p) to model incompressible materials, and a single unified formulation is missing in the literature. Hence coupled field formulation (CFF) is a unified formulation proposed by the author for the solution of complex 1D and 2D structures addressing the gaps in the literature mentioned above. The salient features of CFF and its many advantages over other conventional methods shall be presented in this paper.

Keywords: Coupled Field Formulation, Kinematic Coupling, Material Coupling, Locking Free Formulation.

Ant-Tracking Structural Attribute: A Model for Understanding Production Response

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Abstract

Ant Tracking seismic attribute applied over 4-seconds seismic volume revealed structural features triggered by clay diapirism, growth fault development, rapid deltaic sedimentation and intense drilling. The attribute was extracted on vertical seismic sections and time slices. Mega tectonic structures such as growth faults and clay diapirs are visible on vertical sections with obscured minor lineaments or fractures. Fractures are distinctively visible on time slices yielding recognizable patterns corroborating established geologic models. This model seismic attribute enabled the understanding of fluid flow characteristics and production responses. Three structural patterns recognized in the field include: major growth faults, minor faults or lineaments and network of fractures. Three growth faults mapped on seismic section form major deformation bands delimiting the area into three blocks or depocenters. The growth faults trend E-W, dip down-to-south in the basin direction, and cut across the study area. The faults initiating from about 2000ms extended up to 500ms, and tend to progress parallel and opposite to the growth direction of an upsurging diapiric structure. The diapiric structures form the major deformational bands originating from great depths (below 2000ms) and rising to about 1200ms where series of sedimentary layers overlapped and pinchout stratigraphically against the diapir. Several other secondary faults or lineaments that form parallel streaks to one another also accompanied the growth faults. The fracture networks have no particular trend but form a network surrounding the well area. Faults identified in the study area have potentials for structural hydrocarbon traps whereas the presence of fractures created a fractured-reservoir condition that enhanced rapid fluid flow especially water. High aquifer flow potential aided by possible fracture permeability resulted in rapid decline in oil rate. Through the application of Ant Tracking attribute it is possible to obtain detailed interpretation of structures that can have direct influence on oil and gas production.

Keywords— seismic, attributes, production, structural.

Software Verification of Systematic Resampling for Optimization of Particle Filters

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Abstract—Systematic resampling is the most popularly used resampling method in particle filters. This paper seeks to further the understanding of systematic resampling by defining a formula made up of variables from the sampling equation and the particle weights. The formula is then verified via SPARK, a software verification language. The verified systematic resampling formula states that the minimum/maximum number of possible samples taken of a particle is equal to the floor/ceiling value of particle weight divided by the sampling interval, respectively. This allows for a creation of a randomness spectrum that each resampling method can fall within. Methods on the lower end e.g. systematic resampling have less randomness, thus, are quicker to reach an estimate. Although, lower randomness allows for error by having a larger bias towards the size of the weight; having this bias creates vulnerabilities to the noise in the environment e.g. jamming. Conclusively, this is the first step in characterizing each resampling method. This will allow target-tracking engineers to pick the best resampling method for their environment instead of choosing the most popularly used one.

Index Terms—CDF, Particle Filter, Systematic Resampling, SPARK

I. INTRODUCTION

Target-tracking is a popular area of interest in both the military and commercial industries. It has a wide spectrum of uses, ranging from air surveillance to bio-medical research. Particle filters (PF) are a versatile type of target-tracking algorithm that is typically used in advanced guidance, navigation, or control systems. PFs are one of the few tracking algorithms that can handle non-linear/non-Gaussian dynamic system models. In addition, PFs are easily implemented in parallel, which allows for extremely fast computation. Conversely, a PF's performance is heavily reliant on what resampling method is chosen e.g. systematic, stratified, multinomial, residual resampling. Thus, as the use of PFs becomes more prevalent, so does the research on what resampling method best optimizes the PF algorithm with respect to the environment it is operating in.

In this paper, we dive deep into how systematic resampling works by creating a formula that characterizes the output, then utilize a software verification language to prove that the formula holds true for all possible data inputs. The software verification language used is SPARK, which is specifically designed to ensure that tested software can be deployed in systems where high reliability is required. Additionally, this paper seeks to provide a methodology for characterizing and

verifying resampling methods. This will assist target-tracking engineers in determining which resampling method will best fit the system being designed, allowing for more efficient use of PFs.

II. BACKGROUND

A. Particle Filter Resampling

Particle filters use Bayesian theory to create a probability model from a system's previous state to estimate the next state of the system. Particle filters are usually used for tracking objects in space [1]. At time-step 0, the particles are placed randomly in space, each representing a location. As time progresses, each particle converges to the estimated true location of the object being tracked. A general nonlinear and non-Gaussian system can be represented by:

$$x_k = f(x_{k-1}, u_k) \quad (1)$$

$$z_k = h(x_{k-1}, n_k) \quad (2)$$

where x_k represents the state of the system at time step k , u_k is the Gaussian process noise, f is the systems function to propagate the state to the next time-step, z_k represents the system's measurement at time step k , n_k is the Gaussian measurement noise and h is the measurement function.

Each particle in a particle filter has a state defining it. The state (1) is used recursively, along with the measurements (2) to predict the next state i.e. the posterior [2]. In addition, a weight is assigned to each particle to provide a confidence level for that particle being at the target's true location. The cumulative distribution function (CDF) for the weights can be expressed as:

$$F(x = N) = \sum_{i=0}^N \omega_k^i \quad (3)$$

In (3), $F(x)$ is the cumulative distribution function, ω_k^i represents the i th particle's weight at time step k , and N is the total number of particles. The CDF (3) is used in the resampling of the weights.

The purpose of a resampling method is to maintain the same number of particles while replacing small particles with a copy of large particles [3]; the size of the particle is equal to the weight. For example, consider a particle

Input

 Number of Particles: N

 Particle Weights Array: $\omega = [\omega_0, \omega_1, \omega_2, \dots, \omega_{N-1}]$

 Systematic Sampling Array: $u = [\alpha, \frac{1}{N} + \alpha, \frac{2}{N} + \alpha, \dots, \frac{N-1}{N} + \alpha]$
Output

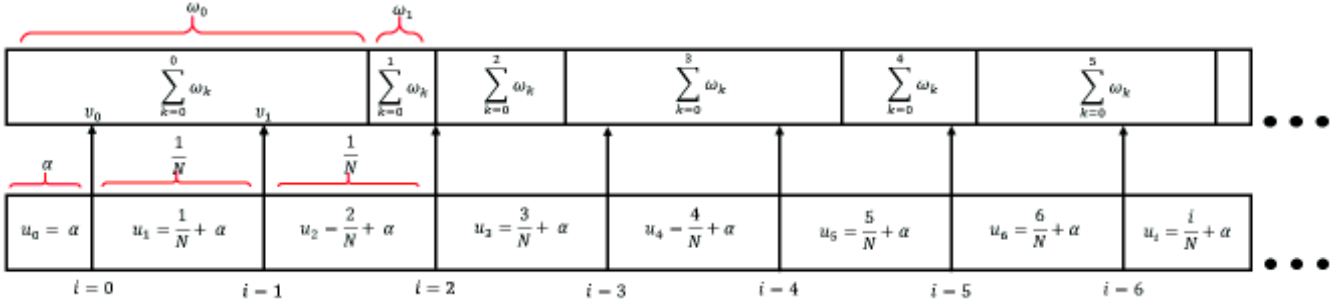
 Indexes of Particles Sampled: $v = [0, 0, 1, 3, 3, 4, 5, \dots, v_{N-1}]$


Fig. 1. Systematic Resampling

array of $p = [p^1, p^2, p^3, p^4, p^5]$ with respective weights of $\omega = [.1, .2, .5, .1, .1]$. A likely resampling result would be $v = [1, 2, 2, 2, 4]$, where each value in v is the index of a sampled particle. Lastly, v is used to mask the prior particle array into the new resampling version: $p = [p^2, p^3, p^3, p^3, p^5]$. Notice that p^1 and p^4 were replaced with a copy of p^2 and p^3 . Furthermore, the weights array is reset to a normalized distribution $\omega = [.2, .2, .2, .2, .2]$. The weights array will change over time until the resampling threshold is crossed. Figure 1 gives a visual representation of how systematic resampling chooses the next set of particles from the CDF of the weights. Each arrow represents a sample, and the total number of samples is equal to N [4]–[6].

$$\alpha_i \in (0, \frac{1}{N}] \quad (4)$$

$$u_i = \frac{i}{N} + \alpha \quad i \in [0, N-1] \quad (5)$$

The most popularly used resampling method is systematic resampling (SR) [7], [8]. The formula for SR is (5), additionally, a visual representation of how SR works is shown in Figure 1. SR is made up of a fixed interval, $1/N$, and a random offset, α , as shown in (5). The offset ranges between $(0, 1/N]$ and is where the first sample will be taken. Furthermore, every sample after the first is taken $1/N$ apart. In Figure 1, the α is estimated to be around $1/2N$. The SR algorithm compares the value of u_0 to CDF_0 , if CDF_0 is larger or equal to u_0 then it will store the index of that particle weight i.e. $v_0 = 0$. In this case, $u_0 = \alpha \approx 1/2N$, which is less than $CDF_0 \approx 2.2/N$, thus, $v_0 = 0$. The next sample will be $1/N$ away from the first sample i.e. $u_1 = 1/N + \alpha$. u_1 is still smaller than $CDF_0 \approx 2.3/N$, thus, $v_1 = 0$. The next sample will be $1/N$ away from the previous sample but this time it is larger than CDF_0 , so the weight index will be iterated and the comparison will now happen between $CDF_1 \approx .3/N + \omega_0$ and $u_2 = 2/N + \alpha$. This time CDF_1 is larger than u_2 , thus,

$v_1 = 1$. This comparison continues until u_{N-1} , where the total number of samples taken is equal to N .

B. Adacore: SPARK

SPARK is a programming language derived from Ada that serves the purpose of verifying software. SPARK has a verification tool built into it, it performs analysis on code in two distinct stages: Flow analysis and proof verification. During the first stage, data initialization and flow are checked for any discrepancies or inefficiencies i.e. unnecessary code. The second stage will check for run-time errors and then follow the user-defined contracts of the code that, when verified, deem the code functionally correct. The user-defined contracts in this paper are pre/post-conditions, which are conditions that the user states need to be met prior to running a function, and conditions that need to be met after a function has been run, respectfully. These pre/post-conditions are checked with the left of sub-contracts within the function such as loop invariants and variants. Loop invariants/variants are sub-contracts inside of a loop that assists the compiler in understanding what is supposed to happen within the loop. [9], [10]

There are multiple levels to SPARK verification and each level is retroactive: stone, bronze, silver, gold, and platinum. Stone means that SPARK accepted the code, as SPARK is a stringent derivation of Ada. Bronze means that the first stage of flow analysis was passed. Silver means that no run-time errors were encountered. Gold means that the user-defined proofs were verified, thus, the code was deemed functionally correct. Platinum means that the code was able to meet a software doctrine that is intended for a specific use e.g. DO-178C, which applies to Airborne Systems and Equipment [9]. The purpose behind having a software-level system in SPARK is not only to give a measurement to the verification achieved but also to follow in correspondence to the software integrity levels in the doctrines mentioned above. Most doctrines will have a level that is analogous to the effect the software has on the entire system e.g. a program may be considered level E and require a bronze verification if it has no effect on the

aircraft. Conversely, a program may be considered level A and require a gold or platinum verification if it has a direct effect on the aircraft. [11]–[14]

III. VERIFYING SYSTEMATIC RESAMPLING IN SPARK

The verification of SR is divided into three distinct sections. The first section explains the process of converting the weights and SR formulas from continuous to discrete. The second section is the definition of the formula that will encompass the output of SR. The third section uses SPARK to prove that the formulas defined in the first section always hold true.

A. Continuous to Discrete Conversion

It is significantly easier and more efficient to verify algorithms in the discrete domain instead of the continuous domain. This is due to the rounding error from summing floats.

$$\Omega_k^i = \lfloor \sigma N \omega_k^i \rfloor \quad (6)$$

$$\sigma \gg 1 \quad (7)$$

The probability that the i th particle at time step k is the true location of the target is ω_k^i . In order to find the weight of a particle it must be normalized for every time step which requires the summation of N weights. The summation process combined with the innate rounding in computers results in the weights not abiding by the rules of a *CDF* function i.e. the final value of the *CDF* does not always equal 1. This error creates difficulties when verifying software because SPARK is aware of this innate rounding error and will not all checks such as $CDF[-1] = 1$ to pass. A solution to the rounding error is converting the continuous weight values to discrete weight values. First, the value of the weight must be conserved, that is why in (6) ω_k^i is multiplied by a very large number σ before converting to the floor value of the weight. In addition, the weight is multiplied by the number of particles, N , for simplicity purposes when converting the sampling array U .

$$A_i = \lfloor \sigma N \alpha_i^{float} \rfloor \in [1, \sigma] \quad (8)$$

$$\begin{aligned} U_i &= \lfloor \sigma N u_i \rfloor \\ &= \sigma i + A_i \end{aligned} \quad (9)$$

As shown in (9), the multiplication of N during the continuous to discrete conversion allows for further simplification. Now, the sampling interval is equal to σ instead of $1/N$ in the continuous domain version (5). Additionally, all future mentions of Ω^i in this paper will be regards to the current time step making the subscript of k no longer necessary. In the next section, a formula bounding the range of SR's output will be created using the discrete sampling and weight formalms.

B. Formula Definition

In order to utilize SPARK for the purpose of proving that SR works the way it is intended, a formula must be defined that represents what it does. The process is not as simple as plugging the SR formula into SPARK and verifying it is correct, this would just restate what has been coded. A meaningful verification will include variables from the weights array and sampling array formulas. Over time, the purpose behind any resampling method in particle filters is to increase the number of particles that reside in an area close to a target and decrease the number of particles that reside in an area that is not close to the target. The only difference between each resampling method is the way they pick samples. SR combines a fixed sampling interval along with a random offset. Thus, if given the same data set and ran multiple times the outputs will rarely be the same. Fortunately, there is still a rule that remains consistent:

The maximum and minimum number of samples that can be taken of a particle is proportional to the weight of the particle.

Due to this observation, Table 1 can be formed:

Range of Weights ω_i	Possible Number of Samples
$\sigma - 1 \geq \Omega_i \geq 1$	[0, 1]
$2\sigma - 1 \geq \Omega_i \geq \sigma$	[1, 2]
$3\sigma - 1 \geq \Omega_i \geq 2\sigma$	[2, 3]
...	...

TABLE I
WEIGHT AND SAMPLE RANGES

Since the distance between each sample is σ the ranges in column 2 were able to be calculated. Additionally, Column 1 can be changed from a range to a value For example, the value of $\frac{\sigma - 1}{\sigma}$ and $\frac{1}{\sigma}$ are both 0 since there are no remainders with an integer divide. Thus, table 2 can be formed, along with a generalized formula:

Range of Weights ω_i	Possible Number of Samples
$\lfloor \frac{\Omega_i}{\sigma} \rfloor = 0$	[0, 1]
$\lfloor \frac{\Omega_i}{\sigma} \rfloor = 1$	[1, 2]
$\lfloor \frac{\Omega_i}{\sigma} \rfloor = 2$	[2, 3]
...	...

TABLE II
WEIGHT AND SAMPLE RANGES-SIMPLIFIED

Range of samples for ω_i :

$$\left[\left\lfloor \frac{\Omega_i}{\sigma} \right\rfloor, \left\lceil \frac{\Omega_i}{\sigma} \right\rceil \right] \quad (10)$$

This formula characterizes systematic resampling. It states a relationship between the weight of a particle and the number of samples that can be taken of it, hence, (10) will be the formula that is proved through SPARK. Additionally, the float domain conversion of (10) is the same, aside from switching

σ for $\frac{1}{N}$. In the next section, we will use SPARK to verify (10).

Range of samples for ω_i :

$$\left[\left\lfloor \frac{\omega_i}{1/N} \right\rfloor, \left\lceil \frac{\omega_i}{1/N} \right\rceil \right] \quad (11)$$

C. SPARK Verification

Below is the code for SR that will be compiled and run. The objective is to use SPARK to provide step-by-step information to the compiler until (10) is considered true.

```

for l in sample'Range loop
  if l > sample'First then
    dup_arr (l) := dup_arr (l-1);
  end if;

  while sample(l) > cdf_weights(dup_arr(l)) loop
    dup_arr (l) := dup_arr (l) + 1;
  end loop;
end loop;
    
```

Fig. 2. Systematic Resampling Code

In Figure 2, *sample* is the sampling array, U_i , that was defined in (9), *cdf_weights* is the *CDF* of the discrete converted weights ω_i/Ω , *big_int* is the sampling interval, σ , and *dup_arr* is the output of systematic resampling, previously defined as v in figure 1. Both CDF_i and U_i have verified rules that they must follow—the compiler knows each of the rules when CDF_i or U_i are used; this is the basis for creating the loop invariants that will prove (10). For the *CDF* function, the first rule is $CDF_0 = \Omega_0$ because there are no previous values to sum, the first value will just be the first weight. The second rule bounds CDF_i : $CDF_{0:(N-1)} \in [0, \sigma N]$. In the float to integer conversion all values were multiplied by σN and dropped the decimal, thus, the range was changed from $(0, 1]$ to $[0, \sigma N]$. The third rule is $CDF_{N-1} = \sigma N$, which is true because the *CDF* must always sum to 1.0 or in our case σN . The final rule for the *CDF* function states $CDF_i \geq CDF_{0:(i-1)}$ because each index in *CDF* includes the sum of all previous values. Next are the rules for the sampling array, U_i , which are similar to the *CDF* rules. The rules for sampling array are that U_i follows (5), $U_i > U_{0:(i-1)}$, and $U_{N-1} \leq \sigma N$. The final rule holds true because $\alpha \in [1, \sigma]$.

The loop shown in Figure 2 iterates through U_i until it has taken N samples of the weights. There are two main steps in this loop: First is to set the value of v_i equal to the index of the most previous weight sampled, v_{i-1} , and the second step is to iterate the value of v_i until the weight being sampled, CDF_{v_i} , is greater than or equal to U_i . The reason we initiate v_i to v_{i-1} is shown in Figure 1; the value of v_i is always greater than or equal to v_{i-1} . The reason for the second step is to make sure the value of v_i is when $CDF_{v_i} \geq U_i$. A

important relationship between the while loop and the output, v_i , is the while-loop is entered when the current sample is sampling a different weight than the previous sample. This is shown in Figure 1 where v_0 and v_1 are sampling the weight, ω_0 , but v_2 is sampling ω_1 . This allows us to organize the loop invariant/variants in SPARK into two categories: When $v_i = v_{i-1}$ and when $v_i \neq v_{i-1}$ i.e. when sampling the same weight or a different weight than the previous sample.

```

while sample(l) > cdf_weights(dup_arr(l)) loop
  dup_arr (l) := dup_arr (l) + 1;
  I.1 pragma Loop_Variant(increases => dup_arr(l));
  I.2 pragma Loop_Invariant(sample(sample'Last)
    <= cdf_weights(cdf_weights'Last));
  I.3 pragma Loop_Invariant(dup_arr(l) in cdf_weights'Range);
  I.4 pragma Loop_Invariant(if l = sample'First then
    dup_arr(l) > dup_arr'Loop_Entry()
  else dup_arr(l) > dup_arr(l-1));
  I.5 pragma Loop_Invariant(sample(l) >= cdf_weights(dup_arr(l)-1) + 1
    and then sample(l) <= cdf_weights(dup_arr(l)-1) + big_int);
end loop;
    
```

Fig. 3. While-Loop Invariants/Variants

Figure 3 shows the loop invariants/variants within the while loop where $v_i \neq v_{i-1}$. I.1 states that v_i increases at every iteration, which is obvious since the only line in the while-loop increments v_i . As previously discusses, the maximum value of U is σN and maximum/final value of the *CDF* is always σN . Hence, I.2 states that the maximum value of the *CDF* is always greater than or equal to the maximum value of U_i . I.3 states that $v_i \in [0, N-1]$. This is true since v can never exceed $N-1$ because it can only increment when $U_i > CDF_{v_i}$ which is bound to fail when $i = N-1$ because of I.2. I.4 states that $v_i > v_{i-1}$; entering the loop guarantees this is true because on loop entry $v_i = v_{i-1}$ and then it is incremented for every iteration of the while loop. I.5 is the first complicated loop invariant, as such, figure 4 provides a visual of the loop invariant. I.5 states the bounds of a sample when it is the first sample being taken of a weight.

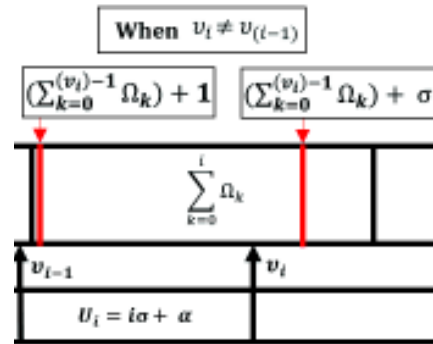


Fig. 4. Visual of I.5

It is important to understand that the summation of Ω_k from $k = 0$ to $(v_i) - 1$ in Figure 4 is the same as $CDF_{(v_i)-1}$. Furthermore, CDF_{v_i-1} is different from $CDF_{(v_i)-1}$: CDF_{v_i-1} is the most previously sampled weight but $CDF_{(v_i)-1}$ is the

weight before the current weight being sampled. In Figure 4, $CDF_{(v_i)-1} + 1$ is the lower bound of the current sample, U_i , and the upper bound is one sampling interval above the lower bound.

Next are the outer loop invariants, which are shown in figure 5. O.1 checks that the proof discussed in I.3 remains true for all previous iterations. That is, $v_{0:i} \in [0, N - 1]$. O.2 checks that I.4 remains true but it also includes when the loop is not entered, creating multiple samples of a weight i.e. $v_i = v_{(i-1)}$. Hence, O.2 states $v_{0:i} \geq v_{0:i-1}$. O.3 Creates the bounds for U_i in regards to the CDF array. The entire purpose of the while loop is it iterates v_i until $U_i \leq CDF_{v_i}$. Thus, O.3 states $U_i \leq CDF_{v_i}$ is true for every value in v_i . O.4 is the second complicated loop invariant, as such, Figure 6 provides a visual of the loop invariant. O.4 states the bounds when multiple samples are taken of a weight i.e. opposite of I.5:

```

O.1 pragma Loop_invariant{for all K in dup_arr'Range =>
dup_arr[K] in cdf_weights'Range};
O.2 pragma Loop_invariant{for all K in dup_arr'First+1..I =>
{for all J in dup_arr'First..K-1 => dup_arr[K] >= dup_arr[J]}};
O.3 pragma Loop_invariant{if dup_arr[I] = 0 then
sample[I] <= cdf_weights[dup_arr[I]] else
sample[I] > cdf_weights[dup_arr[I]-1]
and then sample[I] <= cdf_weights[dup_arr[I]]};
O.4 pragma Loop_invariant{for all K in sample'First..I =>
{for all J in sample'First..K =>
{if dup_arr[K] > 0 and then dup_arr[J] = dup_arr[K] then
sample[J] <= cdf_weights[dup_arr[K]] and then
sample[J] > cdf_weights[dup_arr[K]-1] and then
{if dup_arr[K] = 0 and then dup_arr[J] = dup_arr[K] then
sample[J] <= cdf_weights[dup_arr[K]]}}};
O.5 pragma Loop_invariant{for all K in dup_arr'First+1..I =>
{for all J in dup_arr'First..K =>
{if dup_arr[K-1] = dup_arr[J] and then dup_arr[K] /= dup_arr[J] then
{if J = 0 or {J > 0 and then dup_arr[J] > dup_arr[J-1]} then
K-J in I_Weights[dup_arr[J]]/big_int ..
I_Weights[dup_arr[J]]/big_int + 1} and then
{if K = sample'Last and then dup_arr[K] = dup_arr[J] then
{if J = 0 or {J > 0 and then dup_arr[J] > dup_arr[J-1]} then
K+1-J in I_Weights[dup_arr[J]]/big_int ..
I_Weights[dup_arr[J]]/big_int + 1}}}}};
    
```

Fig. 5. Outer Loop Invariants/Variants

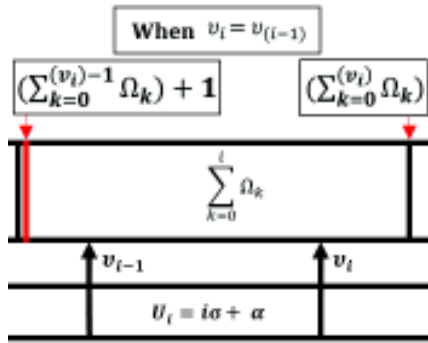


Fig. 6. Visual of O.4

When more than one sample is taken of a weight, the location of where those samples happen is greater than the sum of the previous weights but less than the sum of the previous weights plus the weight that is being sampled. This is

shown in (13). The most important loop invariant is O.5 since it proves (10) by parsing the output array, v , with the use of placeholders K and J to find the number of samples taken of each weight i.e. K-J. Then checks if that value is between the range specified in (10). The next section will discuss the results of the SPARK code.

IV. DISCUSSION

The overall SPARK rating of this proof is gold since all user-defined proofs were verified. It is important to review the steps that were required for this process as they give insight into maximizing the benefits of software verification tools. First, we converted to the integer domain in order for the final equation to be free of the margin of error that floating points bring about. In addition, it is imperative to use a large number when converting to the integer domain to conserve the value of a weight. This method's only drawback is the rounding that takes place but this is only for each individual value, and it is comparable to the rounding that takes place within float storage; integers do not have any summation error. The benefits listed above give evidence to this method being an extremely effective tool in future software verification efforts. The verified formula states a minimum and maximum number of samples that can be taken based on a particles weight. These bounds will vary depending on the type of resampling method chosen because the sampling interval changes for every unique method. For example, in stratified resampling a random number is added to every element, while in systematic resampling it is added to just the first element; this changes the minimum and maximum number of samples that can be taken of a weight. The larger the range between the minimum and maximum number of samples correlates to the randomness of a resampling method. This allows us to create a randomness spectrum that each resampling method can fall within. Furthermore, methods with low randomness are faster in determining an estimation of the targets location but they are vulnerable to the noise created in the environment they are in; this would make jamming effective towards particle filters that use systematic resampling. The opposite is true for resampling methods that are on the higher side of the randomness spectrum; they would be resistant to the noise of the environment but they will take longer to reach a estimation. Future research needs to be conducted on defining the randomness for each resampling method.

V. CONCLUSION

In this paper, we were able to successfully create an equation defining the output of systematic resampling, and prove that it holds true via SPARK. The use of software verification tools to prove the output of advanced algorithms allows for safety and reliance in their implementation. In addition, it allows for the use of a trust system i.e. stone through platinum, for algorithm responsibilities that can range from small to critical for the lives operating the system.

The verified formula states that the minimum/maximum number of possible samples of a particle that is systematically

resampled is equal to the floor/ceiling value of the particle's weight divided by the sampling interval, respectively. The most crucial part of this formula is it allows for resampling methods to be defined on a spectrum of randomness. Methods on the lower side e.g. systematic resampling will be quicker in their estimation of a targets location but they will be vulnerable to the noise of the environment they operate in; the opposite is true for resampling methods that are on the higher end of randomness. This methodology and equation created in this paper allows for target-tracking engineers to pick the best resampling method for their environment instead of choosing the most popularly used one.

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The Performance of Asphalt with Plastic Pallet as Polymer Modified Binder in Extreme Hot Weather

Ka-Lok Kan

Abstract— The asphalt industry is multi-billion pounds industry as we use a large amount of asphalt mix every day, so it makes commercial sense to improve the quality and performance of which. Especially the summer is getting hotter and hotter and there has been report in the United Kingdom that pavement is melting during the heat wave. Traditionally Polymer Modifier Binder (PMB) are very good of increase the performance of asphalt, but they are not very green. Therefore, to fill the literature gap, this paper has investigated three different grade of plastic pallets in replacement of conventional PMB and a controlled asphalt in Thin Surfacing asphalt mix in elevated temperature mimicking the extreme hot weather condition.

Keywords— asphalt materials, extreme hot weather, plastic pallets, pavements.

Exploiting the Potential of Fabric Phase Sorptive Extraction for Forensic Food Safety: Analysis of Food Samples in Cases of Drug Facilitated Crimes

Bharti Jain, Rajeev Jain, Abuzar Kabir, Torki Zughaibi, Shweta Sharma

Abstract— Drug-facilitated crimes (DFCs) entail the use of a single drug or a mixture of drugs to render a victim unable. Traditionally, biological samples have been gathered from victims and conducting analysis to establish evidence of drug administration. Nevertheless, the rapid metabolism of various drugs and delays in analysis can impede the identification of such substances. For this, the present article describes a rapid, sustainable, highly efficient and miniaturized protocol for the identification and quantification of three sedative-hypnotic drugs namely diazepam, chlordiazepoxide and ketamine in alcoholic beverages and complex food samples (cream of biscuit, flavored milk, juice, cake, tea, sweets and chocolate). The methodology involves utilizing fabric phase sorptive extraction (FPSE) to extract diazepam (DZ), chlordiazepoxide (CDP), and ketamine (KET). Subsequently, the extracted sample are subjected to analysis using gas chromatography-mass spectrometry (GC-MS). Several parameters, including type of membrane, pH, agitation time and speed, ionic strength, sample volume, elution volume and time, and type of elution solvent, were screened and thoroughly optimized. Sol-gel Carbowax 20M (CW-20M) has demonstrated most effective extraction efficiency for the target analytes among all evaluated membranes. Under optimal conditions, the method displayed linearity within the range of 0.3–10 $\mu\text{g mL}^{-1}$ (or $\mu\text{g g}^{-1}$), exhibiting a coefficient of determination (R^2) ranging from 0.996–0.999. The limits of detection (LODs) and limits of quantification (LOQs) for liquid samples ranging between 0.020–0.069 $\mu\text{g mL}^{-1}$ and 0.066–0.22 $\mu\text{g mL}^{-1}$, respectively. Correspondingly, the LODs for solid samples ranged from 0.056–0.090 $\mu\text{g g}^{-1}$, while the LOQs ranged from 0.18–0.29 $\mu\text{g g}^{-1}$. Notably, the method showcased better precision, with repeatability and reproducibility both below 5% and 10%, respectively. Furthermore, the FPSE-GC-MS method proved effective in determining diazepam (DZ) in forensic food samples connected to drug-facilitated crimes (DFCs). Additionally, the proposed method underwent evaluation for its whiteness using the RGB12 algorithm.

Keywords— Drug facilitated crime, Fabric phase sorptive extraction, Food forensics, White analytical chemistry.

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Assessing and Characterizing Cellulose Acetate Films Enhanced with Natural Compounds for Active Packaging Applications

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Abstract

Biodegradable and renewable based polymeric packaging like cellulose acetate (CA) as an alternative to petroleum based polymers, in the way of low cost and also which creates a positive outcome on both environmentally. The objective of the present research was to develop bio active packaging films from cellulose acetate incorporated with a low cost cypress essential oil (EO). We prepared cellulose acetate films via solvent casting method incorporating 0, 10, 30, and 60 % (w/w) of EO, with the purpose of evaluating the possible changes caused by the cypress essential oil on the properties of the packaging. The films were characterized using FTIR, TGA, XRD and other analysis technologies. The mechanical, antibacterial and antioxidant properties of the films were analyzed. FTIR and XRD analysis indicating that cypress EO was homogenously distributed on the film. Meanwhile, TGA analysis demonstrated that the addition of EO had impact on thermal properties. The impact of EO on mechanical and optical properties were explored. The results displayed that antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* increased as cypress essential oil percentage increase in cellulose acetate films. Moreover, free radical scavenger activity by DPPH of cellulose acetate films, improved by increasing the cypress essential oil concentration. These results indicate that the films of cellulose acetate containing cypress essential oil has potential for use as active packaging for foods.

Keywords : cellulose acetate ; smart packaging ; Active packaging ; Antibacterial ; antioxidant.

Utilization of Activated Carbon for the Extraction and Separation of Methylene Blue in The Presence of Acid Yellow 61 Using an Inclusion Polymer Membrane

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Abstract

We invariably exist in a world steeped in colors, whether in our clothing, food, cosmetics, or even medications. However, most of the dyes we use pose significant problems, being both harmful to the environment and resistant to degradation. Among these dyes, methylene blue and acid yellow 61 stand out, commonly used to dye various materials such as cotton, wood, and silk. Fortunately, various methods have been developed to treat and remove these polluting dyes, among which membrane processes play a prominent role. These methods are praised for their low energy consumption, ease of operation, and their ability to achieve effective separation of components. Adsorption on activated carbon is also a widely employed technique, complementing the basic processes. It proves particularly effective in capturing and removing organic compounds from water, due to its substantial specific surface area, while retaining its properties unchanged. In the context of our study, we examined two crucial aspects. Firstly, we explored the possibility of selectively extracting methylene blue from a mixture containing another dye, acid yellow 61, using a polymer inclusion membrane (PIM) made of PVA. After characterizing the morphology and porosity of the membrane, we applied kinetic and thermodynamic models to determine the values of permeability (P), initial flux (J_0), association constant (K_{ass}), and apparent diffusion coefficient (D^*). Subsequently, we measured activation parameters (activation energy (Ea), enthalpy ($\Delta H^{\#}_{ass}$), entropy ($\Delta S^{\#}$)). Finally, we studied the effect of activated carbon on the processes carried out through the membrane, demonstrating a clear improvement. These results make the membrane developed in this study a potentially pivotal player in the field of membrane separation.

Keywords: Dyes, methylene blue, acid yellow 61, membrane, activated carbon.

Analyzing Social and Political Constraints in Development Aid Projects in Post Conflict Region of Swat, Pakistan

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Abstract—Non-government organizations (NGOs) in Pakistan have the potential to deliver services such as health, education, and rural development through targeting the most vulnerable communities of society. Having this significant importance, NGOs are facing numerous challenges in service delivery. So, there is a need to identify the challenges NGOs face in community development, particularly post-conflict development. The current study has analyzed the social and political constraints in development projects in the post-conflict region of the Swat district of Khyber Pakhtunkhwa. The objectives of this study are “What are the social and political constraints faced by the non-governmental organizations in the implementation of development aid Projects in post-conflict development of Swat and to examine the challenges in coordination mechanism between government departments, NGOs, and community in reconstruction activities”. This research is based upon both the quantitative and qualitative data that is being gathered from the NGO representatives, government officials, and community members who were involved in post-conflict development interventions in the Swat region. A purposive sampling technique was used to select respondents from the community members/activists (25 in number) and government and NGO officials (10 in number). Based on analysis against our objectives, NGOs have faced numerous constraints such as Insecurity, Negative Perceptions about NGOs, restrictions on women's mobility, government policies and regulations, lack of coordination and networking, trust deficit, and political interference while implementing their project interventions. These findings concluded that constraints have affected project implementation to a greater extent, including women's participation, involvement of marginalized populations, and equal distribution of resources. In the Swat region, NGOs cannot openly discuss sensitive projects such as human rights, gender-based projects, or women empowerment as these issues are very sensitive to the local community due to their cultural values. The community may not allow their females to go outside their homes as this region is a male-dominated society. Similarly, lack of communication and poor networking for the arrangements of the project meetings were also the major constraints.

Keywords— Non-Government Organization, National Disaster Management Authority, Provincial Disaster Management Authority, Federally Administrated Tribal Areas, Post Crises Need Assessment.

I. INTRODUCTION

In February 2009, approximately 2.3 million people were affected by the Swat conflict. The military has launched various military operations to combat terrorism in Swa. As a result of

military operations in the swat, physical and social infrastructures have been endemic, and because of these operations, several people have had to migrate from conflict zones and later in September 2009, they returned to their regions of origin in unfavorable conditions. After their return to their homes, the main concern was to rehabilitate these people urgently so that they could generate opportunities for subsistence. To help the conflict-affected people of Malakand division, the government (both provincial and federal), donors, and NGOs started various interventions soon after people vacated their homes and rushed to the camps to seek protection (Shah and Shahbaz, 2015). Rehabilitation and recovery activities were hampered by floods in 2010, (Bennett, 2011) According to the Provincial Disaster Management Authority, nearly 227.5 million were lost due to these conflicts in the swat. In 2008, nearly \$50 million of agricultural livelihoods were lost in Swat, before the conflict the contribution of the agricultural sector was 110 million. As a result of the conflicts, nearly 33% of the agricultural workforce was unemployed in the era of 2007 and 2010. Due to the floods in Swat, infrastructure such as roads and bridges were damaged. To deal with this damage, a cost of nearly \$ 2.1 billion was made available for the emergency humanitarian response in the province [OCHA, 2010].

Post-conflict development aid projects were launched in the 2010 era in which 16 different development projects were selected to support livelihoods and the agricultural sector for Swat migrants (OCHA, 2010b). Post-conflict development initiatives including livelihood and recovery programs were launched with the support of the non-governmental organization. The response to the floods has focused on food distribution, as well as the rehabilitation of agricultural land and the distribution of seeds. In addition, small grants are provided to shopkeepers and families whose homes have been damaged by the floods [Shah et al., 2015].

Lack of trust of NGOs perceived to be coming from outside and unfamiliar with the local context was a major issue hindering work on women's empowerment (see Shahbaz et al., 2012), Unfamiliarity of some foreign NGOs with the local context and local norms also played a role. NGOs wanted to involve females of the village in the intervention process, which was against the norms and values of our society. In an earlier study, [Shah et al., 2015] observed that interventions of aid agencies in Swat and Dir fell into two broad categories: 1) short-term or immediate relief efforts; and 2) long-term rehabilitation interventions. Immediately after the conflict and floods, cash grants, food, and non-food items were distributed to returnee internally displaced people (IDP). These interventions were mostly supported by international organizations and implemented at the local level, not through community members, but through government agencies such as the Provincial Disaster Management Authority (PDMA) and the Provincial Reconstruction, Rehabilitation and Settlement Authority (PaRRSA) that have a presence in big cities but not at UC/village level. With time local NGOs that operate at the grassroots level often had the advantage of being familiar with governance procedures and socioeconomic conditions and thus were able to design and implement more appropriate interventions [Shah et al., 2012]. Before 2015, in the absence of an elected local government, aid agencies had to work instead with the military and civil bureaucracy at the local level during the post-conflict recovery period. However, a country like Pakistan faces numerous challenges during the implementation of development aid. Several development projects have been launched by the government and NGOs in the post-conflict development programs in the overall Malakand region. The post-conflict activities faced numerous

constraints such as insecurity which is also a major concern for the NGOs as they are working in the conflict zones. Attacks and terror from the militancy created uncertainty in the conflict-affected areas so they had affected the aid negatively. So the broader objective of this research is to identify the social and political constraints faced by non-governmental organizations in the implementation of development aid Projects in the post-conflict development of Swat. And to examine the challenges in coordination mechanisms between government departments, NGOs, and communities in reconstruction activities.

II. LITERATURE REVIEW

Mavrottas, 2010 addressed the effectiveness of aid. The change in aid programming is changing donors' perceptions of aid goals, especially after the end of the Cold War and 9/11, with a greater focus on human safety.

Conflict-affected countries have sought significant financial support and political support from the developed world to support and rebuild their institutional capacity. However, the researchers argue about the post-conflict situation which is highly politicized and there are many variations in donor response. As a result, not all conflict-affected countries are in the limelight of the donor community. The literature on post-war aid is new and there is some empirical work. In this series of studies, it was discussed that support will recover faster and reduce the risk of new conflict in post-conflict situations [Collier2007].

Development aid plays an important role, but it cannot directly reduce the risk of conflict, but it does because it affects growth and employment [Collier, 2005; 2007].

Demeas et al. [2002] it is recommended that rebuilding assistance be carefully designed as it takes time to act, aid immediately after conflict has the greatest welfare impact. They recommend that the post-war environment requires a large amount of short-term humanitarian assistance rather than a small amount of long-term.

Peacekeeping missions can play an important role when it comes to restructuring political systems and implementing complicated peace deals [Sambanis, 2008]. These military missions and initiatives allow the states efficiently to reduce conflicts and support the rehabilitation and recovery processes [Collier, 2009]. Post-conflict activities help improve the living standards of the community through provision of employment. International donors play a vital role in the reconstruction activities.

An NGO is an organization of individuals with specific core principles that shape actions to improve the society in which they serve. Missoni [2014, p. 53] the term NGO has a formal structure, caters to non-members, and is often used for organizations registered with national authorities. Non-government organizations are famous for the provision of basic services to the marginalized community especially in employment, and education [Awan, 2012]. The term NGO was officially used after the founding of the United Nations in 1945 for those people who were working for the affected people after World War second [Missoni, 2014]. NGOs can change their minds and attitudes to deliver products and services more effectively [Awan 2012]. It also improves the quality of life of beneficiaries [Taimur and Hamid 2013]. [Nikkah, 2010] highlights

the importance of NGOs as an institution for the empowerment of women. In addition, where the government or NGOs are weak, such as in Pakistan, such organizations are necessary to bring women's rights issues to the forefront.

Chauvet [2003] found that political and social unrest affects donor attitudes and that the level of care depends on the type of instability. Social instability has a negative impact, and violent and elite instability has a positive impact.

The current situation of NGO aid in Pakistan has changed because it was involved after the war on terror and because of unrest in the region. Due to this prevailing situation in the region Pakistan was forced to take action to stop terrorism. The United States is one of Pakistan's leading NGO donors [Siddique and Ahmed2012].

In Pakistan, many NGOs have initiated different programs to address the different issues

Such as women empowerment, education, health, gender disparities, etc. but with various social and political constraints. Income-generating projects are of particular importance for this, as the majority of Pakistan's female population is very poor, and they are more vulnerable. The main objectives of Projects like Women Empowerment were the promotion of economic-related opportunities and the promotion of women empowerment at the societal level (Buvinic, 2006). However, political influences affect the whole process. Scientists conclude that women's participation in socio-economic projects improves their status in society (Isran, 2012). In Pakistan, however, it was very difficult for NGOs to involve women because of the local Swat culture.

The main problem after the conflict and during the conflict is identified as coordination and cooperation between the parties involved. This problem also affects organizations and other actors in the sector (UNDG / ECHA, 2003). Participants in post-conflict reconstruction efforts must share a common vision and common "end situation" goals.

Inadequate networking and communication are other problems that NGOs face when implementing community development projects. As a result, the projects overlap, and the strategy conflicts with other NGOs implementing the same project. This raises many doubts about the lack of transparency and confidentiality of NGOs [Roodt2001].

Many NGOs face difficulties in implementing community development projects. One of the biggest challenges is government intervention in NGO activities. The Pakistani government is accused of interfering in the activities of NGOs. Relations between the government and NGOs are sometimes hostile. According to Bratton (1989), government is a government capable of creating a legal and political environment in which NGOs operate and relations with the state can take a hostile form. The relationship between NGOs and the state can take the form of outright hostility or lack of trust. Relationships between NGOs and the Pakistani government are handled mainly by sentiments expressed by politicians and senior officials in the Chanakira government.

According to Brinkerhoff [2004], African states generally do not trust NGOs and other non-state actors for various reasons. As a result, NGO programming has been limited due to this distrust of the government in the implementation of community development projects.

According to Chakawarika [2011], government policy can constitute an organization for NGOs. In addition, governments oriented to NGOs are very diverse and can be comprehensive and oriented towards a large urban selection (2008). Government can be formed without participating in information platforms to discuss the development of their communities. Its representatives continue to spearhead community development programs. Ideally, local government should want NGOs to be able to calculate [Busiinge, 2010].

In this case, you will want both NGOs and people to be involved, including those involved in development. Government-making shapes the environment, and reviewing NGOs increases bureaucracy [Korten 1990]. Those who are not lacking in their politics will either not release funds or they will reduce or force the squeezers to Walzer, used by Alden NGOs in many Countries by the PEK, and lushly well-regulated and deregistration from some organizations or restrictions on the Sourcing of Funds from external donors in the favored from external donors through targeted means

III. METHODOLOGY

A pragmatic research approach is used because it provides the philosophical basis for mixed-method research. Qualitative in the sense that the respondent's response is described and explored while quantitative in the sense that data has been collected on a Likert scale and is presented in percentages and graphs. The universe of study is the post-conflict development areas of the Swat region. Swat also known as Swat Valley is a district administered by the Khyber Pakhtunkhwa province of Pakistan; incorporated in 1969 but retains a special formal status that is not prevalent elsewhere in the country. Saidu Sharif is the capital of Swat, but the main town is Mingora bristle with Pashto speakers [Stacul, 2003]. Swat is a place brim over with natural beauty and famous among tourists for its scenic beauty with high mountains, clear lakes, and green meadows; with its exquisite panorama preamble, as referred to as "the Switzerland of Pakistan" [Shaukat, 2013].

The total area of the district is 5337 km² and is divided into six tehsils i.e., Babuzai, Bahrain, Barikot, Charbagh, Khawazakhela, Kabal, and Matta (UNDP, 2015). For the selection of the NGOs, the researcher used the internet to locate the NGOs who are working in the post-conflict development of Swat. Hujra is one of the leading NGOs in Swat. Hujra is working for the development of vulnerable, marginalized, and poor segments of society while focusing on Livelihood and Food Security, Education and Health, WASH (water sanitation and hygiene), Participatory Research, and based Advocacy. One of their Project (see detail in result and discussion) was selected in Union Council Rahimabad fall in the tehsil of Babuzai in District Swat and one of the larger urban towns, Purposive sampling is used to collect data from the 25 community members, /activists and 10 government and NGOs official such as Lasoona, Environmental Protection Agency, Swat Resilient Initiative, IDEA etc., but for the in-depth study we have taken the HUIJRA organization. Respondents are selected from the union council of Rahimabad where the HUIJRA organization has implemented their project. In-depth interviews were conducted with the representatives of NGOs, government officials, and community members who were involved in the post-conflict development initiatives in the region. The primary focus of these in-depth interviews was on the different socio-political constraints. Also, the Structured

interviews were conducted with the representatives of NGOs and government officials who were involved in the post-conflict development initiatives.

IV. RESULT AND DISCUSSION

This section discusses the different challenges and constraints being faced by NGOs in the post-conflict development of the Swat region. The role of the government department and challenges faced in the coordination mechanism are identified. NGOs in Pakistan have the potential to deliver services such as health, education, and rural development through targeting the most vulnerable communities of society. Having this significant importance, NGOs are facing numerous challenges in service delivery. So, there is a need to address the challenges so that the role of the NGOs can be enhanced. While NGOs in Swat after post-conflict, they have done projects in the fields of Agriculture/ Forest, Economic recovery and infrastructure, education in emergencies, Food assistance/Food Security/Livelihoods, Health, Nutrition, Skills and Capacity Building Protection, Human Rights, Rule of Law, Coordination, logistics, support services, etc.

HUJRA is the largest organization in the Swat. Hujra Village Support Organization is a not-for-profit development-oriented organization with no political or ethnic affiliations. The organization is led by eminent development and humanitarian practitioners, dedicated to the social and economic well-being of individuals and communities. Hujra Village Support Organization can also be labeled as an implementing organization that designs and implements various developmental and humanitarian projects with the financial and technical support of international donors and UN agencies. Hujra is distinguished by its professional commitment to ensuring the sustenance of marginalized and vulnerable segments of society for poverty alleviation and social justice. Hujra implemented projects in the past such as Food Security, Livelihoods and Disaster risk reduction, education, health and nutrition, water for sanitation and health (WASH), and governance.

Following are the constraints that the Hujra organization faced during the implementation of the project.

Constraints in the formation of village committees

According to the NGOs 90%, lack of people's awareness about the basic information is the major constraint for them in community formation similarly when the same question was asked of the community members, 60% responded to this constraint. While 90% of NGOs and 70% of community members identified major constraint in community formation was the negative perception prevailing in society. Similarly, 80% of Community members responded about the political and religious influences as constraints in community formation.

These statistics imply that constraints are affecting the formation of the community to a greater extent. The manager shared his views (date March 24, 2021)

“one of the major constraints while entering the community is the lack of people awareness about basic rights, people also perceive NGOs as Western agenda, they often ask us why NGOs are here, why they are supporting us, and in return what NGOs want from us, so lack of information and perception about the NGOs are major constraints for us”.

Community member responded: (date, March 24, 2021)

He said, “Whenever NGOs come into the community, they often approach those people who are very near to them, and they often approach those who can influence the community. People having powers in hand like Movies or political activists, due to these people the poor segment is ignored as the influencer will always want that any initiate should reach his relatives first.”

Negative Perception about NGOs

The perception of the NGOs that they are working on the Western agenda is also a major constraint for them. The manager spoke out about the perception against them as the people perceived that they are foreign agents and why NGOs are focusing on women-related projects.

The manager said that: (date, March 24, 2021)

“The local community did not like them; these people often opposed their activities as NGOs were working on women-related projects. He further said, often people ask us why we are doing women-related projects, these people tell NGOs that, the working of women is western practice but not of this region as males are responsible for doing jobs and their women should stay at their homes”.

People perceive that NGOs are working on the Western agenda and that is why they are focusing the women so that they go outside where they will interact with strangers. According to the local people working with women outside is against the norms, values, and tradition. If women work or get empowered, it means that the male will lose control of them.

For above mentioned reasons, the NGOs are blamed, and it is said they are promoting Western culture in our region. He said that religious leaders are also opposing the NGOs as they perceive that, if the local people are aware, we could lose our influence on them.

Community member shared his views: (date, March 24, 2021)

“Due to refusal from my husband, I could not participate in the project, as my husband does not like the NGOs, he perceives that these people are not good, don’t know why they are working here, and if I go outside then I have to interact with the strangers, and this is not acceptable in our culture”.

Another community member told: (date, March 24, 2021)

“When our males heard that NGOs were working on women-related projects, they told us not to participate and if we participated in it, it meant that we must go outside. Attending sessions is not possible as our males are not allowing us to meet with strangers”.

The manager shared his views: (date, March 24, 2021)

“Once the religious leader announced to the masjid that the NGOs are working against our values and culture, a kind of fatwa he passed against us that we are doing is just Haram. In general, it is perceived that NGOs are spreading Western agenda, which is against our values and culture”.

Another community member replied:

Being religious leaders, they have respect and influence in the local community, so these religious people often use their powers while opposing the projects and passing fatwas against the NGOs.

Female also shared their views that male was not in favor of their participation in the projects

Another community member shared his views:

“He said that the culture is also a constraint for them, as our culture does not allow women to work outside, they perceived that NGOs are un-Islamic, they are foreign-funded, working on Western agenda, and they want to promote their ideology and culture here.

He further said that the NGOs are distorting their culture, values, and traditions as NGOs often want to work on women's rights, women empowerment, and gender issues which are very sensitive to the local community”.

Constraints faced by NGOs and Community

During the implementation of the project, numerous constraints were faced, which include such as Security, Perception of NGOs, restrictions on women's mobility, and political and religious interference.

The constraints faced by Hujra and other Organizations during the implementation of community development programs in Swat.

90% mentioned security as the main constraint in the planning and implementation of the projects. Similarly, 80% mentioned negative perceptions about the NGOs also affecting the project planning and implementation process while 85% mentioned the restrictions on women's mobility which means the lack of women's participation in the project planning and project implementation phase. 75% mentioned the political and religious influence of leaders.

Similarly, the same questions were asked by the community members as well, their responses show that for them the larger constraints are also the same as NGOs had.

The researcher, through one-on-one interviews, got information about these constraints in the activities of community development projects.

Socio-Political Constraints During Implementation of the Project

Social and political constraint means the restriction or compulsion being imposed by the society members such as restrictions on women's mobility etc.

The manager said that (Date March 24, 2021).

“due to instability in the region, implementation, and management of the project activities were affected such as organization of the different meetings, frequent field visits were disturbed, the manager of the NGO further explains that due to uncertainty and instability in the region, the environment is not friendly as it might possible that they get threats so security is the concern for them, due to these disturbances often they have to reschedule their meetings and visits which results in the delays in achieving the project aim”.

The manager also shares his concern about insecurity in the region (Date March 24, 2021).

“He said that insecurity is the major constraint for them as they are working in a conflict zone region; they are more vulnerable to attacks and threats. He also cited the militant's attack on an NGO back in year 2010 which had resulted in the death of five officials. He further said that NGOs are often threatened not to work on sensitive issues such as family planning, women empowerment, gender base projects, and projects like human rights. He said due to the rise of extremism and militants, we are more vulnerable to threats. These militants often mislead the people while blaming the NGOs that they are working on Western agenda”.

It means such an environment cannot be friendly to work in that region. Due to insecurity in the region, our project activities were affected, and we could not perform on time, and we had to go for an extension in the project.

Uncertainty in the region is the major constraint as they face numerous challenges during the implementation of the project activities. The security constraint restricted the project activities of the NGOs working in the region. Some of the officials were not certain about these sudden incidents, but they said:

We are not sure who are the people behind the kidnapping or killing of the NGO staff, he further said that it might be possible that those people were doing this because they feel that NGOs have money from abroad and are doing kidnaping, they can gain monetary advantages.

The manager also said that (Date March 24, 2021).

“Once their female field staff was attacked, I am not sure why they have attacked as, and it might be possible that those people do not want us to work on women-related work. By doing this those people conveyed a strong message for female staff not to work on such women-related projects”

Attacking NGOs could be from the militants who do not want NGOs to work on sensitive issues and by attacking they are giving a strong message to the donor so that the funding could be stopped, and NGOs could be forced to leave this region.

All the officials had such theories and perceptions about attacks and threats to them. The NGOs had no control over such issues, and they needed a friendly environment to work.

Political and Religious Interference

Respondent said that “political influence is also a major constant for them as Priority changes due to political interference in the project implementation process. At the local level, every politician wants to cash NGOs work for their popularity. And the major challenge is the Long Legal Process of Aid Legalization from Government organizations. Secondly, due to the extreme mass of poor people, mostly needy people are mistreated in Projects”.

Similarly, due to religious inference and fatwas from religious scholars also affected the projects where they portrayed the bad image of NGOs to the local people as religious people had the powers.

Another respondent shared his view that conflict between political activists harms our objectives, and then complaints occur to our offices for resolution. He further said that the community itself is challenged because of religious propaganda against NGOs.

Restrictions on Women's Mobility

A restriction on female mobility is also a major constraint as women's participation is very important in the projects. As restrictions on women will not allow them to participate and projects on women will face numerous constraints.

Restrictions on women could be due to patriarchal ideology and instability in the region. The prevailing unrest in the region will affect the women and it will be difficult for them to go outside.

The manager shared his views: (Date March 24, 2021).

The community is worried about the security of their females, because if men are not secure in this region, then how can females travel smoothly so the male will now allow his women to go outside?

The manager shared his views:

The unrest and prevailing situation, different strikes, kidnapping, and poor law and order situation made it very tough for females to go outside.

Due to this worst scenario, women's access to basic rights, and participation in the projects were affected. Due to constraints on women's mobility, the women remained far away from development.

The manager shared his views:

Restrictions on women's mobility are the major constraint for the NGOs as local people do not allow their females to participate. Due to these restrictions, we cannot approach the females for awareness sessions.

A community member shared his views: (Date March 24, 2021).

As our males are not allowing us to go outside this restriction is a constraint for us. My husband didn't allow me to go outside, so I agreed to work at home as our culture now allowing us to go outside frequently.

Another community member responded:

In our region male does not like that their females go outside, so I could not go outside to participate in the projects.

Due to restrictions on women's mobility, women cannot go outside for earning, if we could it means they will have more money and will be less dependent on their male.

V. CONCLUSION

This section highlighted the socio-political constraints being faced by the NGOs in the post-conflict development of the swat region. Constraints such as political, cultural, trust deficit,

government policies, security, and lack of coordination among different stakeholders are affecting the development sector in the region.

Due to these constraints, the project activities were affected, in the swat region where women's mobility is seen to be not easy, so participation of women is also lacking. In swat region NGOs cannot openly initiate sensitive projects such as human rights, gender-based projects, or women empowerment as these issues are very sensitive to the local community due to their cultural values, they will never allow their females to go outside homes to earn purposes as this region is male dominating society. Similarly, the lack of coordination among different stakeholders is also a major constraint; due to this constraint official meetings were not held on time, government's lack of interest is also a kind of constraint for the NGOs in the region.

These findings conclude that constraints affect project implementation to a greater extent. Another major challenge faced by NGOs who carry out community development projects is the participation of community members. Men community members play a vital role in implementing projects in their communities. When community members do not cooperate with an NGO, then it becomes a problem. Also, the attitudes of the community affect the project implementation. Moreover, especially in rural areas, it is impossible to convince the influencer to agree when it comes to projects. In most cases, the leaders are influenced by the politicians of those areas, so it is very difficult to convince.

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Knowledge Capital and Manufacturing Firms' Innovation Management: Exploring the Impact of Transboundary Investment and Assimilative Capacity

Suleman Bawa, Ayiku Emmanuel Lartey

Abstract—

Purpose - This paper aims to examine the association between knowledge capital and multinational firms' innovation management. We again explored the impact of transboundary investment and assimilative capacity between knowledge capital and multinational firms' innovation management. The vital position of knowledge capital and multinational firms' innovation management in today's increasingly volatile environment coupled with fierce competition has been extensively acknowledged by academics and industry investment capitals.

Design/methodology/approach - The theoretical association model and an empirical correlation analysis were constructed based on relevant research using data collected from 19 multinational firms in Ghana as the subject, and path analysis was constructed using SPSS 22.0 and AMOS 24.0 to test the formulated hypotheses.

Findings - Varied conclusions are drawn consequential from theoretical inferences and empirical tests. For multinational firms, knowledge capital relics positively significant to multinational firms' innovation management. Multinational firms with advanced knowledge capital likely spawn greater corporations' innovation management. Second, transboundary investment efficiently intermediates the association between knowledge physical capital, knowledge interactive capital, and corporations' innovation management. At the same time, this impact is insignificant between knowledge of empirical capital and corporations' innovation management. Lastly, the impact of transboundary investment and assimilative capacity on the association between knowledge capital and corporations' innovation management is established. We summarized the implications for managers based on our outcomes.

Research limitations/implications - Multinational firms must dynamically build knowledge capital to augment corporations' innovation management. Conversely, knowledge capital motivates multinational firms to implement transboundary investment and cultivate assimilative capacity. Accordingly, multinational firms can efficiently exploit diverse information to augment their corporate innovation management. Practical implications – This paper presents a comprehensive justification of knowledge capital and manufacturing firms' innovation management by exploring the impact of transboundary investment and assimilative capacity within the manufacturing industry, its sequential progress, and its associated challenges. Originality/value – This paper is amongst the first to find empirical results to back knowledge capital and manufacturing firms' innovation management by exploring the impact of transboundary investment and assimilative capacity within the manufacturing industry. Additionally, aligning knowledge as a coordinative instrument is a significant input to our discernment in this area.

Keywords— knowledge capital, transboundary investment, innovation management, assimilative capacity.

A Comparative Study of Essential Oils Used in Papyrus Sterilization: A Case Study from the Early Islamic Period

Bahaa Fawwaz

Abstract— The study was conducted on a papyrus housed at the Museum of Islamic Art in Cairo, Egypt. This papyrus was inscribed with black ink. Twelve fungal species were isolated and identified. Five types of fungi were ultimately identified to complete the study. The isolated fungi were then incubated for three months after the aging procedure. This study investigates the in-vitro growth inhibition of *Aspergillus niger*, *Aspergillus flavus*, *Penicillium chrysogenum*, *Trichoderma longibrachiatum* Rifai, and *Paecilomyces variotii* on papyrus. The hyphal growth was observed using the environmental scanning electron microscope (ESEM). Natural oils, such as lavender oil, lemongrass oil, and rosemary oil, were used. The impact of these natural oils on the newly aged papyrus was assessed using scanning electron microscopy and color analysis to identify the most effective oils for inhibiting fungus growth.

Keywords— conservation, papyrus, fungi, growth, environmental, essential oils.

“Ethiopia as a Tourist Destination, an Exploration of German Tourists' Market Demand (Case Study)”

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Abstract

Within the last two decades Ethiopia's tourism industry has relatively grown as a foreign exchange earner and major employment generator. Since Ethiopia also depends enormously on tourism for its growth and development, this paper provides an exploration of German tourists demand towards Ethiopian tourist destination. In compliance with this trend, the purpose of this thesis and research is to review Ethiopia as an international tourist destination and its current marketing activities in the tourism trade, to investigate the proper use of marketing efforts, and to suggest guidelines for the future destination marketing strategies.

However, the demand of international tourism for Ethiopia currently lags behind other African countries such as Egypt, south Africa, Tanzania, and Kenya. Therefore, to offer demand-driven tourism products, the Ethiopian government, ministry of Ethiopian, Tourism planners, Tour & Travel operators need to understand the important factors, that affect international tourists' decision to visit Ethiopian tourist destinations. The aim of this study was intended to analyze German Tourists Demand towards Ethiopian destination. The researcher aimed to identify the demand for German tourists' preference to Ethiopian tourist destinations comparing to the above mentioned African countries.

For collecting and analysing data for this study, qualitative and quantitative research methodology approach is being used and the most important data is sourced by primary data collecting method using questionnaires and interviews, and by secondary data by reviewing magazines, journals, books, electronic websites and Past researches. The author also used strategic sampling technique whereby ample potential feedbacks could be gathered from nine German active tourists, one from Ethiopian tourism and culture office, one lecturer of tourism management from Addis Ababa University, four African embassies, 12 tourist guiders and scouts in Ethiopia and four well functioning private tour companies.

Based on the analysis of the data which was collected during the interview and surveys, the study disclosed that majority of German tourists have not that much high demand on Ethiopian Tourist destinations due to the following reasons;

- The vast majority of Germans are fascinated by adventures, safari and simply want to lie on the beach and relax. These interests have led them to look for other African countries which have sources of Adventure, safari and Beach trips.
- Uncomfortable infrastructure and transport problems attributed for the decreasing the number of German tourists in the country.

- inadequate marketing operation of Ethiopian Tourism Authority and its delegates in advertising and clarifying the above irregularities which are raised by the tourists.
- Tourism suffered its deepest crisis in recorded history during the COVID-19 pandemic, from 2020 to 2022. This was very severe problem specially for Ethiopian tourism as it is the developing country.

Keywords: Environmental Benefits of Tourism, Social Benefits of Tourism, Economic Benefits of Tourism, political factors in tourism.

Methodology

As described earlier, this dissertation concentrates on exploring German tourists market demand only. By doing this, it is intended to address the roles that three parties have played in accelerating the flow of German tourists to four African countries. The four data sources which are involved in this research are German tourists who have ample experiences in visiting different African Countries, tour companies, Local experts in tourism of the country (tourism and culture officials, tour guiders, hotel and tourism management teachers of AAU) and Four African Embassies marketing experts (Tanzania, Kenya, Egypt and South Africa).

significance of the study

The majority of studies on tourism just apply general marketing demand concepts and strategies to the industry, disregarding the particular characteristics of the industry of travel and tourism. Although general tourism marketing demand principles are universal, situational factors might indicate need for specific approaches. Unlike the majority of earlier studies, this work aims to address sector-specific marketing issues of tourism demand and offer a unified, comprehensive alternative model.

The purpose of this study is to evaluate the attitudes of German tourists, destination tourist marketing organization, host community and stakeholders and assess tourism marketing implication.

The study aims to provide empirical information to tourism and government organizations, decision-makers, tourists, and other stakeholders about the establishment of a sustainable tourism sector in Ethiopia.

Moreover, the study holds practical relevance since it can serve as a foundation or point of reference for future researchers wishing to investigate the field further or provide insights for future research.

“Ethiopia as a Tourist Destination, an Exploration of German Tourists' Market Demand (Case Study)”

Dagneu Dessie Mengie

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Abstract

Ethiopia attracts tourists from a variety of source markets in all over the world, and the country's tourism industry has expanded throughout its history. The purpose of this study was to investigate German tourists' demand for Ethiopian tourism destinations. The author has made every effort to identify the differences in the preferences of German visitors' demand in Ethiopia comparing with other African countries which are Egypt, Kenya, Tanzania, and South African tourism sectors if they are invited to visit at the same time.

However, the demand of international tourism for Ethiopia currently lags behind other African countries such as Egypt, south Africa, Tanzania, and Kenya. Therefore, to offer demand-driven tourism products, the Ethiopian government, ministry of Ethiopian, Tourism planners, Tour & Travel operators need to understand the important factors, that affect international tourists' decision to visit Ethiopian tourist destinations. The aim of this study was intended to analyze German Tourists Demand towards Ethiopian destination. The researcher aimed to identify the demand for German tourists' preference to Ethiopian tourist destinations comparing to the above-mentioned African countries.

For collecting and analysing data for this study, both quantitative and qualitative methods of research are being used in this study. The most significant data for this study comes from primary data collection methods like surveys and interviews as well as secondary data gathered from books, journals, previous research, and electronic websites. The researcher

By using the primary data collection method, the researcher gathered large number of potential responses and feedback from nine German active tourists, one from Ethiopian tourism and culture office, one lecturer of tourism management from Addis Ababa University, four African embassies, 12 tourist guiders and scouts in Ethiopia and four well functioning private tour companies.

based on the data analysis of the information gathered from interviews and questionnaires, the study disclosed that majority of German tourists have not that much high demand on Ethiopian Tourist destinations due to the following reasons;

- The vast majority of Germans are fascinated by adventures, safari and simply want to lie on the beach and relax. These interests have led them to look for other African countries which have sources of Adventure, safari and Beach trips.
- Uncomfortable infrastructure and transport problems attributed for the decreasing the number of German tourists in the country.
- inadequate marketing operation of Ethiopian Tourism Authority and its delegates in advertising and clarifying the above irregularities which are raised by the tourists.

- Tourism suffered its deepest crisis in recorded history during the COVID-19 pandemic, from 2020 to 2022. This was very severe problem specially for Ethiopian tourism as it is the developing country.

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As described earlier, this dissertation concentrates on exploring German tourists market demand only. By doing this, it is intended to address the roles that three parties have played in accelerating the flow of German tourists to four African countries. The four data sources which are involved in this research are German tourists who have ample experiences in visiting different African Countries, tour companies, Local experts in tourism of the country (tourism and culture officials, tour guiders, hotel, and tourism management teachers of AAU) and Four African Embassies marketing experts (Tanzania, Kenya, Egypt and South Africa).

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The purpose of this study is to evaluate the attitudes of German tourists, destination tourist marketing organization, host community and stakeholders and assess tourism marketing implication.

The study aims to provide empirical information to tourism and government organizations, decision-makers, tourists, and other stakeholders about the establishment of a sustainable tourism sector in Ethiopia.

Moreover, the study holds practical relevance since it can serve as a foundation or point of reference for future researchers wishing to investigate the field further or provide insights for future research.

An Exploration of German Tourists' Market Demand Towards Ethiopian Tourist Destinations

Dagne Dessie Mengie

Abstract— The purpose of this study was to investigate German tourists' demand for Ethiopian tourism destinations. The author has made every effort to identify the differences in the preferences of German visitors' demand in Ethiopia comparing with Egypt, Kenya, Tanzania, and South African tourism sectors if they are invited to visit at the same time. However, the demand for international tourism for Ethiopia currently lags behind these African countries. Therefore, to offer demand-driven tourism products, the Ethiopian government and tour and travel operators need to understand the important factors that affect international tourists' decision to visit Ethiopian tourist destinations. The aim of this study was to analyze German Tourists' Demand for Ethiopian destinations. The researcher aimed to identify the demand for German tourists' preference for Ethiopian tourist destinations compared to the above-mentioned African countries. For collecting and analysing data for this study, both quantitative and qualitative methods of research are being used in this study. The most significant data are collected by using the primary data collection method i.e. survey and interviews which are the most and large number of potential responses and feedback from nine German active tourists, 12 Ethiopian tourism officials, four African embassies, and four well functioning private tour companies and secondary data collected from books, journals, previous research and electronic websites. Based on the data analysis of the information gathered from interviews and questionnaires, the study disclosed that the majority of German tourists do have not that high demand for Ethiopian Tourist destinations due to the following reasons: (1) Many Germans are fascinated by adventures and safari and simply want to lie on the beach and relax. These interests have led them to look for other African countries which have these accesses. (2) Uncomfortable infrastructure and transport problems are attributed to the decreasing number of German tourists in the country. (3) Inadequate marketing operation of the Ethiopian Tourism Authority and its delegates in advertising and clarifying the above irregularities which are raised by the tourists.

Keywords— environmental benefits of tourism, social benefits of tourism, economic benefits of tourism, political factors on tourism.

The Effect of Technology on International Marketing Trading Researches and Analysis

Omil Nady Mahrous Maximous

Abstract— The article deals with the use of modern information technologies to achieve pro-ecological marketing goals in company-customer relationships. The purpose of the article is to show the possibilities of implementing modern information technologies. In B2C relationships, marketing departments face challenges stemming from the need to quickly segment customers and the current fragmentation of data across many systems, which significantly hinders the achievement of marketing goals. Thus, Article proposes the use of modern IT solutions in the field of marketing activities of companies, taking into account their environmental goals. As a result, its importance for the economic and social development of the emerging countries has increased. While traditional companies emphasize profit maximization as a core business principle, social enterprises must solve social problems at the expense of profit. This rationale gives social enterprises an edge over traditional businesses by meeting the needs of those at the bottom of the pyramid. This also represents a major challenge for social business, since social business acts on the one hand for the benefit of the public and on the other strives for financial stability. Otherwise, the company is unlikely to be fired from the company. Cultures play a role in business communication and research. Using the example of language in international relations, the article presents the problem of the articulation of research cultures in management and linguistics and of cultures as such. After an overview of current research on language in international relations, this article presents the approach to communication in international economy from a linguistic point of view and tries to explain the problems of communication in business starting from linguistic research. A step towards interdisciplinary research that brings together research in the fields of management and linguistics.

Keywords— international marketing, marketing mix, marketing research, small and medium-sized enterprises, strategic marketing, B2B digital marketing strategy, digital marketing, digital marketing maturity model, SWOT analysis consumer behavior, experience, experience marketing, marketing employee organizational performance, internal marketing, internal customer, direct marketing, mobile phones mobile marketing, Sms advertising.

Causality between Stock Indices and Cryptocurrencies During the Russia-Ukraine War

Nidhal Mgdmi¹, Abdelhafidh Othmani²

Abstract—This article examines the causal relationship between stock indices and cryptocurrencies during the current war between Russia and Ukraine. The econometric investigation runs from February 24, 2022, to April 12, 2023, focusing on seven stock market indices (S&P500, DAX, CAC40, Nikkei, TSX, MOEX and PFTS) and seven cryptocurrencies (Bitcoin, Ethereum, Litecoin, Dash, Ripple, DigiByte and XEM). In this article, we try to understand how investors react to fluctuations in financial assets to seek safe havens in crypto currencies. We used dynamic causality to detect a possible causal relationship in the short term and seven models to estimate the long-term relationship between cryptocurrencies and financial assets. The causal relationship between financial market indexes and cryptocurrency coins in the short run indicate that three famous cryptocurrencies (BITCOIN, ETHEREUM, RIPPLE) and the two digital asset with minor popularity (XEM, DigiByte) are impacted by the German, Russian and Ukrainian stock markets. In the long-run, we found a positive and significant effect of the American, Canadian, French and Ukrainian stock market indexes on Bitcoin. Thus, the stability of the traditional financial markets during the current war period can be explained on the one hand by investors' fears of an unstable business climate, and on the other hand, by speculators' sentiment towards new electronic products, which are perceived as hedging instruments and a safe haven in the face of the conflict between Ukraine and Russia.

Keywords—Causality, Stock indices, Cryptocurrency, War, Russia, Ukraine.

I. INTRODUCTION

Over the last five years, the world's population has been confronted with two major crises: the Covid-19 health crisis and the geopolitical emergency of the war between Russia and Ukraine. Initially, these two crises have caused serious economic and financial difficulties for many of the world's economies, due to the disruption of the international supply chain. During these periods, financial and commodity markets around the world experienced a considerable downward trend. The spread of Covid-19 and high mortality rates have led the World Health Organization to declare a global containment situation in 2019. This caused a lot of anxiety and fear among people, which led to the selling of safer assets such as gold and 10-year government treasury bills ([1]). The response of the financial market has been more remarkable than that of the subprime crisis in 2008; for example, the FTSE stock index of

the 100 most capitalized British companies on the London Stock Exchange fell by 14.3% in 2020 ([2]). In the United States, the consequences are more drastic on the job market, where the unemployment rate is around 9% ([2]). In this respect, the International Monetary Fund (IMF) assumes that a decade of employment expansion is coming to an end, with the global economy contracting by 4.4% in 2020, rates worse than the Great Depression of 1930 ([2]).

The two countries at the root of the current geopolitical crisis, Russia and Ukraine, are the world's leading exporters of black gold and its derivatives, as well as of basic foodstuffs to the world in large quantities. [3] Points out that these two countries are among the world's largest producers of wheat (28.9% of global exports) and sunflower oil (60% of global exports). The ongoing war between Russia and Ukraine not only has a negative impact on production, but its effects on the breakdown of international supply chains, a rise in the global consumer price index ([4]-[6]) and increased volatility in traditional asset markets and crypto-currency markets ([7]-[9]).

Numerous empirical studies have investigated the major impact of the current war and the Covid-19 pandemic on traditional and digital financial assets. [10]-[12], for example, studied the impact of the war between Russia and Ukraine on the volatility and returns of stock market indices in Australia, the G20 countries and Europe. Their results revealed negative effects on returns on financial assets. The work of [8]-[9] focused on a study of digital markets and showed significant negative effects in the short term. However, we must not neglect the importance of economic impacts and the volatility of oil and gold prices in the analysis ([13]-[15]).

However, studies that have sought to identify the interactions between financial and digital markets during periods of crisis are still rare. The unifying objective of our article is to study the nexus between the volatility of traditional financial assets and cryptocurrency markets. In this article, we explore the causal direction between traditional financial markets and Crypto-currencies. The originality and authenticity of our article lies in the fact that it is the first attempt to shed light on the impact of stock market indices on the exchange and performance of crypto-currencies in the short and long term. We refer to the seven traditional financial assets, which are: S&P500, DAX, CAC40, Nikkei, TSX, MOEX and PFTS. In addition, we address the seven cryptocurrencies namely: Bitcoin, Ethereum, Litecoin, Dash, Ripple, DigiByte and XEM. We analyze the causal direction between these two markets over a study period running from February 24, 2022, to April 12, 2023.

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In this article, we investigate the causal direction between traditional financial asset markets and crypto-currency markets. To this end, we summarize the main empirical works that have studied the dynamic and structural links between these traditional and digital assets in the first part. Dans une seconde partie, nous validons empiriquement ces liens à partir d'une base des données collectées auprès Coin-Desk and Yahoo Finance pour les sept actifs traditionnels et numériques.

II. LITERATURE REVIEW

The ongoing conflict between Ukraine and Russia is having a negative impact on the domestic and international economy. However, the current war is affecting traditional financial markets by reducing trading volumes of well-known stock market indices such as the S&P500, CAC40 and DAX. Moreover, the geopolitical conflict between Russia and Ukraine has had a severe impact on the highly volatile cryptocurrency market. Many recent academic studies discuss the state of traditional and digital financial markets in light of the current war.

In this frame of reference, the study of [8] refers to the database covering the period from February 24, 2022 to June 21, 2022. These authors mention the prices of four cryptocurrencies (Bitcoin, Ethereum, Ripple, Litecoin), Stock Indexes of the seven developed countries (S&P500, CAC40, DAX, FTSE100, TSX, NIKKEI, FSTEMIB), and Google trend as an indicator of public attention to this war (GTW). [8] Found that the military conflict between Russia and Ukraine has had a significant impact on prices of cryptocurrencies and the returns of seven stock market indices. Indeed, these authors showed that public attention to this conflict has different implications depending on the pessimistic, bullish, or normal state of traditional and digital financial markets over time. [8] Found that this conflict negatively affects cryptocurrency prices in the short term. Thus, authors have suggested that the S&P500 and FTSE100 indices are highly dependent on public attention to this conflict.

[16], using a panel method with a sample of 20 countries during a period from January 23, 2022 to April 16, 2022, found that this current war has affected the cryptocurrency market and especially on Bitcoin exchange returns. The war caused bitcoin trading volume to drop by 0.2%. [13] Used stylized VARX method to study the impact of sanctions on the Russian economy (GDP, industrial production, goods exports, agricultural production, FDI stock). The main findings of empirical studies show that sanctions affected individuals and firms, but had a little impact on the global economy. [14] Use Generalized Autoregressive Score (GAS) to model and predict volatility and correlations between oil prices and equity returns using monthly data from January 1871 to October 2020. The authors show that dynamic correlations between crude oil and stock market returns tend to increase significantly during crisis.

[17] Examined the impact of the Russo-Ukrainian war on stock market returns in 23 developed and 24 emerging economies. These authors used the Cumulative Abnormal Return (CAR) of each stock market index as an endogenous

variable, referring to the share of foreign trade in GDP by country. Therefore, these authors adopted lagging returns as a control variable and a binary variable to distinguish between developed and emerging markets. This study uses the event method to determine the impact of the Russian invasion of Ukraine on developed and emerging financial markets. Empirical evidence shows that the current war has a significant and positive impact on global stock markets. [17] Concluded that this invasion would introduce significant heterogeneity in profits across these markets.

[18] Advocate that the conflict between Russia and Ukraine adversely affected the performance of stock market indices in 94 countries during the daily survey period excluding weekends. [18] Employ a panel approach and conclude that the ongoing conflict between Russia and Ukraine has a negative and significant impact on the performance of the stock market indices in 94 countries. [18] Found a significant negative association between the military conflict and the stock market indices. These authors argue that the impact of Russia's invasion of Ukraine on stock market indices is greater for UN member countries that have condemned the invasion than for neutral countries. [11] Emphasized similar finding on negative reactions to G-20 stock market using an event study of abnormal returns before and after the launch of the "special military operation". As a result, Russian military forces on February 24, 2022 revealed a strong negative impact on the majority of stock markets, particularly the Russian market.

[12] Adopted an event-study approach during the period from February 2021 to March 2022 for a sample of 12 countries. These authors pointed out that the imposition of economic sanctions against Russia had a significant negative impact on the stock market performance of European firms. In this sense, [19] Created a new index to measure the intensity of the conflict between Russia and Ukraine. These authors have shown that this conflict affects global markets through economic and financial channels. Commodity markets become more volatile during periods when Russia's foreign exchange reserves are high. Previous research has shown that political and economic turmoil in a particular region can cause financial contagion, transmitting stress and volatility in financial markets from one market to another ([20]).

[21] Used the event method proposed by [22] to investigate the impact of the Russo-Ukrainian War on the Australian stock market. The authors found that abnormal returns were clearly negative, the stock market reacted negatively, Small and Medium-sized Enterprises (SMEs) were more affected before and after the event, and exporters were more affected by this war. In this regard, [23] used the fractional integration technique for the period 7 May 2015 to 5 October 2018, using six crypto-currencies and six stock market indices. Gil-Alana et al (2020) showed that these six cryptocurrencies have a statistically significant positive effect on investor portfolios.

[14] Used Multivariate Generalized Autoregressive Score model (GAS) to analyze crypto-asset prices (Bitcoin and Ethereum) and equities (S&P500, NASDAQ, Dow Jones Industrial) and forecast their volatilities and correlations.

Daily period from December 1, 2016 to the end of February 2023, describing the dynamic relationship. These authors show that the GAS model outperforms the traditional GARCH dynamic conditional correlation model (GARCH-DCC) because it captures the persistence of volatility and nonlinearity between stock market indices and cryptocurrencies.

[7] Conducted Quantile-on-Quantile Regression (QQR) for seven major emerging (E7) and developed (G7) stock markets. The period is from February 24, 2022 to July 25, 2022. The authors point out that the impact of geopolitical risks (GPR) on stock markets is not only idiosyncratic, but also asymmetric. All E7 and G7 stocks except Russia and China react positively to GPR between Russia and Ukraine under normal circumstances.

[15] Referred to Asymmetric Dynamic Conditional Correlation (ADCC) and wavelet methods to study connectivity between five cryptocurrencies (Bitcoin, Ethereum, Ripple, Bitcoin cash and Ethereum) and five stock market indices (NYSE composite index, NASDAQ composite index, Shanghai Stock Exchange, Nikkei 225 and Euronext NV). The survey period runs daily from 2016 to 2019. The authors find a significant time-varying conditional correlation between most crypto assets and traditional assets, suggesting that negative shocks play a greater role than positive shocks of the same magnitude. They explored potential opportunities for investors to diversify their portfolios through cryptocurrencies and stock market assets.

[24] Used wavelet methods to explore the impacts of the Covid-19 pandemic and the Russo-Ukrainian war on the link between US and Chinese stock markets (S&P 500 and SSE), crypto-assets and commodities markets. Daily data from January 1, 2020 to April 18, 2022 is used. Results showed that the current military conflict combined with the sanctions imposed on Russia, could have a global economic consequences, including: Declining energy supplies, food supply problems, and global supply chain disruptions ([13], [25]-[26]).

The conflict between Russia and Ukraine has exacerbated tensions in global financial markets, causing increased risk aversion and uncertainty. This has led to higher risk premiums and currency depreciation in many emerging markets and economies with close trade ties to Russia ([27]-[28]). There is also researches on the economic impact of GPR, which captures the uncertainties arising from wars, acts of terrorism, and conflicts between nations ([29]). Studies highlight the negative impact of political risk indicators ([29]) on cryptocurrencies and stock markets ([30]-[33]). Several articles have examined the impact of the Russian-Ukraine war on equities ([17] and [12]).

Recent studies have similar goals but differ in methods and empirical techniques. Indeed, to analyze stock market returns and cryptocurrency volatility [14] adopt GARCH model to clarify the structural adjustments of variables. [16] Endorses the panel model as an econometric technique suitable for studying possible relationships between stock market indices, numerical assets and economic variables. The asymmetric

impact of the Russian-Ukrainian conflict is highlighted by the quantile-to-quantile regression by [7]. Another related conditional correlation technique was applied by [15] to capture changes in correlations between financial assets as a function of market conditions. However, with the exception of [14], this research focuses specifically on the limited period around the onset of a large-scale crisis, leaving no answers to long-term macroeconomic implications and alternative investment strategies. Moreover, only well-known cryptocurrencies are discussed. The unifying objective of our research is to examine the returns of seven stock assets (S&P500, DAX, CAC40, Nikkei, TSX, MOEX and PFTS), five well-known assets (Bitcoin, Ethereum, Litecoin, Dash and Ripple) and two assets with minor popularity (DigiByte and XEM). The investigation period covers 413 days from the start of the military conflict between Russia and Ukraine on 24 February 2022. The next part will focus on the impact of the current war between Russia and Ukraine on financial and digital asset earnings.

III. EMPIRICAL VALIDATION

Seven financial assets are selected (S&P500, DAX, CAC40, Nikkei, TSX, MOEX and PFTS). The S&P500 is an index of the top 500 publicly traded companies in the United States. The DAX index is a German stock market index that measures the performance of the 30 largest companies listed in Frankfurt. The CAC40 Index is a stock market index covering the 40 largest French companies. The Nikkei Stock Average is an index of 225 of Japan's largest listed companies. The TSX Index is Canada's benchmark stock market index, representing the performance of more than 200 companies listed on the Toronto Stock Exchange. The MOEX Index is Russia's leading stock market index, reflecting the performance of major companies listed on the Moscow Stock Exchange. The PFTS Index is Ukraine's leading stock market index, reflecting the performance of major companies listed on the Kiev Stock Exchange. These seven stock market indices measure the overall performance of these countries' financial markets and guide investors' investment decisions. When choosing cryptocurrencies we opt for five well-known assets (Bitcoin, Ethereum, Litecoin, Dash and Ripple) and two less popular (DigiByte and XEM). The database was collected from Coin-Desk and Yahoo Finance. The survey period is 413 days from February 24, 2022, to April 12, 2023.

We apply eight statistical indicators to explore trading volume and assess the profitability of traditional and digital assets. Position, spread, and shape indicators provide information about database distribution. We use averages to determine general trends in transactions. Standard deviation is applied to discuss profitability. Information symmetry helps to analyze asset liquidity. The Kurtosis statistic is used to examine the flattening of the return distribution. The Kurtosis statistic allows us to study the flattening of return distribution. The Jarque-Berra statistic is employed to explore the possible impact of the ongoing war between Russia and Ukraine on stock market anomalies.

Table -1- Descriptive statistics

	Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis	Jarque-Bera	Significance
LS&P500	8.2985	8.2923	8.4407	8.1823	0.0548	0.3390	2.8761	7.7998	0.0202
LDAX	7.0342	9.4766	9.6586	2.5178	3.3340	-0.5692	1.3257	67.2966	0.0000
LNIKEI225	3.7241	3.3099	10.2502	3.2075	1.6579	3.6698	14.4729	3045.2470	0.0000
LTSX	9.9046	9.9030	10.0028	9.8095	0.0467	0.2228	2.4822	7.6605	0.0217
LMOEX	3.6573	0.9045	7.8374	0.6507	3.3878	0.3603	1.1315	65.8378	0.0000
LCAC40	8.7796	8.7803	8.9088	8.6442	0.0644	0.1842	2.3226	9.7616	0.0076
LPFTS	6.2475	6.2523	6.2523	6.2286	0.0094	-1.4838	3.2430	145.5488	0.0000
LBITCOIN	24.0134	24.0356	25.5023	22.7664	0.3900	-0.0548	3.8475	11.9872	0.0025
LETHEURM	23.2033	23.2645	24.5463	21.5986	0.5311	-0.4070	3.0083	10.8807	0.0043
LLITCOIN	20.1853	20.1726	21.4896	18.9995	0.3895	0.4266	3.7501	21.1871	0.0000
LDASH	18.4597	18.3560	20.1929	17.6423	0.4664	0.9902	4.0284	81.7423	0.0000
LDIGIBYTE	15.8704	15.7996	19.7765	14.1568	0.9467	0.7312	3.8396	46.6779	0.0000
LXEM	16.4239	16.3028	19.9704	15.3331	0.6751	1.5272	7.0430	421.4859	0.0000
LRIPPLE	20.9852	20.9693	22.7772	19.2334	0.5409	0.0085	3.3552	2.0760	0.3542

We applied the natural logarithm to normalize the values in the database. The results point out significant high trading volumes for various cryptocurrencies during this ongoing wartime. However, there are exceptions for the Japanese and Russian stock indices, which we found to be relatively low. This disparity can be interpreted as a result of the European Union blocking Russia’s international bank accounts. Moreover, the transmission mechanism of this war appear to be reflected in the profitability of Japan’s stock market. In terms of standard deviation, we found it to be the smallest among all the traditional stock indices and crypto assets we investigated. Information asymmetry plays an important role in the analysis of various traditional and digital assets, with the exception of Ripple, which presents flowing information. The Skewness statistic is strictly positive and exhibits a shift to the right for most assets. However, the logarithms of DAX, PFTS, Bitcoin, and Ethereum show a left shift, indicated by a strictly negative Skewness statistic.

We noted the presence of market anomalies in various stock indices and cryptocurrencies displayed by important Jarque-Berra statistics, with the exception of Ripple, which seems to follow a normal distribution. The median divides the increasing cumulative frequency into two parts. One part below the median and one part above the median. Our study found the median to be close to the mean, corroborating the small information asymmetry (also observed from skewness statistics). This asymmetry did not exceed one.

We analyzed the dependencies between these different financial assets using both a variance-covariance matrix to assess absolute relationships and a total correlation matrix to examine relative relationships. A variance-covariance matrix showing these relationships is shown in Table 2.

Table -2- Variance-Covariance Matrix

	LS&P500	LDAX	LNIKEI225	LTSX	LMOEX	LCAC40	LPFTS	LBITCOIN	LETHEURM	LLITCOIN	LDASH	LDIGIBYTE	LXEM	LRIPPLE
LS&P500	0.003													
LDAX	-0.071	11.087												
LNIKEI225	0.001	1.135	2.742											
LTSX	0.002	0.062	0.004	0.002										
LMOEX	-0.0036	7.140	1.755	0.004	11.448									
LCAC40	0.001	0.071	0.042	0.002	0.150	0.004								
LPFTS	0.000	-0.013	0.008	0.000	-0.020	0.000	0.002							
LBITCOIN	-0.001	0.139	0.097	0.001	0.325	0.007	0.001	0.152						
LETHEURM	0.005	0.751	0.110	0.001	1.070	0.013	0.002	0.168	0.281					
LLITCOIN	0.006	0.359	0.017	0.007	0.061	0.004	0.000	0.085	0.099	0.151				
LDASH	0.018	0.956	0.044	0.016	0.522	0.005	0.000	0.047	0.103	0.100	0.217			
LDIGIBYTE	0.0036	2.084	0.214	0.025	1.788	0.001	0.002	0.097	0.270	0.143	0.343	0.894		
LXEM	0.017	0.768	0.041	0.012	0.550	0.006	0.000	0.061	0.127	0.079	0.176	0.341	0.455	
LRIPPLE	0.003	0.590	0.057	0.002	0.683	0.009	0.001	0.119	0.171	0.097	0.108	0.179	0.085	0.292

The variances of the traditional and digital assets are plotted on the diagonal of the matrix. We can see that the accuracy of each financial asset is very good, as the variance is generally small. However, there is a large variance in the Frankfurt stock market Index (DAX) and the Russian financial Index. During this period of war, cryptocurrencies have been shown to be characterized by low variance and low risk. The dependence measured by the covariance outside the diagonal of the matrix is very small. In addition, the interaction between exchange markets is tight, and the reaction of crypto assets is low compared to other traditional financial assets. We use the overall correlation matrix shown in Table 3 to identify various relative dependencies between stock market indices and cryptocurrencies.

Table -3- Total Correlation Matrix

	LS&P500	LDAX	LNKEI225	LTSX	LMOEX	LCAC40	LPFTS	LBITCOIN	LETHEURM	LLITCOIN	LDASH	LDIGIBYTE	LXEM	LRIPPLE
LS&P500	1.000													
LDAX	0.387	1.000												
LNKEI225	0.007	0.206	1.000											
LTSX	0.899	0.396	0.047	1.000										
LMOEX	0.195	0.634	0.313	0.025	1.000									
LCAC40	0.417	0.331	0.395	0.504	0.690	1.000								
LPFTS	0.029	0.399	0.513	0.127	0.616	0.779	1.000							
LBITCOIN	0.054	0.107	0.150	0.079	0.246	0.262	0.165	1.000						
LETHEURM	0.180	0.425	0.125	0.040	0.596	0.389	0.349	0.815	1.000					
LLITCOIN	0.289	0.277	0.027	0.377	0.046	0.171	0.015	0.563	0.478	1.000				
LDASH	0.723	0.617	0.057	0.732	0.331	0.181	0.005	0.258	0.417	0.552	1.000			
LDIGIBYTE	0.691	0.662	0.137	0.566	0.559	0.023	0.196	0.262	0.539	0.388	0.778	1.000		
LXEM	0.452	0.342	0.307	0.387	0.241	0.142	0.052	0.231	0.354	0.301	0.529	0.534	1.000	
LRIPPLE	0.098	0.328	0.064	0.098	0.374	0.261	0.170	0.564	0.595	0.460	0.429	0.351	0.233	1.000

Analyzing this table revealed a small, if not significant, dependency between various stock market indices and cryptocurrencies during the ongoing war between Russia and Ukraine. Therefore, it is noted that the war crisis will not spread to various international financial and cryptocurrency markets. This lack highlights the independence of exchanges and cryptocurrency markets

We continue to explore the non-stationarity of the following seven cryptocurrencies and seven traditional assets, both at level and at first difference. We look for the presence or absence of unity roots, with or without trend breaks.

A test for non-stationarity without trend breaks is used for the traditional and numerical assets. The optimal number of lags, T-statistics, and corresponding specifications in level and first difference are plotted in table 4.

From Table 4, we can see that financial assets are subjected to the [34]-[35] test with the optimal number of lags set to 1. Financial asset t-statistics, in level, exceed [36] critical values for each specification, even without constants or trends. The logarithm of the S&P500 Index is modeled using specifications that include constant but not trend. The CAC40 index is specified by including both a constant and a trend. Using the first difference, we find that these traditional financial assets become stationary, as their T-Statistics are

lower than the tabulated values of [36]. Therefore, financial assets are I(1).

Next, we apply [36] test to cryptocurrencies series, as their optimal number of lags are strictly greater than one, with the exception of Ethereum and Ripple, where the optimal number of lags is 1. Each of these cryptocurrencies was tested including both constants and trends. Litecoin, however, was an exception, having a constant but no linear trend. Cryptocurrencies series are stationary in level, as the T-Statistics are below the Mackinnon critical values.

Table -4- Dickey-Fuller (1979-1981) Tests

	Lags	Level			First difference		
		Model	T-Stat	Critical value	Model	T-Stat	Critical value
LS&P500	1	M2	-2.4546	-2.8684	M2	-21.4525	-2.8684
LDAX	1	M1	0.3566	-1.9416	M1	-20.260	-1.9416
LNKEI225	1	M1	0.81278	-1.9416	M1	-20.2811	-1.9416
LTSX	1	M1	-0.0813	-1.9416	M1	-19.481	-1.9416
LMOEX	1	M1	0.1809	-1.9416	M1	-20.2054	-1.9416
LCAC40	1	M3	-2.1905	-3.4208	M3	-22.1881	-3.4208
LPFTS	1	M1	-1.3955	-1.9416	M1	-20.2485	-1.9416
LBITCOIN	3	M3	-6.9796	-3.4211	M3		
LETHEURM	1	M3	-7.6607	-3.4211	M3		
LLITCOIN	2	M2	-6.8808	-2.8683	M2		
LDASH	3	M3	-3.9476	-3.4211	M3		
LDIGIBYTE	5	M3	-3.5704	-3.4211	M3		
LXEM	4	M3	-6.1229	-3.4211	M3		
LRIPPLE	1	M3	-9.2078	-3.4211	M3		

The problem of heterogeneity and autocorrelation in financial and digital assets presents serious statistical criticisms that can be addressed using the [34]-[35]. Since the data are daily, we perform the [37] to overcome any remaining autocorrelation and/or hetero-correlation issues. Table 5 summarize [37] test.

Table -5- Philips-Perron (1988) Test

	Lags	Level			First difference		
		Model	T-Stat	Critical value	Model	T-Stat	Critical value
LS&P500	1	M2	-2.454629	-2.868405	M2	-21.45250	-2.868457
LDAX	1	M1	0.356601	-1.941594	M1	-20.25979	-1.941596
LNKEI225	1	M1	0.812779	-1.941594	M1	-20.28113	-1.941596
LTSX	1	M1	-0.081337	-1.941594	M1	-19.48081	-1.941596
LMOEX	1	M1	0.180959	-1.941594	M1	-20.20537	-1.941596
LCAC40	1	M3	-2.190550	-3.420768	M3	-22.18808	-3.420768
LPFTS	1	M1	-1.395485	-1.941594	M1		
LBITCOIN	3	M3	-8.509134	-3.420930	M3		
LETHEURM	1	M3	-7.660756	-3.421270	M3		
LLITCOIN	2	M2	-8.175296	-2.868336	M2		
LDASH	3	M3	-4.933788	-3.420768	M3		
LDIGIBYTE	5	M3	-6.186188	-3.420768	M3		
LXEM	4	M3	-11.46808	-3.420768	M3		
LRIPPLE	1	M3	-9.207821	-3.420768	M3		
LRIPPLE	1	M3	-9.207821	-3.420768	M3		

The [37] test confirms the non-stationarity of financial assets in level, as the T-statistic exceeds the critical value by 5%. Considering the first difference, financial assets are stationary as long as the t-statistic is statistically significant. Therefore, financial assets have an identical order of integration I(1) and cryptocurrencies are I(0). The results of [37] are consistent with previous tests by [34]-[35], suggesting that heterogeneity of residual variance does not affect traditional and digital assets.

The [38] test is applied to our data to study the non-stationarity with structural breaks. Table 6 shows the results of this test in level and first-order difference and the break-up date.

	Level			First difference		
	T-Stat (Alpha)	Critical value	TB	T-Stat (Alpha)	Critical value	TB
LS&P500	-3.60828	-5.08	2022:05:03	-5.83332	-5.08	2022:06:15
LDAX	-181.14620	-5.08	2022:07:20			
LNIKEI225	-227.72040	-5.08	2023:03:12			
LTSX	-4.43706	-5.08	2022:06:06	-5.65969	-5.08	2022:06:15
LMOEX	-147.46925	-5.08	2022:10:18			
LCAC40	-4.21870	-5.08	2022:10:22	-7.53509	-5.08	2022:09:28
LPFTS	-15.66201	-5.08	2023:01:04			
LBITCOIN	-5.81877	-5.08	2022:11:13			
LETHEURM	-5.76958	-5.08	2022:11:23			
LLITCOIN	-5.27883	-5.08	2022:10:31			
LDASH	-4.62535	-5.08	2022:08:25	-9.82313	-5.08	2022:04:09
LDIGIBYTE	-8.78649	-5.08	2022:09:18			
LXEM	-12.96182	-5.08	2023:01:26			
LRIPPLE	-4.73715	-5.08	2022:11:24	-9.94008	-5.08	2023:03:19

The results of the [38] show that the natural logarithms of stock market indicators for the US, Canada, and France show trend breaks and are not stationary in level. However, after one single difference, they become stationary. These indices are therefore integrated at order one with different delays. The other traditional assets and the 5 cryptocurrencies are integrated at order zero. DASH and Ripple series, in logarithmic terms, are not stationary in level, as their T-Statistics exceed the simulated critical value. After a first difference, Ripple and DASH become stationary, which means that they are integrated at order one with different lags.

We use [39] causality test to analyze nexus between stock market indices and cryptocurrencies. We verify the direction of causality for each traditional financial asset and virtual currency. Table 7 summarize the results. The natural logarithm of the Russian stock index causes, in the sense of [39], the prices of tow cryptocurrencies BITCOIN and DIGIBYTE. The Ukrainian financial market Index causes just Ethereum prices in logarithmic terms according to [39] sense with no impact in the other cryptocurrencies. The German stock market Index in logarithmic terms causes five digital assets ETHEREUM, LITCOIN, DIGIBYTE, XEM and RIPPLE prices in the same sense of [39]. However, cryptocurrency are not impacted by the US, Canadian, French and Japanese financial markets.

Variables endogènes	Variables explicatives	Stat-F	Significativités	Décision
LBITCOIN	ALS&P500	F(2,406) = 0.01324	0.98684921	ALS&P500 do not cause LBITCOIN
	LDAX	F(2,406) = 1.09910	0.33416068	LDAX do not cause LBITCOIN
	LNIKEI225	F(2,406) = 1.07874	0.34099544	LNIKEI225 do not cause LBITCOIN
	ALTSX	F(2,406) = 0.15929	0.85279889	ALTSX do not cause LBITCOIN
	LMOEX	F(2,406) = 3.00545	0.05061926	LMOEX cause LBITCOIN
	ALCAC40	F(2,406) = 0.27840	0.75714191	ALCAC40 do not cause LBITCOIN
	LPFTS	F(2,406) = 2.22473	0.10941253	LPFTS do not cause LBITCOIN
LETHEURM	ALS&P500	F(2,406) = 0.06980	0.93259180	ALS&P500 do not cause LETHEURM
	LDAX	F(2,406) = 4.17996	0.01596258	LDAX cause LETHEURM
	LNIKEI225	F(2,406) = 0.51707	0.59665985	LNIKEI225 do not cause LETHEURM
	ALTSX	F(2,406) = 0.36767	0.69257881	ALTSX do not cause LETHEURM
	LMOEX	F(2,406) = 11.68515	0.00001164	LMOEX do not cause LETHEURM
	ALCAC40	F(2,406) = 0.18542	0.83082968	ALCAC40 do not cause LETHEURM
	LPFTS	F(2,406) = 3.90136	0.02097663	LPFTS cause LETHEURM
LLITCOIN	ALS&P500	F(2,406) = 0.88141	0.41499119	ALS&P500 do not cause LLITCOIN
	LDAX	F(2,406) = 3.49501	0.03126475	LDAX cause LLITCOIN
	LNIKEI225	F(2,406) = 0.14440	0.86558969	LNIKEI225 do not cause LLITCOIN
	ALTSX	F(2,406) = 0.77598	0.46093530	ALTSX do not cause LLITCOIN
	LMOEX	F(2,406) = 0.08652	0.91713302	LMOEX do not cause LLITCOIN
	ALCAC40	F(2,406) = 0.73502	0.48013371	ALCAC40 do not cause LLITCOIN
	LPFTS	F(2,406) = 0.02775	0.97262887	LPFTS do not cause LLITCOIN
LDASH	ALS&P500	F(2,406) = 0.21716	0.80489802	ALS&P500 ne cause pas LDASH
	LDAX	F(2,406) = 5.02755	0.00696888	LDAX do not cause LDASH
	LNIKEI225	F(2,406) = 0.75607	0.47016849	LNIKEI225 do not cause LDASH
	ALTSX	F(2,406) = 0.06630	0.93586458	ALTSX do not cause LDASH
	LMOEX	F(2,406) = 1.60130	0.20290520	LMOEX do not cause LDASH
	ALCAC40	F(2,406) = 0.14091	0.86860704	ALCAC40 do not cause LDASH
	LPFTS	F(2,406) = 0.21132	0.80960033	LPFTS do not cause LDASH
LDIGIBYTE	ALS&P500	F(2,406) = 1.14925	0.31790363	ALS&P500 do not cause LDIGIBYTE
	LDAX	F(2,406) = 7.19717	0.00084809	LDAX cause LDIGIBYTE
	LNIKEI225	F(2,406) = 1.30186	0.27315908	LNIKEI225 do not cause LDIGIBYTE
	ALTSX	F(2,406) = 0.14589	0.86429930	ALTSX do not cause LDIGIBYTE
	LMOEX	F(2,406) = 8.31252	0.00028965	LMOEX cause LDIGIBYTE
	ALCAC40	F(2,406) = 0.51367	0.59868151	ALCAC40 do not cause LDIGIBYTE
	LPFTS	F(2,406) = 1.18589	0.30652922	LPFTS do not cause LDIGIBYTE
LXEM	ALS&P500	F(2,406) = 0.08422	0.91924453	ALS&P500 do not cause LXEM
	LDAX	F(2,406) = 7.44358	0.00066858	LDAX cause LXEM
	LNIKEI225	F(2,406) = 0.30734	0.73557330	LNIKEI225 do not cause LXEM
	ALTSX	F(2,406) = 0.06959	0.93278820	ALTSX do not cause LXEM
	LMOEX	F(2,406) = 2.95284	0.05331349	LMOEX do not cause LXEM
	ALCAC40	F(2,406) = 0.77916	0.45947652	ALCAC40 do not cause LXEM
	LPFTS	F(2,406) = 0.56682	0.56777420	LPFTS do not cause LXEM
LRIPPLE	ALS&P500	F(2,406) = 1.97899	0.13953958	ALS&P500 do not cause LRipple
	LDAX	F(2,406) = 4.76275	0.00902521	LDAX cause LRipple
	LNIKEI225	F(2,406) = 0.62945	0.53340425	LNIKEI225 do not cause LRipple
	ALTSX	F(2,406) = 1.00234	0.36792444	ALTSX do not cause LRipple

	LMOEX	$F(2,406) = 5.59536$	0.00400731	LMOEX <i>do not cause</i> LRipple
	ΔLCAC40	$F(2,406) = 0.00233$	0.99767193	ΔLCAC40 <i>do not cause</i> LRipple
	LPFTS	$F(2,406) = 1.27460$	0.28065817	LPFTS <i>do not cause</i> LRipple

We use Autoregressive Moving Average in level and first difference to model each stock index and crypto-currency. Table 8 shows the specification of each traditional and digital asset.

	Constant	AR (1)	AR(2)	AR(3)	White	LM
ΔLS&P500	-0.000133	-0.061864			2.093400	5.450072
ΔLDAX	0.017034	-0.003047			0.063556	0.027404
ΔLNIKEI225	0.017020	-0.004112			1.361352	0.017188
ΔLTSX	-8.66E-05	0.032884			2.592889	3.592658
ΔLMOEX	0.017221	-0.004956			2.528724	0.001649
ΔLCAC40	0.000246	-0.078037			2.142473	0.128158
ΔLPFTS	-5.80E-05	-0.004750			0.008921	0.014219
LBITCOIN	7.099549	0.704335			0.494835	6.490981**
LETHEURM	2.978477	0.734440	-0.008537	0.145498	13.84178	8.306530**
LLITCOIN	5.052187	0.651015	0.098635		4.308940	1.933644
LDASH	1.258058	0.796805	0.014523	0.120424	5.443854	6.787242**
LDIGIBYTE	1.170501	0.701378	0.062349	0.162202	7.163236	10.64310*
LXEM	5.419484	0.441012	0.118269	0.110694	11.43480	6.743529
LRIPPLE	20.99396	0.719706			11.9717*	15.26950

Analyzing the table above, we can conclude that all conventional financial assets are specified with an autoregressive process of order one in first difference. White test indicates that homogeneity of the residual variances of financial assets is statistically insignificant. We confirm the absence of a residual autocorrelation problem for each asset, as evidenced by the non-significance of the Likelihood Ratio (LR) statistic. Thus, the stability of traditional financial markets during the current war period can be explained by investor anxiety about the unstable business environment on the one hand, and speculator sentiment on new electronic products on the other. Cryptocurrency is a hedge and a safe haven in the face of conflict between Ukraine and Russia.

We used level models to specify the prices of BITCOIN and RIPPLE, each using an order 1 autoregressive process. We identified the presence of residual autocorrelation problems only for BITCOIN prices, whereas RIPPLE prices showed heterogeneity of variance. As for the prices of ETHEREUM, DASH, DIGIBYTE and XEM in logarithmic terms, we modeled them with a third-order autoregressive process. The latter three crypto-currencies have a residual autocorrelation problem, as shown by the statistical significance of their LR statistics. In contrast, no heteroscedasticity issues were observed for the last three cryptocurrencies. Litecoin logarithms were specified using a quadratic autoregressive process with no residual autocorrelation or heterogeneity.

We ran regressions using ordinary least squares (OLS) for each crypto-currency logarithm as a function of the seven

financial assets. This analysis was performed over a study period from February 24, 2022 to April 12, 2023, using daily data frequency. The objective was to examine the impact of these financial assets on crypto-currencies. We also examined the stability of the fundamental value of each crypto-currency relative to its long-term equilibrium. The following table shows the estimates for each regression as well as the residual stationarity tests.

	LBITCOIN	LETHEURM	LLITCOIN	LDASH	LDIGIBYTE	LXEM	LRIPPLE
Constante	92.58582*	65.04318**	-29.02941	53.50438*	26.40645	72.69758	77.52236**
LS&P500	0.176770	3.484842*	-0.722156	2.282668*	11.73860*	5.110214	-2.733410*
LDAX	0.009769	-0.020026**	-0.039403*	-0.049561*	-0.106545*	0.050910	0.000600
LNIKEI225	-0.013877	0.009806	0.002884	-0.006032	-0.044154**	0.043254	0.088792*
LTSX	0.899739	-3.203660	2.770089**	3.586788*	-5.889381*	3.758545	6.802173*
LMOEX	-0.013255	-0.064691*	0.031975*	0.018258**	-0.093580*	0.055251	0.041760**
LCAC40	-2.577238*	-1.162112	0.224521	-0.710262	2.063635	2.873221	-4.236576*
LPFTS	-9.010494*	-4.559071	4.153420	-13.25946*	-10.64104	13.75854	10.27819**
Stationarity of resides							
T-Statistiques	-8.926118	-8.216489	-9.674893	-9.102265	-10.45566	13.42638	-6.281895
Modèles	M1	M1	M1	M1	M1	M1	M1
Valeurs critiques	-1.941632	-1.941632	-1.941632	-1.941632	-1.941632	1.941632	-1.941632

From the results presented in the table, we can observe that the logarithm of the S&P500 index and that of the Canadian stock index have significant positive impact on the logarithm of Bitcoin. The logarithm of the CAC40 index and the Ukrainian stock index have significant negative impacts on Bitcoin prices. The logarithmic stock indices of Germany, Japan and Russia have negligible influences on Bitcoin prices.

The [34] test shows that the BITCOIN target is stationary in level, indicating convergence to its fundamental value. The estimated constant in the regression that relates Bitcoin's prices to the various traditional assets is significantly high. This suggests that the average effect of the omitted variables is strongly positive, meaning that the positive impacts of the explanatory variables outweigh the negative effects of the unobserved variables, with a significantly positive average.

Most financial assets react negatively and significantly to the various crypto-currencies, with the exception of the S&P500 index, which has a positive and significant effect on ETHEREUM, DIGIBYTE and XEM. The cryptocurrency targets are statistically stationary in level, and an adjustment mechanism is present to bring each target back to a partially stable situation in the long run.

IV. CONCLUSION

Our findings highlight significantly high trading volumes for different cryptocurrencies and low trading volume for Russian and Japanese stock indices during this ongoing war period. Results show low information asymmetry indicating lower level of risk for digital money. The causal relationship between financial market indexes and crypto currency coins in the short run indicate that three famous crypto currencies (BITCOIN, ETHEREUM, RIPPLE) and the two digital asset with minor popularity (XEM, Digibyte) are impacted by the

German, Russian and Ukrainian stock markets. Thus, the stability of the traditional financial markets during the current war period can be explained on the one hand by investors' fears of an unstable business climate, and on the other hand by speculators' sentiment towards new electronic products which are perceived as hedging instruments and a safe haven in the face of the conflict between Ukraine and Russia.

In the long run we found a positive and significant effect of the American, Canadian, French and Ukrainian stock market indexes on Bitcoin. Thus, crypto-currency targets are statistically stationary in level, and an adjustment mechanism is present to bring each target back to a partially stable situation in the long run.

According to the results, we can advocate for the absence of contagion effect and transmission of the war crisis to the various international financial markets and cryptocurrency markets. That to say stock exchanges and crypto asset markets are independent during worldwide crises. Bitcoin is stable in the short run with no significant impact of financial market in the long term.

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Banking and Accounting Analysis Researches Effect on Environment

Marina Magdy Naguib Karas

Abstract— New methods of providing banking services to the customer have been introduced, such as online banking. Banks have begun to consider electronic banking (e-banking) as a way to replace some traditional branch functions by using the Internet as a new distribution channel. Some consumers have at least one account at multiple banks and access these accounts through online banking. To check their current net worth, clients need to log into each of their accounts, get detailed information, and work toward consolidation. Not only is it time-consuming, but it is also a repeatable activity with a certain frequency. To solve this problem, the concept of account aggregation was added as a solution. Account consolidation in e-banking as a form of electronic banking appears to build a stronger relationship with customers. An account linking service is generally referred to as a service that allows customers to manage their bank accounts held at different institutions via a common online banking platform that places a high priority on security and data protection. The article provides an overview of the account aggregation approach in e-banking as a new service in the area of e-banking.

Keywords— compatibility, complexity, mobile banking, observation, risk banking technology, Internet banks, modernization of banks, banks, account aggregation, security, enterprise development.

The Revitalization of South-south Cooperation: Evaluation of South African Direct Investment in Cameroon

Albert Herve Nkolo Mpoko

Abstract— The Foreign Direct Investment (FDI) landscape in Cameroon has garnered significant attention from both European and Asian nations due to perceived benefits such as capital infusion, technology transfer, and potential for economic expansion. However, it is noteworthy that South Africa's investment presence remains comparatively subdued in Cameroon, lagging behind that of Europe and Asia. Equally surprising is the limited footprint of Africa's economic powerhouse within other African economies. This study delved into four specific facets of South African investment in Cameroon. Initially, it focused on identifying South African companies operating within Cameroon. Subsequently, the analysis encompassed assessing the correlation between South African investment and poverty alleviation. Additionally, the study examined the nexus between South African investment and technological advancement, and underscored the significance of investment incentives in both countries. Key findings of the research shed light on several crucial points. South Africa ought to reassess its economic engagement with Francophone Africa, particularly Cameroon. Despite existing policies aimed at fostering investment, there remains substantial ground to cover in this realm. The proliferation of South African enterprises in Cameroon holds the potential to ameliorate poverty and foster employment opportunities across both nations. The advent of South African firms in Cameroon can catalyse technological advancements within the region. Data collection involved surveying 100 executives from the respective administrations and conducting ten interviews. The gathered data underwent triangulation, wherein quantitative findings were juxtaposed with qualitative insights. In conclusion, the study underscores the underutilization of Cameroon by South Africa, emphasizing the untapped potential for mutual economic growth. Furthermore, it posits that the success of South Africa's multinational corporations abroad could serve as a pivotal pillar for sustaining its domestic economy.

Keywords— FDI, transfer of technology, South-South cooperation, mutual economic growth.

Strategy Implementation: The Implications of Demographic Perspectives among SME Owners and Managers in Nigeria

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Abstract

What are the socio-demographic characteristics of SME owners/managers that influence the extent of strategy implementation effectiveness? As pointed out by the upper echelons theory, an organisation's degree of strategy implementation is likely to depend on the socio-demographic profile of the owner and manager. In this context, this paper investigates the influence of socio-demographic characteristics of SME owners and managers on strategy implementation in Nigeria. The exploratory study involves 274 respondents, employing a structured questionnaire survey to collect data from SME owner-managers in Lagos, Nigeria. Mann-Whitney test results found that SME male owners and managers in Nigeria displayed a positive and statistically significant on strategy implementation than their female counterparts. The results of Kruskal-Wallis test show that the age, educational level, business experience, and the age of the organisation do not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria. The study discussed the theoretical and practical implications.

Keywords: Strategy implementation, Demographic characteristics, SME owner-manager, Nigeria.

Introduction

Effective strategy implementation in small, medium and in large organisations has now become a major factor in sustaining competitive advantage in the 21st century (Slater, Hult, & Olson, 2010). So, the nature of successful strategy implementation among small and medium enterprises (SMEs) has to turn out to be an established concept in small business management literature because of its positive impact on SME owners and managers (Slater et al., 2010). Given this imperative, managers and researchers have begun to investigate the causes of strategy implementation failure, challenges, and obstacles in successful strategy implementation among SMEs (Gakure & Amurle, 2013; Sorooshian et al. 2010; Okumus, 2001). Strategy implementation is "the communication, interpretation, adoption, and enactment of strategic plans" (Noble, 1999) and is extensively perceived as a major determinant of performance. Owners and managers of SMEs therefore, need to play a pivotal role to ensure that the strategic plans of their organisations are effectively implemented: on one hand, through concentrated efforts and actions and by all stakeholders within

the organisation (Sage, 2015) and, on the other hand, through what they [i.e. owners and managers of SMEs] themselves are as secluded individuals. As pointed out by the upper echelons theory (Hambrick, 2007; Hambrick and Mason, 1984), an organisation somewhat reflects the socio-demographic features of her top management, for instance, empirical review shows that the manager's gender influences the implementation capabilities in sales organisations (Lane, 2005; Comer & Drollinger, 1997; Comer & Jolson, 1991; Comer *et al.*, 1995).

Meanwhile, empirical inquiries on whether the socio-demographic characteristics of owners and managers of SMEs influence strategy implementation of their organisation is still sporadic. The abundant studies carried out on strategy implementation are mostly concentrated on a narrow gamut of issues such as missions and control systems, strategy and structure, formalised programmes of change, budgeting and resource allocation, and goals (Cespedes & Piercy, 2002; Lane, 2005; Jong *et al.*, 2017). Comparatively, little consideration is given to the personal characteristics of owners and managers in relation to strategy implementation effectiveness. Consequently, to extend the existing knowledge of strategy implementation literature, this study draws on the upper echelons theory (UCT) to investigate the relationship between the socio-demographic characteristics of owners and managers of SMEs and strategy implementation effectiveness of a sample of 274 owners and managers of Nigerian small and medium-sized enterprises.

As pointed out by Hambrick & Mason (1984) successful implementation of strategies depends on the owners or managers' background traits or characteristics which, in turn, have significant implications on the organizational performance level. The UET however, advocates that the more complex a decision, for example, strategy implementation measures, the more important the individual characteristics of the decisions makers, such as age, educational level, business experience, and age of the organisation. According to Nielsen, (2010) the UET recognizes that firms' owners or managers' different characteristics such as age, educational level, business experience, and age of the organisation affect their decisions on strategy implementation and in turn, will directly affect organizational performance. The UET further maintains that firms' owners or top managers characterised by bounded rationality will make a decision or judgment based on their social, cognitive, and physiological features. Hence, this study seeks to identify the socio-demographic characteristics that influence strategy implementation effectiveness of SMEs other than the manager's gender. In addition to extending existing research on the strategy implementation process, this study aims to contribute more generally to the strategic management literature by applying the upper echelons theory and assessing strategy implementation effectiveness via socio-demographic measures with SMEs in Nigeria, since to the best of the author's knowledge, this is the first study that investigates the effects of socio-demographic variables of executives/managers on strategy implementation of Nigerian SMEs. That is the research gap which this study is motivated to fill.

Consequently, evaluating the relative influences of socio-demographic characteristics (e.g. gender, age, educational level, business experience, and the age of the organisation) of owner or manager on strategy implementation effectiveness in one single quantitative study other than gender alone as found in previous studies (Lane, 2005; Comer & Drollinger, 1997; Comer & Jolson, 1991; Comer *et al.*, 1995) will hopefully, provide a better understanding in this vital area of strategic management literature in developing economies. In addition, the results of the research will have the potential to contribute to policy debates about the improvement of the strategy implementation

process within the context of small and medium-sized enterprises in Nigeria and developing countries. The paper, however, addresses the following research question: What are the socio-demographic characteristics of SME owners and managers that influence the degree of strategy implementation effectiveness? The paper is organized as follows. First, the introduction presents the need and justification to conduct the study. This leads to the review of literature and development of hypotheses in relation to the study. The next section discusses the research methods used in the study. The findings section presents the results and discussions. Lastly, the conclusion section provides insightful implications and recommendations.

Literature Review and Hypotheses

Strategy implementation

According to Noble (1999), strategy implementation is “the communication, interpretation, adoption, and enactment of strategic plans” while Andrews *et al.* (2011) explain strategy implementation as the process that turns strategic plans into action. Cespedes & Piercy (1996) maintain that strategy implementation is the attainment of the strategy’s goals through apposite actions. Meanwhile, a review of literature has recognised that crafting strategies is not difficult than making them work under company, competitor, and customer restrictions (Sage, 2015; David, 2011; Carter & Pucko, 2010). Effective strategy implementation among SMEs, and in large organisations are influenced by factors which include the following: (a) organizational structure (Oslo, Slater & Hult, 2005; Chandler, 1962), (b) leadership styles (Jooste & Fourie, 2009; Sorooshian *et al.*, 2010; Okwachi *et al.*, 2013), (c) Human resources (Myloni, Harzing & Mirza, 2004; Wei, 2006; Lee, Lee & Wu 2010), (d) managing culture (Rinke, 1998; Lasher, 1999; Burns, 2001) and (e) budgeting (Lasher, 1999; Kuratko & Hodgetts, 2001). Although myriad factors are influencing the effectiveness of strategy implementation, this study has chosen to focus on the aforementioned drivers of strategy implementation.

Socio-demographic Profile of SME Owners and Managers and Strategy implementation

The relevant question is, “What are the socio-demographic characteristics of SME owners and managers that influence the extent of strategy implementation effectiveness?” As noted by the UET, an organisation’s characteristics are fairly a reflection of the psychological and socio-demographic profile of its owners or managers (Hambrick and Mason, 1984). Meanwhile, numerous studies have long-established that the features of owners and managers influence an organisation’s degree of market strategy implementation (Quinn, 1980; Bailey & Johnson, 1997; Stewart & Kringas, 2003). The effect of owner’s or manager’s socio-demographic profile on effective strategy implementation has a few formal research studies, in contrast to the manager’s gender (Lane, 2005). It has been empirically proven that female sales managers displayed a slightly higher level of vigor in strategy implementation effectiveness when compared to their male counterparts (Lane, 2005; Comer & Drollinger, 1997; Comer & Jolson, 1991; Comer *et al.*, 1995). However, according to UET, owner and manager’s strategic decisions are probable to be influenced by socio-demographic features other than gender, e.g. age, educational level, business experience, and age of the organisation (Hambrick and Mason, 1984). In this paper, to gain an insightful knowledge on the association between the socio-demographic profile of the SME owners and managers and strategy implementation effectiveness, this study examines the following five socio-demographic characteristics: gender, age, educational level, business

experience, and age of the organisation. Based on the foregoing review, this study suggests the following five hypotheses:

Hypothesis 1: There is no statistically significant difference in strategy implementation of male and female SME owners and managers in Nigeria.

Hypothesis 2: Age does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

Hypothesis 3: Educational level does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

Hypothesis 4: Business experience does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

Hypothesis 5: The age of the organisation does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

Methodology

Sample and procedure

To empirically test the relative influences of socio-demographic characteristics of SME owners and managers on strategy implementation effectiveness, the sample for this study was drawn from SME owners and managers in Lagos state, Nigeria. This is justified by the fact that Lagos is the commercial hub of Nigeria, where the majority of the SMEs operate (CBN, 1999). The study surveyed SMEs' owners and managers using a convenient sampling technique and a questionnaire (via a web link google form). The rationale for employing convenience sampling in this study as pointed out by Starmass (2007), convenience sampling has been marked to be most apt for a population that is homogeneous since it is cost-effective and time-saving. The response rate recorded was 63.5%, which means 292 participants completed the questionnaires out of which 274 were deemed useable for the study. A pilot study was carried out to establish the reliability coefficient of the strategy implementation measures (SI) developed by Andrews *et al.*, (2011). Examples of items that measured the strategy implementation effectiveness of SME owners and managers included: "when implementing strategies, we have clearly defined tasks", "we have weekly—monthly plans to implement strategies", ... "our strategy develops through a process of ongoing adjustment while implementing". All the 10 items were rated on a five-point frequency-based scale (5= strongly agree, 1 = strongly disagree). The Cronbach's alpha for the scale was found to be 0.84 which was deemed to be appropriate (Field, 2005). As pointed out by Pallant (2010), any reliability coefficient that is equal to 0.7 or more is assumed to be statistically significant. The reliability test, therefore, indicates the ability of the instrument to generate a reliable result. Also, the choice of the study to survey SME owners and managers is a result of their involvement in the strategy implementation processes of their organizations.

See table below:

TABLE 1. Respondents' Demographic Variables

Variable	Value Label	Respondents (%)	Total
Gender	Male	166(60.6)	274(100%)
	Female	108(39.4)	
Age	18 – 24 years	3(1.1)	274(100%)
	25 -34 years	93(33.9)	
	35 - 44 years	93(33.9)	
	45 - 54 years	74(27.0)	
	Over 55 years	11(4.0)	
Education	Secondary	9(3.3)	274(100%)
	Bachelor's Degree or equivalent	115(42.0)	
	Master's Degree	140(51.1)	
	Doctorate Degree	10(3.6)	
Business Experience	0 – 5 years	94(34.3)	274(100%)
	6 – 10 years	70(25.5)	
	11 – 15 years	51(18.6)	
	16 – 20 years	31(11.3)	
	Above 20 years	28(10.2)	
Age of Organisation	Less than 5 years	111(40.5)	274(100%)
	5-10 years	64(23.4)	
	11-15 years	23(8.4)	
	16-20 years	8(2.9)	
	Above 20 years	68(24.8)	

Data Analysis

To test for the normality of the data the Kolmogorov-Smirnov test was employed. The result revealed that the ten items and the variable were significant. Based on this the study applied a non-parametric test. Mann-Whitney test was employed to test if there were differences in strategy implementation of male and female SME owners and managers. Furthermore, the Kruskal-Wallis test was employed to test if the age, educational level, business experience, and age of the organisation significantly influence the strategy implementation effectiveness of SME owners and managers in Nigeria. These analyses were carried out with aid of SPSS version 26.

Results and Discussion

The main objective of this study was to investigate the influences of socio-demographic characteristics of SME owners and managers on strategy implementation effectiveness in Nigeria. To examine the influence of age, educational level, business experience, and the age of the organisation on strategy implementation effectiveness among SME owners and managers in Nigeria, the Kruskal-Wallis test was conducted, while the Mann-Whitney test was performed to examine the difference in strategy implementation effectiveness between male and female SME owners and managers.

The first hypothesis pertained to examining the difference in strategy implementation effectiveness between male and female SME owners and managers. Table 2 presents the results of the Mann-Whitney's U test. As shown in Table 2, the result revealed an average range for males as 149.87 and females 118.49. As visible from the table, the Mann-Whitney's U test has a value of 6,911 with a p-value of 0.001 which is less than .05. This implies that the SME male owners and managers in Nigeria displayed a slightly higher level of vigor in strategy implementation effectiveness when compared to their female counterparts. Based on the results, the study rejects

the hypothesis that there is no statistically significant difference in strategy implementation of male and female SME owners and managers in Nigeria. These findings contradict the findings of the studies where women demonstrate a superior level of strategy implementation effectiveness when compared to their men counterparts (Andrews, Beynon, & Genc 2017; Lane 2005; Beyer 1990). The interpretation for this findings however, would require some care. Probably that the differences in the results could be accredited to diverse cultural contexts and the present economic situation of the country as at when the study was conducted. For example, the discriminatory socio-cultural values and customs on women entrepreneurs in Nigeria and other African countries as pointed out by Adesua & Lincoln (2011), could partly explain the results based on the perception of a patriarchal society where men tend to be superior to women, which limits women's access to acquisition of special skills such as strategy formulation and implementation skills, managerial skills, negotiating skills, self-awareness, personal skills, and assertiveness necessary to undertake entrepreneurial ventures. Another probable and remote cause of SME female owners and managers in Nigeria has displayed a low level of vigor in strategy implementation effectiveness could be due to the proliferated responsibility assigned to a woman to act simultaneously as a wife, a mother or a sister versus employment.

Table 2 Average gender ranges and Mann-Whitney's U test

	Gender	N	Average Range	Statistics	Value
Strategic implementation	Male	166	149.87	Mann-Whitney's U test	6,911
	Female	108	118.49	Wilcoxon W	12,797
	Total	274		Standard error	638.854
				Asymptotic Sig (2-side test)	.001

To examine the second hypothesis whether age does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria, the Kruskal-Wallis test was conducted (Table 3). The results show the average ranges resulting from the Kruskal-Wallis test which reveals a higher value from ages 25 above, and a value of .538 from the Kruskal-Wallis test. While the p-value is 0.97, which is greater than 0.05. Based on the results in Table 3, the study fails to reject the hypothesis that age does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

On the issue of no association between age and strategy implementation among SME owners and managers, the result of the study provides credence for the studies by (Andrews et al., 2017) that established no significant age differences in levels of strategy implementation. It is also consistent with the perspectives of upper echelons of the organization (Hambrick & Mason, 1984), who noted that owners and managers of entrepreneurial ventures irrespective of their ages are more likely to have a positive perception of strategy implementation effectiveness of their organization than those in the lowest echelon.

The possible explanation that could be given to this finding that established no significant age difference in strategy implementation among SME owners and managers in Nigeria is that both young and old SME owners and managers most probably have the same expectations to perform optimally as cultural status in Nigerian society frowns at any entrepreneurs regardless of their age who fail to strive. For instance, friends, associates, family members may disassociate themselves from entrepreneurs who fail in their businesses; in the same manner, banks shut them down and the media dishearten.

Table 3 Average age ranges and Kruskal-Wallis test

	Age brackets	N	Average Range	Statistics	Value
Strategic implementation	18 - 24	3	111.50	Kruskal-Wallis test	.538
	25 – 34	93	140.67	Degree of freedom	4
	35 – 44	93	135.54	Asymptotic Sig (2-side test)	0.97
	45 – 54	74	137.29		
	Over 55 years	11	135.77		
	Total	274			

Again, to examine whether educational level does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria, the educational qualifications of respondents were in four categories; secondary school certificate, B.Sc./B.Ed., Master's degree, and Doctorate. Data were analyzed using the Kruskal-Wallis test (see Table 4). The table shows the average ranges resulting from the Kruskal-Wallis test which reveals a higher value for the first-degree holders, and a value of 3.960 from the Kruskal-Wallis test. While the p-value is 0.266, which is greater than 0.05. Based on the results, the study accepted the hypothesis that educational level does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria. The finding of this study confirms the findings of Andrews et al., (2017) who in their study found there is no significant effect of educational level on strategy implementation of managers. The foregoing also gives credence to what was reported by (Mathieu, & Zajac,1990) who in their studies found no significant effects of educational qualifications on levels of organizational performance of workers. This corroborates Avery, McKay & Wilson, (2007), argument that the educational level of a manager is not a significant predictor of performance and work engagement. Therefore, the probability of strategy implementation effectiveness depends more likely on how the owner or manager of an SME firm perceives the performance of his or her organization.

Table 4 Average educational level range and Kruskal-Wallis test

	Educational level	N	Average Range	Statistics	Value
Strategic implementation	Secondary	9	104.67	Kruskal-Wallis test	3.960
	BSc/B.Ed.	115	146.89	Degree of freedom	3
	Master's Degree	140	131.67	Asymptotic	.266
	Doctorate	10	140.75		
	Total	274			

To examine whether business experience does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria, the number of years of business experience of the respondents were grouped into five categories: 0 – 5years, 6–10 years, 11–15 years, 16 – 20 years and above 20 years. Table 5 shows the average ranges resulting from the Kruskal-Wallis test which reveals a higher value for 16 – 20yrs, and a value of 6.307 from the Kruskal-Wallis test. While the p-value is 0.177, which is greater than 0.05. Based on the results, the study accepted the hypothesis that business experience does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

The result of this study disconfirms the finding of Ng & Feldman (2010), who in their studies reported significant differences in the achievement of managers with a long time of experience. However, the result of this study is also consistent with the perspectives of Andrews et al., (2017) who in their study found no significant association between years of experience and strategy implementation effectiveness among managers. This probably suggests that SME owners and managers regardless of their length of experience under this study were more inclined to hold a positive view on the goal orientation that predicts the success of any SMEs within the psychosocial environment in which this study was conducted. These dimensions of goal orientation which have enabled strategy implementation effectiveness among owners or managers of SMEs in Nigeria as pointed out by Isiwu & Onwuka (2017) include the ‘performance approach orientation’- strive to demonstrate abilities and expertise and to do better than others, and ‘performance-avoidance approach orientation’- strive to avoid failure.

Table 5 Average business experience range and Kruskal-Wallis test

	Business Experience	N	Average Range	Statistics	Value
Strategic implementation	0 – 5yrs	94	137.02	Kruskal-Wallis test	6.307
	6 – 10yrs	70	147.85	Degree of freedom	4
	11 – 15yrs	51	114.65	Asymptotic Sig (2-side test)	.177
	16 – 20yrs	31	149.98		
	Above 20yrs	28	141.05		
	Total	274			

To examine whether the age of the organisation does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria, the age of respondents’ organisation were in eight categories; less than 5years, 5 – 10years, 11 – 15years, 16 – 20years, above 20 years. However, the Kruskal-Wallis test, as shown in Table 6, indicates no significant association (p-value is 0.843, which is greater than 0.05) between strategy implementation among SME owners and managers in Nigeria and the age of the organization. Meanwhile, the Kruskal-Wallis test reveals a higher value for 16 – 20years and a value of 1.406 from the Kruskal-Wallis test. Based on the results in Table 6, the study fails to reject the hypothesis that the age of the organisation does not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria. The findings follow the expectation of this study and probably the reason could be that since the owners and managers of the SMEs under this study regardless of the length of the age of their organisations know that organizational success of their firm will have either positive or negative impact on their livelihood, survival, and wellbeing. The owners or managers of these SMEs recognizing the impact of their organizational success on the emancipation from poverty, need for individual’s freedom, control, and authority (Calvin, 2012) makes them more to engage in the successful strategy implementation of their organizations.

Table 6 Average age ranges of organisation and Kruskal-Wallis test

	Age brackets	N	Average Range	Statistics	Value
	Less than 5yrs	111	139.82	Kruskal-Wallis test	1.406
	5 – 10yrs	64	135.05	Degree of freedom	4

Strategic implementation	11 – 15yrs	23	124.33	Asymptotic Sig (2-side test)	0.843
	16 – 20yrs	8	159.25		
	Above 20 years	68	137.90		
	Total	274			

Implications

This study has contributed to knowledge in both theory and practice. In terms of theoretical implications, this study contributes to strategic management literature by expanding how the socio-demographic characteristics of SME owners and managers influence the strategy implementation effectiveness of their organisations. The importance of the demographics on their right was established in the study. The importance of demographic characteristics of SME owners and managers in stimulating effective strategy implementation which, in turn, will increase the performance and sustainability of SME firms is acknowledged by scholars (e.g. Hambrick & Mason, 1984; Andrews et al., 2017). This study applied the upper echelons theory to explain how strategy implementation effectiveness is affected by the gender, age, educational level, business experience, and the age of the organisation, thereby reinforcing our understanding of demographic characteristics of managers in the upper echelons of the organization as an explanatory pathway to successful strategy implementation.

Moreover, ascertaining the antecedents of demographic characteristics as the predictors of successful strategy implementation using samples of SME owners-managers in Lagos, Nigeria, which is a developing country has helped bridge the gap in strategic management literature. In addition, the application of a non-parametric test (i.e. Mann-Whitney test and Kruskal-Wallis test) to the literature on demographic characteristics of SME managers and strategy implementation fills a methodological gap. To the best of the knowledge of the researcher, this is the first study on demographic characteristics of SME managers and strategy implementation to be conducted within the Nigerian context employing Mann-Whitney test to ascertain the differences in strategy implementation of male and female SME managers and the Kruskal-Wallis test to see if there are links between age, educational level, business experience, the age of the organisation and strategy implementation of SMEs

From the practice point of view, this study implies for SME owners-managers. First, it underscores the importance of demographic characteristics of SME owners-managers and strategy implementation. The study results indicate that SME owners-managers regardless of their age, education, experience, the age of the organisations should know that success of their organisations rest on them. For example, as pointed out by Andrews *et al.*, (2017), it is the sole responsibility of managers in the upper echelons of the organization (i.e. SME owners and managers) to perceive the performance of their organization positively than those than those in the lowest echelon. Therefore, SME owners and managers need to pay attention to ensure successful strategy implementation of their organizations since it has significant impact not only their livelihood, survival, and wellbeing but also could position the organization to gain and sustain competitive advantage. Secondly, the study revealed that SME male owners and managers in Nigeria displayed a positive and statistically significant on strategy implementation effectiveness than their female counterparts. It is noteworthy to understand this finding provides a useful guide to successive governments in Nigeria, various organisations that promote women entrepreneurship, and SMEs policymakers on the need to organize workshops, seminars, and training for both existing and intending female SME owners and managers to impart women with the skills necessary to

overcome cross-cultural barriers such skills will not only allow them to come out openly to undertake entrepreneurial ventures but will also enable to understand internal process of strategic management process which include successful strategy implementation. The skill development programmes according to Chitsike (2000), should include; enrichment of managerial skills, personal skills, negotiating skills, self-awareness and assertiveness. The need to develop programmes that tailored toward educating men on the need to take cognizance of the effects of their behaviour towards women, more especially on women participation in entrepreneurial activities should be considered by the governments and SMEs policy-makers. The reason is that participation of women in entrepreneurial activities has significant effects not only in the family but also in the national and global economy.

Conclusion

The study was aimed at investigating the influences of socio-demographic characteristics of SME owners and managers on strategy implementation effectiveness in Nigeria. The study applied the non-parametric test, Mann-Whitney test was employed to test if there were differences in strategy implementation of male and female SME owners and managers while the Kruskal-Wallis test was employed to test if the age, educational level, business experience, and age of the organisation significantly influence the strategy implementation effectiveness of SME owners and managers in Nigeria. The choice of method was based on test for the normality of the data using the Kolmogorov-Smirnov test. The outcome of the Mann-Whitney revealed that SME male owners and managers in Nigeria displayed a positive and statistically significant on strategy implementation effectiveness than their female counterparts while the results of Kruskal-Wallis test revealed that the age, educational level, business experience, and the age of the organisation do not have a statistically significant influence on strategy implementation among SME owners and managers in Nigeria.

Based on the outcome of the study, the study recommends that SME owners and managers regardless of their age, educational level, business experience, and the age of the organisation need to pay attention to ensure successful strategy implementation of their organizations since it has significant impact not only their livelihood, survival, and wellbeing but also could position the organization to gain and sustain competitive advantage. Furthermore, successive governments in Nigeria, various organisations that promote women entrepreneurship, and SMEs policymakers need to organize workshops, seminars, and training for both existing and intending female SME owners and managers to impart women with the skills necessary to overcome cross-cultural barriers such skills will not only allow them to come out openly to undertake entrepreneurial ventures but will also enable to understand internal process of strategic management process which include successful strategy implementation.

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Banking and Accounting Analysis Researches Effect on Environment and Income

Gerges Samaan Henin Abdalla

Abstract— Ultra-secured methods of banking services have been introduced to the customer, such as online banking. Banks have begun to consider electronic banking (e-banking) as a way to replace some traditional branch functions by using the Internet as a distribution channel. Some consumers have at least one account at multiple banks and access these accounts through online banking. To check their current net worth, clients need to log into each of their accounts, get detailed information, and work toward consolidation. Not only is it time consuming, but it is also a repeatable activity with a certain frequency. To solve this problem, the concept of account aggregation was added as a solution. Account consolidation in e-banking as a form of electronic banking appears to build a stronger relationship with customers. An account linking service is generally referred to as a service that allows customers to manage their bank accounts held at different institutions via a common online banking platform that places a high priority on security and data protection. Consumers have at least one account at multiple banks and access these accounts through online banking. To check their current net worth, clients need to log into each of their accounts, get detailed information, and work toward consolidation. The article provides an overview of the account aggregation approach in e-banking as a new service in the area of e-banking.

Keywords— compatibility, complexity, mobile banking, observation, risk banking technology, Internet banks, modernization of banks, banks, account aggregation, security, enterprise development.

The Need for Higher Education Stem Integrated into the Social Science

Luis Fernando Calvo Prieto, Raul Herrero Martínez, Mónica Santamarta Llorente, Sergio Paniagua Bermejo

Abstract— The project that is presented starts from the questioning about the compartmentalization of knowledge that occurs in university higher education. There are several authors who describe the problems associated with this reality (Rodamillans, M) indicating a lack of integration of the knowledge acquired by students throughout the subjects taken in their university degree. Furthermore, this disintegration is accentuated by the enrollment system of some Faculties and/or Schools of Engineering, which allows the student to take subjects outside the recommended curricular path. This problem is accentuated in an ostentatious way when trying to find an integration between humanistic subjects and the world of experimental sciences or engineering. This abrupt separation between humanities and sciences can be observed in any study plan of Spanish degrees. Except for subjects such as economics or English, in the Faculties of Sciences and the Schools of Engineering, the absence of any humanistic content is striking. At some point it was decided that the only value to take into account when designing their study plans was “usefulness”, considering the humanities systematically useless for their training, and therefore banishing them from the study plans. forgetting the role they have on the capacity of both Leadership and Civic Humanism in our professionals of tomorrow. The teaching guides for the different subjects in the branch of science or engineering do not include any competency, not even transversal, related to leadership capacity or the need, in today's world, for social, civic and humanitarian knowledge part of the people who will offer medical, pharmaceutical, environmental, biotechnological or engineering solutions to a society that is generated thanks to more or less complex relationships based on human relationships and historical events that have occurred so far. If we want professionals who know how to deal effectively and rationally with their leadership tasks and who, in addition, find and develop an ethically civic sense and a humanistic profile in their functions and scientific tasks, we must not leave aside the importance that it has, for the themselves, know the causes, facts and consequences of key events in the history of humanity. The words of the humanist Paul Preston are well known: “he who does not know his history is condemned to repeat the mistakes of the past.” The idea, therefore, that today there can be men of science in the way that the scientists of the Renaissance were, becomes, at the very least, difficult to conceive. To think that a Leonardo da Vinci can be repeated in current times is a more than crazy idea; and although at first it may seem that the specialization of a professional is inevitable but beneficial, there are authors who consider (Sánchez Inarejos) that it has an extremely serious negative side effect: the entrenchment behind the different postulates of each area of knowledge, disdaining everything. what is foreign to it.

Keywords— STEM, higher education, social sciences, history.

Adopting English as a Language of Instruction of STEM in Tunisian Higher Education Institutions: Promises and Challenges

Mimoun Melliti

Abstract— This research paper investigates the promises, challenges, and perspectives associated with teaching STEM subjects in English within Tunisian higher education institutions. The study explores the potential benefits of English-medium instruction in Science, Technology, Engineering, and Mathematics (henceforth STEM) education, with a special focus on enhanced global competitiveness, improved English language proficiency, and increased access to international resources and collaborations. Additionally, it examines the various challenges faced by educators and students, such as language shift/barriers, curriculum adaptation, faculty training, and student support. Through a comprehensive analysis of promises and challenges, this paper aims to provide insights and recommendations for effectively implementing English medium instruction (henceforth EMI) of STEM in Tunisian higher education institutions. The paper concludes with a recommended action plan for the proper introduction of EMI of STEM in Tunisia.

Keywords— EMI, STEM education, EFL, language reforms.

Hybrid Learning and Testing at times of Corona: A Case Study at an English Department

Mimoun Melliti

Abstract— In the wake of the global pandemic, educational systems worldwide faced unprecedented challenges and had to swiftly adapt to new conditions. This necessitated a fundamental shift in assessment processes, as traditional in-person exams became impractical. The present paper aims to investigate how educational systems have adapted to the new conditions imposed by the outbreak of the pandemic. This paper serves as a case study documenting the various decisions, conditions, experiments, and outcomes associated with transitioning the assessment processes of a higher education institution to a fully online format. The participants of this study consisted of 4666 students from health, engineering, science, and humanities disciplines, who were enrolled in general English (Eng101/104) and English for specific purposes (Eng102/113) courses at a preparatory year institution in Saudi Arabia. The findings of this study indicate that online assessment can be effectively implemented given the fulfillment of specific requirements. These prerequisites encompass the presence of competent staff, administrative flexibility, and the availability of necessary infrastructure and technological support. The significance of this case study lies in its comprehensive description of the various steps and measures undertaken to adapt to the "new normal" situation. Furthermore, it evaluates the impact of these measures and offers detailed recommendations for potential similar future scenarios.

Keywords— hybrid learning, testing, adaptive teaching, EFL.

Promoting Effective Institutional Governance in Higher Education for Sustainable Academic Future. A Case Study for Nigerian Universities System

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Abstract

This paper focused on promoting effective institutional governance in higher education for sustainable academic future. A case study for Nigerian universities system. The paper analyzed that in contemporary Nigerian universities system, a discourse on promoting effective institutional governance in higher education is pleasant given her current economic, political, and social dimensions. The paper explained that Higher education is the highest form of education rendered by the government of any nation. Higher education consists of institutions such as universities, polytechnics, junior colleges, and various forms of technical specialty schools that are 2-3 years in length of academic programs. Lastly, the paper outlines line-up officers for promotion of effective institutional governance in the University to include vice-chancellor, registrar, bursar, librarian, director of works, deans of faculties and heads of departments.

Keywords: Education, Effective, Governance, Sustainable.

Introduction

In contemporary Nigerian universities system, a discourse on promoting effective institutional governance in higher education is pleasant, given her current economic, political, and social dimensions especially with regard to issues of government and governance in our educational institutions. Development scholars have pointed out that effective governance is a prerequisite for successful development which every institution desire for. The guidelines for promoting effective institutional governance in higher education as may be applicable to university system are those factors traditionally responsible for the operation of higher education institutions which are research, teaching and learning, and community service. Broadly, effective governance is predicated on the existence of a collective or public good, and is also based on a particular combination of economic efficiency, social justice and individual freedom. Economic efficiency in this regard is not only about attaining the maximum individual freedom and satisfaction of personal needs, but also the distribution of wealth and goods in a socially equitable manner. Effective institutional governance is about the creation and maintenance of spaces in which

individual members of the institution have personal freedom to pursue their desires while they produce wealth and goods to be redistributed [1].

Governance is the heart of higher education. It is an essential pre-requisite for involving institution staff members as well as students in the decision-making process. Unfortunately, the implementation level of governance in Nigerian universities are unsatisfactory, and their performances are below the expectation. The growing demand for higher education services, represented by the remarkable rise in students' enrolments in universities around the world, encourages universities to pay more attention to total quality management by upgrading their management systems and methodologies to achieve quality standards. Governance is one of those basic systems, and higher education is the most suitable ground for meeting effective governance standards.

Higher education is the highest form of education rendered by the government of any nation. It comprises all post-secondary education such as universities that are authorized as institutions of higher education by state authorities, polytechnics, junior colleges, and various forms of technical specialty schools that are 2-3 years in length. In Nigeria, the National Policy on Education [2] section 5 described Tertiary Education as the education given after Post Basic Education in institutions such as Universities and Inter-University Centres such as the Nigeria French Language Village, Nigeria Arabic Language Village, National Institute of Nigerian Languages, institutions such as Innovation Enterprise Institutions [IEIS], and Colleges of Education, Monotechnics, Polytechnics, and other specialized institutions such as Colleges of Agriculture, School of Health and Technology and the National Teachers' Institutes [NTI].

For University, the policy stated in a clear term that the university Education shall make optimum contribution to national development with emphasis in intensifying programmes for higher achievement among others.

The main functions of the university are the transmission of knowledge and the training of human minds. University education in Nigeria has witness a number of developmental stages. The number of universities has grown from 4 [Federal university] in 1960s to 262 Universities; 52 Federal Universities, 63 State Universities and 147 private universities [3]. Public universities in Nigeria are established, controlled, administered and funded by the federal and state governments. Their governance is undertaking by governing councils appointed by the State Government if the university is funded by state and Federal Government if it is funded by federal as well as the respective university communities; internal university management; University Senates, while standards are regulated by regulatory agency known as the National Universities Commission. The major responsibility of the National Universities Commission among others include: granting approval for all academic programmes run in Nigerian universities; granting approval for the establishment of all higher educational institutions offering degree programmes in Nigerian universities; ensure quality assurance of all academic programmes offered in Nigerian universities and channel for all external support to the Nigerian Universities.

The university staff comprises of the Academic and Non-teaching. The Academic staff are directly responsible for teaching and research while the Non-teaching staff are responsible for the day-to-day supportive services for the smooth running of the university. The non-teaching staff are grouped into departments, these include: Registry, Bursary, Works and Maintenance, Physical Planning, Health, Sports, Information Technology and Resource Centre and Library services. The day-to-day administration of the university is directly the responsibility of the Registry Department, statutorily accountable to the Registrar. The contribution of university

education to the socio-political, economic and technological advancement of a nation cannot be over emphasized. This is because it is the peak in the three levels of education and also one of the various tertiary educational institutions through which the nation hopes to achieve its vision. Its roles include teaching, research and community services. In order to effectively perform these roles, it thus becomes imperative that its administrative capacity is properly sharpened for effective governance.

Statement of the Problem

The consequences of governance changes for the involvement of individual members of the academic community in the life of the institution is more difficult to assess. As universities have got bigger it is inevitable that individuals find themselves pushed further away from the decision-making process. Universities need effective governance to survive in a changing and more marketized environment. They have complex governance structures which reflect their complex organizational structures, which can be made to seem, and often are, sluggish and self defeating. On the other hand, when they work well, they confer great benefit on the institution concerned. But making them work well demands vigilance, transparency and a significant investment in time and resources. The greatest threat to shared governance is that the academic community becomes no longer willing to invest in making it work.

Theoretical Framework of the Study

Theoretical framework for this study is Resource Dependency Theory: This theory was developed by the American business theorist Jeffrey Pfeffer and the American organizational theorist Gerald R. Salancik. The theory was propounded in the year of 1978 at the Stanford University [5]. Resource dependency theory (RDT) is one of the most influential organizational theories that addresses strategic management, and deals with the connection between environment, organization and organizational decisions or actions. The purpose of the Resource Dependency Theory is presenting a guide on how to design and manage organizations that are externally constrained. The basic assumption of Resource Dependency Theory is ensuring organizational survival by minimizing any situation of uncertainty and dependency and characterizes an organization as an open system, dependent on contingencies in the external environment.

Characteristics of Good Governance

The United Nations Economic and Social Commission for Asia and the Pacific [UNESCAP] has identified the following as the major characteristics of good governance These characteristics are presented by UNESCAP [6] thus:

- 1. Aspect of Participation:** Good governance is participatory. Participation in good is characterized as a process for governance achievement.
- 2. Aspect of the Rule of Law:** Good governance follows the rule of law. There must be need for the rule of law otherwise effectiveness of the institutional governance would not be achieved. Through the rule of law, there must legal framework to enact impartiality.

3. Aspect of Transparency: Good governance is transparent; for an effective institutional governance to be achieved, there must be governance transparency. Transparency is institutional watch dog for realization of the goals and objectives of the organization.

4. Aspect of Responsiveness: Good governance is responsive. Every institution is expected to be responsive the organizational needs of her members.

5. Aspect of Consensus Oriented: A good governance need mediation of the different interests in that particular organization to be succeeded.

6. Aspect of Equity and Inclusiveness: An organization like the university depends on ensuring that all her members have a stake in it.

7. Aspect of Effectiveness and Efficiency: effectiveness of any organization depends the efficiency of its leaders. Good governance required good leaders in minding the affairs of the organization.

8. Aspect of Accountability: Accountable is a key requirement of good governance. Without proper accountability, no organization can achieve it stated goals and objectives.

9. Aspect of Strategic Vision: There is need for leaders in an organization setting like university to be strategic with vision.

Line-Up officers for promotion of effective institutional governance in the University

Vice Chancellor: The Vice Chancellor is the highest principal officer in the university [9]. Although, the university is a non-trading organization (NTO) for business operation [10], the Vice Chancellor is the Chief Executive Officer (CEO) who is saddled with the day-to-day administration or management of the entire university [11]. He is responsible to the Chancellor through the Pro-chancellor. He is the spokesperson of the university to the Governing Council – the highest policy-making body of the university. All other principal officers of the university report to him. He/She chairs the two most important decision making bodies of the University, namely the senate (Academic matters) and the congregation (Administrative matters). His/her office has so many units including the internal audit, the security, the linkage, etc.

The Registrar: The Registrar is a principal officer of the university. He is both a member and secretary of the Governing Council [12]. As an officer saddled with the responsibility of secretaryship, he/she is in charge of administrative matters on a daily basis [13]. It is the general belief, and rightly too, that nobody officially enters, leaves or transacts any official business with the university without a letter from the Registrar legally. In this wise, the registrar is the custodian of all the important documents, records and proceedings of all statutory gatherings of the university irrespective of the location, campus, faculty, department, centre or unit. He or she heads all the administrative members of staff including the Deputy Registrars, Principal Assistant Registrars, Senior Assistant Registrars, Assistant Registrars, Administrative Officers, Administrative Clerks, Caretakers, Messengers, Cleaners, and many others [14].

Bursar: Bursar is a principal officer of the university. He is responsible for the accurate analysis, recording and accounting for all the financial transactions undertaken by the university [15]. As an accountant who practices the accountancy profession, he/she prepares the books, accounts, statements, schedules, budgets, analysis, notes, etc, of the entire university irrespective of the campus, location, faculty, department, centre, unit, etc. for the purpose of internal and external auditors as well as for use by other stakeholders according to the legal requirements of the day. He or she heads the Deputy Bursars, Chief Accountants, Assistant Chief Accountants, Principal Accountants, Senior Accountants, Accountants, Executive Officers, Assistant Chief Executive

Officers, Principal Executive Officers, Senior Executive Officers, Executive Officers, Account Officers, Accountants, Account Clerks, Caretakers, Messengers, Cleaners, etc. [16].

Librarian: The librarian is a principal officer of the university [17] who is charged with the responsibility of safe keeping and Acquisition/purchase all the publications and academic documents either to or from/by the university [18]. Such publications include charts, print, film, visuals, books, magazines, journals, research, publications, tapes, manuals, etc. Librarian also provides avenues for private and public reading of all the human resources of the university irrespective of the location, campus, faculty, department, centre, unit, etc. One of the most important functions of the librarian is the procurement or borrowing of required publications into the university at the request of any other officer of the university. The librarian maintains a very strong inter and intra-library connections within and outside the university locally, nationally and internationally. He or she heads the Deputy Librarians, Chief Librarians, Assistant Chief Librarians, Principal Librarians, Senior Librarians, Library Assistants, Library Clerks, Caretakers, Messengers, Cleaners and other library workers [19].

Director of works: The Director of Works is a principal office of the university who is saddled with the responsibility of accommodation/plant layout, infrastructure and facilities provisions, vehicles/equipment purchases, lighting and electrification as well as general and routine maintenance [20]. As a practicing engineer in Nigeria, he/she ensures that all safety standards are met and precautions are taken in accordance with national and international/global specifications. It should be noted that where the Director of Works is unable to supply the manpower requirement, his/her expert advice is usually applied in the engagement of qualified and competent contractors and casuals. He or she heads the Deputy Directors of Works, Chief Engineers, Assistant Chief Engineers, Principal Engineers, Senior Engineers, Engineers, Supervisors, Assistant Supervisors, Superintendents, Technicians, Clerks, Messengers, Cleaners, Casuals, etc. [21].

Deans of Faculties: In the 1960s it was the common rule that in pre-1992 universities deans were elected for two- or three-year periods (apart from deans of medical schools) from within their own faculties. In the 1990s, with financial devolution to faculties occurring in many universities, the post of dean, which had previously been thought of as the representative of the faculty, often became a fixed term full-time appointment with line management responsibilities to the vice-chancellor. While this is the norm in post-1992 universities it has now been adopted in some pre-1992 institutions. In some pre-1992 universities, where faculties have been merged to make larger academic units, super-deanships have been created, sometimes called provosts, however, acquired line management responsibilities over central administrative functions within the faculty.

Heads of Departments: Becher and Kogan describe the department as the basic academic unit and state that the unit is particularly important in the determination of professional values and in the maintenance of particular areas of academic expertise [22]; Again, almost invariably, deans will be budget holders for their faculties with a priority remit to work within their budgets and avoid deficits. In this structure, heads of departments will have a reporting responsibility to the dean.

Conclusion

The university which is the highest educational institution for the acquisition of knowledge, required in order to develop and transform nations, needs officers to be responsible for its day-to-

day activities and operations. University principal officers therefore perform vital functions on a daily basis for the effective and efficient achievement of university goals. Although, the Vice Chancellor is the highest principal officer and chief executive, other principal officers who function under him/her on a daily basis. It is therefore the university principal officers functionalism that enhances the effective and efficient achievement of university goals by promoting effective institutional governance in university education for sustainable academic future not only in Nigeria but also all over the world generally.

Recommendations

Based on the specification of the study, the following recommendations were presented:

1. Universities should apply governance standards for the aim of reforming the higher education system and thus achieving maximum quality education in accordance with international criteria.
2. Academic and administrative systems in universities should adhere to the principles of accountability, transparency, integrity, participation and performance monitoring to realize their visions and move successfully in education reform approach.
3. There is need for institutions to provide resources and ensure appropriate management of the resources in order to achieve effective institutional governance in university education for sustainable academic future.
4. There is need to achieve equilibrium between governance principles and quality standards to underpin competitiveness.

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Working Memory and Phonological Short-Term Memory in the Acquisition of Academic Formulaic Language

Zhicheng Han

Abstract— This study examines the correlation between knowledge of formulaic language, working memory (WM), and phonological short-term memory (PSTM) in Chinese L2 learners of English. This study investigates if WM and PSTM correlate differently to the acquisition of formulaic language, which may be relevant for the discourse around the conceptualization of formulas. Connectionist approaches have led scholars to argue that formulas are form-meaning connections stored whole, making PSTM significant in the acquisitional process as it pertains to the storage and retrieval of chunk information. Generativist scholars, on the other hand, argued for active participation of interlanguage grammar in the acquisition and use of formulaic language, where formulas are represented in the mind but retain the internal structure built around a lexical core. This would make WM, especially the processing component of WM an important cognitive factor since it plays a role in processing and holding information for further analysis and manipulation. The current study asked L1 Chinese learners of English enrolled in graduate programs in China to complete a preference ranking task where they rank their preference for formulas, grammatical non-formulaic expressions, and ungrammatical phrases with and without the lexical core in academic contexts. Participants were asked to rank the options in order of the likeliness of them encountering these phrases in the test sentences within academic contexts. Participants' syntactic proficiency is controlled with a cloze test and grammar test. Regression analysis found a significant relationship between the processing component of WM and preference of formulaic expressions in the preference ranking task while no significant correlation is found for PSTM or syntactic proficiency. The correlational analysis found that WM, PSTM, and the two proficiency test scores have significant covariates. However, WM and PSTM have different predictor values for participants' preference for formulaic language. Both storage and processing components of WM are significantly correlated with the preference for formulaic expressions while PSTM is not. These findings are in favor of the role of interlanguage grammar and syntactic knowledge in the acquisition of formulaic expressions. The differing effects of WM and PSTM suggest that selective attention to and processing of the input beyond simple retention play a key role in successfully acquiring formulaic language. Similar correlational patterns were found for preferring the ungrammatical phrase with the lexical core of the formula over the ones without the lexical core, attesting to learners' awareness of the lexical core around which formulas are constructed. These findings support the view that formulaic phrases retain internal syntactic structures that are recognized and processed by the learners.

Keywords— formulaic language, working memory, phonological short-term memory, academic language.

School as a Space of Power: A Foucauldian Critique

Yildirim Ortaoglan

Abstract— The attempt to make thought school-like by fitting it into various frameworks with the institutionalization of it is almost simultaneous with philosophy itself. What once sprouted in the “academia” of old has institutionalized under the enlightenment’s light, becoming the fundamental space reflecting the spirit of its age. However, the shift from the thinking temple where truth’s knowledge was sought to functional spaces where power/power relations are constructed indicates a significant rupture in the meaning of school. Therefore, a genealogical inquiry into the meaning of the school can provide us with a path toward understanding how it should be approached in contemporary times. From this perspective, it is essential to highlight how power/power relations operate in the school in terms of disciplinary practices, temporal management, and spatial organization to construct a distinct subjectivation. Recognizing that the changing and evolving nature of education is related to the structure of space can be understood by revealing how disciplinary power and bio-power, two fundamental aspects of genealogical research, operate. In disciplinary power, the relationship of the subject with discipline, temporal management, and space is about improvement and normalization, while in biopower, it manifests in maximizing utility, increasing free time, and constructing spaces that seem more vital. These indicators not only facilitate the formation of students as a subjectivation but also enable the condition of the possibility of power/power relations. Because power is not applied to subjects but used by them for passage, and behind this lies the idea that the individual is already one of the components of power. As one of the components of power, in terms of subjectivation type, the student is one of the primary targets of power relations. Therefore, conducting a genealogical inquiry of the student as a type of subjectivation and the school as its living area from the philosophical foundations of education may offer a new opportunity for thinking about the contemporary crisis of thought. Within the framework of this possibility, our investigation will consider which aspects of the school and the student, brought together for educational purposes, can be thought of within and beyond power/power relations.

Keywords— power, education, space, school, student, discipline.

Anthropometric Indices of Obesity and Coronary Artery Atherosclerosis: An Autopsy Study in South Indian population

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Abstract:

The association between human physique and morbidity and mortality resulting from coronary artery disease has been studied extensively over several decades. Multiple studies have also been done on the correlation between grade of atherosclerosis, coronary artery diseases and anthropometrical measurements. However, the number of autopsy-based studies drastically reduces this number. It has been suggested that while in living subjects, it would be expensive, difficult, and even harmful to subject them to imaging modalities like CT scans and procedures involving contrast media to study mild atherosclerosis, no such harm is encountered in study of autopsy cases.

This autopsy-based study was aimed to correlate the anthropometric measurements and indices of obesity such as waist circumference (WC), hip circumference (HC), body mass index (BMI) and waist hip ratio (WHR) with the degree of atherosclerosis in the right coronary artery (RCA), main branch of the left coronary artery (LCA) and the left anterior descending artery (LADA) in 95 South Indian origin victims of both the genders between the age of 18 years and 75 years. The grading of atherosclerosis was done according to criteria suggested by the American Heart Association. The study also analysed the correlation of the anthropometric measurements and indices of obesity with the number of coronaries affected with atherosclerosis in an individual.

All the anthropometric measurements and the derived indices were found to be significantly correlated to each other in both the genders except for the age, which is found to have a significant correlation only with the WHR. In both the genders severe degree of atherosclerosis was commonly observed in LADA followed by LCA and RCA. Grade of atherosclerosis in RCA is significantly related to the WHR in males. Grade of atherosclerosis in LCA and LADA is significantly related to the WHR in females. Significant relation was observed between grade of atherosclerosis in RCA and WC and WHR, and between grade of atherosclerosis in LADA and HC in males. Significant relation was observed between grade of atherosclerosis in RCA and WC and WHR, and between grade of atherosclerosis in LADA and HC in females.

Anthropometric measurements/indices of obesity can be an effective means to identify high risk cases of atherosclerosis at an early stage that can be effective in reducing the associated cardiac morbidity and mortality. A person with anthropometric measurements suggestive of mild atherosclerosis can be advised to modify his lifestyle, along with decreasing his exposure to the other risk factors. Those with measurements suggestive of higher degree of atherosclerosis can be subjected to confirmatory procedures to start effective treatment.

Keywords: Atherosclerosis, Coronary Artery Disease, Indices, Obesity.

Law Relating to Health and Health Care: A Systematic Mechanism and Critical Study with Reference to Bangladesh

Md. Kamruzzaman

Abstract—As a developing country, Bangladesh has seen an increase in total GDP in recent years. But it can be further improved by developing “Health-Care” (HC) services because it has enormous infrastructure problems all over the country. Bangladesh's HC system is now clearly poised to undergo reform at any process level, including prevention, diagnosis, and treatment. Although the Bangladeshi government is trying to develop the HC sector, due to health corruption in this sector, the improvement has not accelerated yet. For this reason, lots of Bangladeshi people are facing acute diseases. Regarding the prevention, diagnosis, and treatment of disease, this research will illustrate the law relating to health and HC to ensure excellent health and well-being. Firstly, this paper investigates health under Bangladeshi law from different perspectives related to the HC system. A massive gap has been investigated in this research after comparing Bangladeshi and International Health Law (HL). Secondly, a practical scenario is investigated and compared with international HC law. It is evident that the Bangladeshi HC system did not achieve a satisfactory standard level concerning international law. A staggering 70% of Bangladesh's population lives in rural areas, with no restrictions on access to hospitals and clinics. However, it is clear that proper HC infrastructure and some new medical practices are urgently needed to ensure HC quality. Finally, this research provides suggestions for developing a HC system to ensure the health of all Bangladeshi people that needs to be immediately implemented by the Bangladeshi government. This research has practical implications in the HC system for any developing country to maintain their citizen's safety.

Keywords—HC system, law relating, Bangladeshi HL, international HL, human HC suggestions.

I. INTRODUCTION

EVERY person has the right to a life of grandeur, which can only be achieved via excellent health and a sense of well-being. Because people's health and morals are essential to their well-being as well as the state's peace and stability, the legislature must protect and promote these critical interests. It is impossible to build a powerful nation on a foundation of straws. Healthy populations live longer and are more productive. Therefore, national HC mostly contributes to economic success. As a result, a nation's growth is dependent not only on its industrial, agricultural, and service balance sheets but also on its success on the human development index [1].

The state of a nation's HC is one of the evaluative markers of that nation's performance. That is far more significant for a nation like Bangladesh. In order to address health-related issues at a cost that is acceptable and affordable to the general public

as well as the nation, as well as in a manner that is responsive to their social, cultural, and economic well-being, the government, as well as health professionals, are responsible for developing and implementing applicable human HC policies and plans. They should be carried out so that all citizens benefit equitably. The author of this study attempted to shed light on various aspects of human HC on a national and international level, including the meaning, history, and HC issues in Bangladesh, government efforts in the health sector through various constitutional legislative provisions, the current state of the HC sector and HC policies and programs; and suggestive reforms in the HC sector that could eliminate health hazards [2], [3].

HC in Bangladesh requires revolutionary transformation since the health and well-being of its people are possibly more important than anything else. Bangladesh's HC system is now clearly poised to undergo reform at any process level, including prevention, diagnosis, and treatment. A healthy population may undoubtedly help a country's economic growth and development. HC services aim to protect and improve the public's health by nourishing the HC system, growing human resources, and strengthening public health capability and norms. These are essential aspects of the human HC sector [4].

The Bangladeshi government has enacted and implemented significant legal provisions in the HC sector at both the national and international levels to protect humans from HC-related risks, which has resulted in significant improvements in health indicators such as life expectancy, infant mortality rate, and maternal mortality rate as a result of the increased thrust of HC services across the country, as well as an increase in the number of government and private HC providers [5], [6].

Despite the remarkable achievements, the Bangladeshi HC system confronts many deficits which need to be amended if a sound and adequate HC infrastructure are to be attained for a healthy Bangladesh. Hence, the author has laid out some gaps to be implemented successfully to move the nation toward a healthy nation in this research. The research mainly focused on the below-mentioned problems of HC in Bangladesh:

- The persisting infrastructure is not being utilized to the extent intended because of the scarcity of doctors, nurses, and other health personnel. Hence, there is a need to enhance the number of medical personnel [7].
- Lack of proper review of health policies at regular intervals [8].

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- Lack of an exhaustive, coordinated, and intermingled approach among different performers to produce more fruitful consequences [9].
- Inadequate infrastructure, investments in the medical field, government oversight of how the funds are being used, and digital health technologies [10].
- Lack of improvement in public hospitals, living circumstances for people, and rural HC institutions [11].
- Lack of insurance to comprehend the current environment of the Bangladesh HC system [12].

II. HEALTH UNDER BANGLADESHI LAWS

HC is one of the essential determinants of a nation's development, as healthy citizens promote a healthy nation. Because there is a strong link between a person's health and their standard of living, the government is obligated to ensure the well-being of the people. This can be accomplished by announcing a comprehensive legislative structure, providing favorable conditions for restoring equilibrium in the HC sector. Countries that have developed a universal approach to HC have accepted comprehensive legislation that has organized the human HC system under a single canopy and combined steps to provide structured and synchronized HC services to their population. Access to HC, provision of proper infrastructure, unfairness, carelessness, unfair practices, dishonesty in HC systems, standards in HC systems, occupational and environmental-related health issues, health issues relating to reproduction, infringement of rights, allotment of resources, professional behavior, and other issues are all addressed by legislation. Also, the legislature should take steps to make the right to HC a fundamental right so that it may be enforced under the constitution [13]-[15].

Human health is one of our most basic needs. Both the law and health have implications for society and social welfare. Because human health is deteriorating day by day despite various health schemes and policies, the framers of the Bangladeshi Constitution inserted numerous provisions concerning human HC, and the Bangladeshi Supreme Court has ALSO BEEN INSTRUMENTAL IN SAFEGUARDING PEOPLE'S HEALTH THROUGH various landmark decisions. Furthermore, the HC issue will be controlled through the proper implementation of laws created based on constitutional provisions [16].

The Bangladesh Constitution, which went into effect on November 4, 1972, sheds light on several aspects of people's lives, including socioeconomic, political, and other issues. Bangladesh's constitution focuses on ensuring social, economic, and political justice among the masses, protecting individual rights and promoting national health. The purpose of the constitutional substructure is to achieve the goals outlined in the preamble, which establishes rights and imposes duties on citizens, as well as commands the state to protect the various rights of its citizens, one of which is the right to health, as the nation's prosperity is dependent on a healthy population [17].

The Bangladeshi constitution declares health to be a key indicator of human progress. Bangladesh's constitution has clauses about the right to health. Constitutional directions

impose on the state the responsibility of determining the conditions conducive to well-being. Since independence, Bangladesh has viewed the people as owners of rights and the state as obligated to act as the primary provider of HC. Not only that, but Bangladesh is a member of the United Nations and has accepted several international accords that pledge to protect individuals' human HC rights [18].

Although HC does not appear as a sector in many places in the Bangladeshi Constitution, there are indirect and implied allusions to people's HC and the state's role in their development. In 2011, the National Health Bill was introduced, which views human HC as a public good and HC as a human right [19].

The Constitution's Preamble addresses social, economic, and political justice, with social justice referring to the general public's equal access to HC facilities. The concept of democratic socialism attempts to improve the people's HC situation. Also included in the preamble is equality of position and opportunity, which refers to equality in all domains, including medical practice, admission to medical, educational institutions, and so on, to improve citizens' health. The preamble aims to provide for a welfare state with socialistic social patterns that relate to the right to HC for the public [20].

Article 15(a) imposes a legal obligation on the state to maintain social order to advance the people's welfare. Still, this welfare cannot be achieved without human HC, and the state is obligated to implement particular policy ideas to expand people's HC [21].

One of the fundamental obligations of the state, according to Article 18 (1), is to keep track of the increase in the level of nutrition and living standards of its citizens and the improvement in human health. As a result, the state is required to take steps to prohibit the consumption of intoxicating drinks as well as excessive doses of drugs that are harmful to one's health, except for medical reasons, following the Bangladeshi Constitution, which expresses the state's brotherly role in safeguarding citizens' health. When it comes to intoxicating drinks, narcotics, smoking, and other substances that have such negative consequences, the government's responsibility is to intervene effectively to reduce their consumption [22].

III. HC UNDER INTERNATIONAL LAWS

Generally speaking, international law refers to the norms, agreements, and treaties that bind nations together. International law applies to the government just as domestic law applies to citizens and others. Every state government has a responsibility to enforce and comply with international law [23].

In international law, HL is an emerging field. It has been argued that health protection is a pressing social need that should now be addressed by international law. Health is a fundamental requirement that requires strong protection under international law. Therefore, it is crucial to focus on the ability of individuals to function correctly in society, pursue personal life services, and create conditions for health, including access to safe drinking water and sanitation, access to health-related information and education, and access to safe, healthy food opportunities. The right to the highest attainable standard of health is a key human rights norm in international HL, as it underscores the need to protect individual health and strive for equity in health on a global scale. It is a human rights norm linked to the protection of health. Globalization continues to affect the world economy

and the HC of populations and individuals worldwide. It poses several significant challenges to the health sector that require national and international responses. Plans that also show that not only a secure approach to HC should be prioritized [24].

Health research shows that health inequalities within and between countries are increasing. Many countries continue to grapple with the negative health impacts of environmental degradation, climate change, urbanization and other factors. Due to the growing influence of international trade and multinational corporations, changes in disease patterns are also being screened, some of which are related to lifestyle. Because of these developments, attention to international health should focus not only on the spread of infectious diseases but also on domestic and international health inequalities and issues such as HC and medical methods and human health. in international and national emergencies and armed conflicts [25].

Some human rights documents proclaim the right to the best possible quality HC, sometimes referred to as the right to health. The term "human rights" first appeared in the Charter of the United Nations, ratified in San Francisco on June 25, 1945, and includes civil, cultural, economic, political, and social rights. Human rights are promoted in international forums, recognized in international conventions, and voluntarily recognized by states [26].

They have universally recognized principles that protect individuals and groups from activities that interfere with human dignity, fundamental freedoms, and principles of rights to ensure individual well-being and growth. Their powers are based on the shared commitment of all ratifying governments to respect, safeguard, and honour them. Governments have a responsibility to achieve these goals. The importance of international cooperation in exercising rights for states to perform their duties was emphasized.

Everyone has the right to a minimum standard of living, which includes food, clothing, housing, medical care, and essential services, as stated in Article 25 of the Universal Declaration of Human Rights (UDHR). This article also mentions disability, widowhood, old age, or lack of livelihood in other situations outside the control of the right to security.

The International Covenant on Economic, Social, and Cultural Rights (ICESCR), commonly known as the Economic Covenant, has come into play in human health. The Economic Covenant recognizes the right of everyone to the best possible physical and mental health. It sets out the steps states must take to realize the rights set out in Article 12, including the rights to maternal, child, and reproductive health, the rights to a healthy natural and working environment, the rights to disease prevention, treatment, and control, and access to the right to sanitation, goods, and services.

In order to increase agricultural output and help combat famine and malnutrition, the United Nations established the FAO in 1945. It provides funds to states to help them improve their food production and guidance to states on how to improve their land's productivity, help alleviate the strain of starvation in their country, and contribute to improving the health of the masses.

The UN established the Global Fund to Fight AIDS, Tuberculosis, and Malaria in 2001, contributing to improving health by providing cash to statewide programs in countries with

high disease burdens. Public, private, and governmental organisations were given the authority to apply for funds to promote their country's health infrastructure development and improvement. All applications had to be aimed at improving AIDS, tuberculosis, and malaria treatment and prevention on a national level.

UNICEF was formed by a UN official decision in 1946 to improve the welfare of children around the world. UNICEF supports children's educational efforts and works to reduce child and infant mortality by working directly in countries where children are affected by the disease, starvation, and war. UNICEF works with governments and non-profit organisations to adopt national policies to support children's welfare and health.

The UNHCR was established in 1950 by UN official order to function as the UN's vehicle for ensuring refugee well-being and providing access to life-saving cardinal HC. Because they are not citizens of the country they are compelled to live in, refugees' HC is jeopardized. As a result, it is the responsibility of the UNHCR to ensure that the needs of displaced individuals are met regardless of their country of origin or status within their country of residence.

IV. PRESENT SCENARIO OF HUMAN HC

Despite years of national plans to control most of these diseases, infectious diseases remain a serious public health problem. Infectious diseases such as hepatitis, tuberculosis, dengue fever, malaria, and pneumonia continue to plague Bangladesh due to a growing reluctance to receive medical treatment. The World Health Organization recommends introducing dengue vaccines in high-burden countries such as Bangladesh. Dengue cases doubled from 12,317 in 2006 to 27,247 in 2009.

Additionally, the leading cause of death worldwide is non-communicable diseases. Poor diet, physical inactivity, exposure to tobacco smoke, and harmful alcohol use put children, adults, and seniors at risk for NCDs. Poor eating habits and a lack of exercise may cause people's blood pressure, blood sugar, blood lipids, and obesity, which can result in cardiovascular disease, long-term respiratory diseases, cancer, and diabetes. Human health is significantly impacted by subpar sewage infrastructure, wastewater treatment facilities, and sanitation.

A key aspect of the world people want to live in is for everyone to have access to clean, accessible water, and there is enough fresh water on Earth to make that happen. Every year, millions of people, including children, die from inadequate water, sanitation, and hygiene due to poor economic conditions or poor infrastructure. More than 2 billion people are currently at risk of limited freshwater resources. At least one in four people will live in a country with chronic or recurring freshwater shortages by 2050.

According to the minimum standard of the World Health Organization, one doctor is required for one thousand patients. According to the Medical Council of Bangladesh, Bangladesh has 0.389 physicians per 1,000 inhabitants, which is fewer than what the World Health Organization requires. The doctor-to-population ratios in various nations are as follows:

- Doctor and population ratio in Australia is 3.374:1000.

- Doctor and population ratio in Brazil is 1.852:1000.
- Doctor and population ratio in China is 1.49:1000.
- Doctor and population ratio in France is 3.227:1000.
- Doctor and population ratio in Germany is 4.125:1000.
- Doctor and population ratio in Russia is 3.306:1000.
- Doctor and population ratio in USA is 2.554:1000.

According to the UN, most under-five deaths are due to avoidable or curable conditions such as congenital disorders, pneumonia, diarrhea, malaria, and other illnesses. Generally speaking, generally speaking. The under-five mortality rate for rural children is 50% higher than for children in large cities. According to a paper published in the international journal *The Lancet* in 2017, adopting preventive approaches, such as enabling diarrhea and pneumonia treatments, and providing measles and tetanus vaccinations, helped increase hospital birth rates and reduce child deaths. In 2017, Bangladesh's infant mortality rate was 32 per 1,000 live births, compared with the global average of 12. There were similar differences in neonatal mortality in Bangladesh, with 24 infant mortality per 1,000 live births, compared with the global average of 18.

Although the Bangladeshi government has made significant efforts in recent years to address the problem of malnutrition, it persists in the country and remains a significant public health concern. Nutrition is inextricably linked to a country's human resource development, efficiency, and wealth. Improving people's nutritional status has been a global effort, particularly in underdeveloped countries.

The general population's mental health is one of our country's most neglected issues. A national mental health survey was recently conducted, which found that almost 150 million people in Bangladesh require mental HC, with 70% to 92% of these patients failing to receive the necessary treatment. According to the World Health Organization, Bangladesh has the highest rate of teen suicide globally.

Despite the government's efforts, the Bangladeshi public HC system faces significant obstacles in providing care, including primary, secondary, and tertiary care institutions. As a result, it would be appropriate to assess Bangladesh's existing HC system compared to those of other industrialized countries. The government's HC system is divided into three tiers: primary, secondary, and tertiary care facilities, with public and private providers providing services ranging from single doctors to super-specialist tertiary care corporate hospitals.

Bangladesh initially accepted a public-sector-led HC delivery model, with most services being provided for free to all citizens. Teaching hospitals, secondary level hospitals, community health centres or rural hospitals, dispensaries, primary health centres, sub-centres, and other facilities are included. Primary health facilities were linked to district hospitals, which provided secondary care, and government-run medical college hospitals, which provided tertiary care.

Over 80% of HC requirements are met by private HC facilities, which account for most of the HC in Bangladesh. Private hospitals charge substantially more for treatment than United, IBN Sina Hospital, or other public hospitals. As a result of private hospitals overhauling state facilities, HC costs have increased, making private-sector HC expenses for most

Bangladeshis.

People generally prefer the private sector to the public sector because most public HC services are provided in rural areas. Poor service quality results from experienced HC professionals' unwillingness to visit rural areas, so the majority of the public HC system delivering services in rural and remote areas relies on inexperienced and unmotivated interns who are directed to spend time in public HC. Other key factors that entice people to the private sector include the distance from public sector facilities, excessive wait times, and inconvenient operating hours.

The most significant problem the Bangladeshi government has faced since independence has been providing HC to people. Bangladesh's population is more susceptible to diseases due to rising poverty, population pressure, and climatic variables. Infrastructure has been identified as a critical component in delivering public health services. The primary criterion for assessing a country's HC policy and welfare system is its health infrastructure. It expresses a preference for HC facility development as an investment.

Health infrastructure focuses on tangible potential building in public HC delivery mechanisms rather than solely the country's health policy (HP) results. The HC system necessitates solid planning and management abilities and policies that are well-executed and administered by government agencies in collaboration with private HC providers.

V. CHALLENGES TO GROWTH OF HUMAN HC SECTOR

Today, Bangladesh faces a double burden of infectious and chronic diseases. History shows that treatment alone does not reduce the burden of infectious diseases; prevention also requires government action. However, the government has made various efforts through Upazilla Health Complexes (UHC), Primary HC in Bangladesh (PHCB), and others to address the double burden of disease effectively. "Bangladesh's National Health Policy" (BNHP) has several components that primarily focus on infectious diseases but rarely adhere to the prevention of chronic diseases. PHCB is another initiative that supports the treatment of certain chronic diseases, but not prevention. The government has given up prevention and public health functions to a certain extent, negatively affecting human HC.

Another factor affecting the HC landscape in Bangladesh is the high out-of-pocket costs of the population. Generally, most Bangladeshi patients pay for their hospital visits and doctor appointments through direct cash aftercare without payment arrangements. Furthermore, the World Bank and the National Committee revealed that health insurance policies cover only 3% of Bangladeshis. This low number comes in a budding health insurance market that only applies to urban, middle- and high-income people. Medicare is primarily limited to urban areas, while in other areas, mainly rural ones, people continue to pay out of pocket.

Infrastructure is another pain point for the Bangladeshi HC industry. The country faces severe resource shortages in both human and capital goods. HC infrastructure requires human resources, i.e. highly skilled human resources ranging from doctors to other HC support staff (such as nurses, laboratory technicians, pharmacists, etc.) to provide adequate HC to the population. Still, Bangladesh has a doctor-to-population ratio of 0.34 per 1,000 people, compared with 1.9 and 3.2 in China and

the OECD. There is a shortage of health professionals, but most of these professionals happen to be concentrated in urban areas where consumers are more affordable, leaving rural areas unattended. There is an 81% shortage of specialists in rural community health centres in Bangladesh. There are fewer than 3,000 doctors in rural Bangladesh's 25,308 primary HC centres.

Public sector HC in Bangladesh has received a lot of criticism due to a lack of focus on promoting public HC delivery. In Bangladesh, the public versus private HC debate is often highly vindictive, and policymakers need to take practical rather than ideological stances in both areas. The country will need to intervene adequately in every sector to improve the quality and affordability of public and private HC services.

The medical device industry is one of the fastest-growing industries in the country and is very similar to the health insurance market but is the smallest piece of the HC puzzle in Bangladesh. The HC industry faces many regulatory challenges that hinder the growth and development of the medical device industry. Recently, the government has been optimistic about removing regulatory barriers to importing and exporting medical devices. Foreign and regional investors regard the medical device industry as the most promising field in the future, which is lucrative and has been insisted on in other countries.

A staggering 70% of Bangladesh's population lives in rural areas, with no restrictions on access to hospitals and clinics. Given this impression of the human HC system, it is clear that proper HC infrastructure and some new medical practices are urgently needed to ensure HC quality even in the most affected parts of the country.

VI. HC POLICY IN BANGLADESH

The right to health does not automatically entail that one has that right, according to Mary Robinson, the High Commissioner for Human Rights. It does not imply that a resource-constrained government must offer prohibitively expensive HC services. But in order to provide HC for everyone in the shortest amount of time, governments and public bodies must put policies and action plans into place. It is difficult for the human rights community and public health experts to ensure this occurs.

The birth of a powerful country cannot be achieved by relying on straws. National health contributes to economic progress because healthy people live longer and are more skilled. Governments and HC providers must develop and implement practical human HC policies. They plan to manage health-related matters at a cost that is generally acceptable and affordable and in a way that is responsive to their social, cultural, and economic well-being. Their implementation should enable all citizens to benefit equally from HC services. HC has increased significantly for the development of individual health, thereby affecting the health of families and nations. These government actions will primarily ensure HC for every citizen of the country. Thus, Bangladesh seems to be able to tackle the various health problems plaguing the country today confidently.

HC is an essential part of the HC system. It is often one of the broadest areas of global government and personal spending. Health promoters are keen to recognize and encourage the adoption of policies that will encourage the health and wellbeing of communities. Because of established accountability, policies and programs are developed in response to the population's needs. A human rights-based approach recognizes relationships,

enables people to assert their rights, and motivates policymakers and service professionals to deliver on their commitment to creating a more inclusive HC system. HP symbolizes the decisions, plans, and actions taken to achieve society's specific HC goals.

The Ottawa Charter recognizes a healthy public policy that enhances the health and well-being of the individuals and communities it affects. In addition, the World Health Organization explained that a clear HP could define a vision of the future, set priorities and the expected roles of different groups, build consensus and inform people.

There are many categories of health policies (including "personal HC policies", and "medicine policies") related to public health such as "vaccination policies", "tobacco control policies", "breastfeeding promotion policies", etc., and may cover topics such as financing and delivery of HC, the right approach, HC quality, and health equity.

VII. SUGGESTIONS FOR BETTER HUMAN HC INFRASTRUCTURE

Some recommendations must be successfully followed because the Bangladeshi HC system has several flaws that must be addressed. Some recommendations must be successfully followed if a solid and adequate HC infrastructure for a healthy Bangladesh is to be achieved.

- There is a need to increase the number of medical staff in the national HC system, such as doctors, nurses, and pharmacists, to address the shortage of medical personnel, which might significantly improve the general public's health. The existing infrastructure is not being exploited to its full potential because of the scarcity of doctors, nurses, and other health professionals.
- The government must regularly review health policy to assess the impact of various plans and programs to identify regions where HC services lag, and special attention must be given to these areas. Bangladesh's health policies have been developed and changed regularly. Although these policies have good programs to reach the poor and those living in rural regions, their execution is still weak, owing to corruption and poor governance at the local level. As a result, proper implementation of health policies is required.
- There is also a need for better coordination among the various actors involved in HC, whether directly or indirectly, such as the federal government, state governments, and civil society. A more comprehensive, coordinated, and intertwined strategy would provide more fruitful results and significantly improve our HC system.
- Furthermore, developing digital health technology is critical for improving the HC system's productivity and results and delivering better HC results in approach, quality, affordability, disease burden minimization, and effective monitoring of citizens' health entitlements.
- In addition, further investments in the HC sector are required. Inequalities in access to quality and affordable health services are primarily due to insufficient financial allocations to health. In recent years, government

spending on health has stabilized at around 1% of GDP, well behind the international average. Despite smaller grants, these funds are inefficient due to fragmented planning and vertical disease programs, and there is an urgent need to increase the government's share of public health spending.

- Though investment in the HC sector of 2% to 3% of GDP is assured, it is still insufficient to bring about significant changes, as the government is required to monitor the use of these allotted funds, as there is a lack of monitoring on the part of the government of the funds and resources dedicated to the improvement of the HC sector.
- Government hospitals are running out of beds, rooms, and medicine, resulting in insufficient resources and infrastructure. Therefore, infrastructure upgrades are required. In addition, infrastructure needs to be improved in terms of equipment. Most public health agencies do not have sufficient infrastructure to conduct medical tests such as X-rays, blood tests and other complex tests. These devices should be made available to the public through public-private partnerships or by encouraging public and private entities to produce such devices locally at competitive prices.
- Because there are insufficient beds, rooms, and medicines, government hospitals face a lack of resources and infrastructure. As a result, adjustments to the infrastructure are required. In addition, there is a need for infrastructure improvements in terms of equipment, as most public health institutions lack the necessary equipment for medical examinations like X-rays, blood testing, and other complex tests. The equipment should be made available to the general public through a public-private partnership or by supporting localized production of such equipment at competitive prices by both public and private entities.
- The government should make more efforts to improve HC facilities in rural areas because few government hospitals exist in these areas. Even those that do exist lack the majority of medical facilities. Furthermore, rural communities have a scarcity of skilled medical doctors in comparison to urban areas. Most HC professionals are concentrated in urban areas, where consumers have more disposable income, leaving rural areas untreated. Then an urgent need to correct this alarming scenario by expanding medical infrastructure and expertise.
- There is also a need for an international surveillance network because different diseases have erupted in one country. There is a risk of disease spreading to other countries globally; as a result, WHO must declare that states should be held accountable for sharing information about disease outbreaks to protect the human community. So, necessary efforts can be made to prevent disease transmission from spreading further.
- Health surveys are also required to monitor the impact of public health and disease interventions, among other things, using digital techniques.
- There is also a pressing need for HC regulation to be resurrected. An excellent regulatory structure is required to achieve significant public health results. There are numerous enforcement, monitoring, and assessment gaps, resulting in a shaky human HC system. As a result, public health regulation must be revitalized through government collaboration, which can be accomplished by revising and implementing public health regulations and increasing public awareness of current rules and enforcement procedures.
- Another key step is to strengthen and increase the effectiveness of health promotion activities by extending them to rural areas and holding diabetes days, heart days, and other similar activities in villages, which will help to raise awareness at the grassroots level, as well as help young people to understand the harms of smoking and promote physical activity. These events focus on encouraging people to make healthy decisions.
- As clean drinking water and sanitation are significant determinants of health, which would directly contribute to a 70-80% reduction in the burden of infectious illnesses, it is necessary to concentrate on inadequate sanitation, lack of access to fresh water, poor hygiene, and incorrect waste disposal methods.
- Another significant component is population stabilization, which is necessary to ensure the quality of life for all inhabitants.
- Furthermore, the effects of climate change and calamities on HC must be minimized. The public health concerns associated with climate change include temperature extremes and weather disasters, vector dissemination, food or water illnesses, etc. The public HC system must be appropriately trained and equipped at predetermined levels to respond effectively to catastrophes and emergencies.
- The need of the hour is for mass awareness of HC issues, cooperation, and focused efforts to implement government policies and programmes to accomplish the goal of a healthy nation as a whole. The lack of public knowledge is a challenge that must be overcome while developing a HC strategy. Even if the therapy is free, there is no doubt that people will take advantage of it until and unless the masses are educated and informed about the signs of the diseases, their repercussions and complications, and the treatment options available.
- The current chaos in public HC has prompted people to seek treatment in private hospitals. Suppose the government truly cares about the health of its citizens. In that case, it must improve public hospitals so that they can compete with private competitors and provide affordable, high-quality, universal HC. The role of private firms in the HC sector is growing, which means that HC facilities are becoming more expensive and out of reach for the poor.
- All three pillars of the public HC system are dysfunctional. Primary, secondary, and tertiary HC systems are critical components of the public HC system because they provide emergency treatment to patients in an emergency. Yet, they are insufficient to service such a large population. Primary, secondary, tertiary, and outpatient care are all undeveloped, and there is a need for improvement in all three sectors of HC.

- In addition, the lack of health insurance complicates the approach to HC, as about 75% of the Bangladeshi population pays for HC services out of pocket, putting an immense financial strain on the country. Bangladesh's inpatient surgical operations have been limited to critical sickness, and they have frequently been limited to one-time lump-sum payouts. As a result, insurance is required to comprehend the existing state of Bangladesh's HC system, aid a large number of people, and make a significant improvement in the HC sector by eliminating its flaws.
- Bangladesh's constitution needs to include HC as a fundamental right. While different regulations, national health policies, and programs have contributed significantly to the development of the HC industry, much remains to be done to improve the industry. Existing HC systems need to be restructured to achieve equity and social justice, which can be achieved by enacting a comprehensive legislative framework. Therefore, legislation should be supplemented by making the right to HC a fundamental right that can be enforced.

VIII. CONCLUSION

The government of Bangladesh has developed and implemented essential legal provisions in the HC sector at the national and international levels to protect people from HC-related dangers. Significant improvements in health indicators include life expectancy, infant mortality, and maternal mortality. Other programs launched by the Bangladeshi government to protect public health include the National Health Mission, National Tobacco Control Program, and National Elderly Care Program, which provide different goals and strategies for protecting human health and strengthening the HC system.

A universal HC strategy is an explicit goal of international organizations and national governments. Bangladesh's National Health Policy 2011 aims to achieve the highest level of health and well-being for all ages by introducing preventive and primary HC and a universal approach to high-quality HC services that do not put citizens in financial hardship. Bangladesh's progress on several health-related indicators has driven the country's progress toward the Millennium Development Goals. Nonetheless, much remains to be done to achieve the goal of universal health coverage.

Despite the extraordinary achievements, Bangladesh's HC system still has some deficiencies that must be addressed if the national health policy goals are to be achieved. Low health budget allocations are an important cause of inequalities in access to quality and affordable health services. Government spending on health has remained around 1% of GDP for many years, putting Bangladesh well behind the international average. These funds are not used effectively due to fragmented planning and vertical disease programs. Therefore, the government must increase its contribution to public health spending. In addition, the country has a severe shortage of labour and infrastructure. Despite Bangladesh's role as a global pharmacy, medical supplies are scarce, and access to life-saving medicines remains a problem. On the other hand, the private sector, which provides care to about 70% of the population, is unregulated and prohibitively expensive for the public. Bangladesh also faces significant problems in providing safe drinking water, sanitation,

solid waste management and drainage. Access to health services is disparate, with more than 90% of urban residents having access to health services, compared to 39% in rural Bangladesh. Rural and urban disparities are also stark in access to health services.

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Negative Self-Awareness and Its Effect on Crime

Guinevere Servis

Abstract— This paper hypothesizes that withdrawal from positive self-awareness, and the increase of counterfactual-thinking and self-handicapping can help provide ample justification for an individual before, during and/or after committing a crime. The understanding of who someone is, one's perspective on the world, and why they think the way they do is key to therapy in preventing recidivism. Developing habits to escape self-awareness, by using self-handicapping and counterfactual ideologies, may provide the necessary thinking patterns to decide disobeying the law is a worthy act to pursue. An increase in self-awareness is hypothesized to decrease the likelihood of recidivism, and ways of thinking that withdraw from self awareness can increase the likelihood of it. Especially for those who have been disadvantaged in life and disobeyed the law, self-handicapping and counterfactual thinking can also help to justify one's wrongdoing. The understanding of how a criminal views their disadvantages in the world, and one's thinking patterns are hypothesized to help one better understand the entire scope on why a crime was committed and thus reduce the likelihood of recidivism. Utilizing therapy for prisoners to increase self-awareness of both thought and action can lead to a healthy, happier life and reduce the likelihood of reoffending. By discussing the terms associated with self-awareness theory and other psychological topics such as self-handicapping, counterfactual thinking, this paper argues the actions towards increasing positive self-awareness can help decrease likelihood of recidivism. Adversely, hypothesizing that increasing the ways of thinking that withdraw one from self-awareness, through counterfactual thinking and self-handicapping, can inherently increase the likelihood of recidivism. Evaluating these findings to further understand the needed changes in correctional institutions is fundamental to reducing crime, benefiting the criminal, the victim(s) and their family, and the state.

Keywords— crime, self-awareness theory, correctional institutions, self-regulate, counterfactual thinking, recidivism.

The Impact of Artificial Intelligence on Human Rights Principles and Obligations and Rights

Samy Ayoub Abdou Ghobrial

Abstract— The interface between development and human rights has long been the subject of academic debate. Therefore, to understand the dynamics between the two concepts, a number of principles have been adopted, ranging from the right to development to a human rights-based approach to development. Despite these attempts, the exact connection between development and human rights is not yet fully understood. However, the inherent interdependence between these two concepts and the idea that development efforts should be undertaken with respect for human rights guarantees have gained momentum in recent years. It will then be examined whether the right to sustainable development is recognized. The article therefore concludes that the principles of sustainable development are recognized, directly or indirectly, in various human rights instruments, which represents a positive answer to the question posed above. Therefore, this work discusses international and regional human rights instruments as well as case law and interpretative guidelines from human rights bodies to demonstrate this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Effect of Artificial Intelligence on Human Rights Regulations

Karam Aziz Hamdy Fahmy

Abstract— Although human rights protection in the industrial sector has increased, human rights violations continue to occur. Although the government has passed human rights laws, labor laws, and an international treaty ratified by the United States, human rights crimes continue to occur and go undetected. The growing number of textile companies in Bekasi is also leading to an increase in human rights violations as the government has no obligation to protect them. The United States government and business leaders should respect, protect and defend the human rights of workers. The article discusses the human rights violations faced by garment factory workers in the context of the law, as well as ideas for improving the protection of workers' rights. The connection between development and human rights has long been the subject of academic debate. Therefore, to understand the dynamics between these two concepts, a number of principles have been adopted, ranging from the right to development to a human rights-based approach to development. Despite these attempts, the precise connection between development and human rights is not yet fully understood. However, the inherent interdependence between these two concepts and the idea that development efforts must respect human rights guarantees has gained momentum in recent years. It will then be examined whether the right to sustainable development is recognized.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Human Rights on Society and Legislations

Eid Nasr Saad Nasr

Abstract— Although human rights protection in the industrial sector has increased, human rights violations continue to occur. Although the government has passed human rights laws, labor laws, and an international treaty ratified by the United States, human rights crimes continue to occur and go undetected. The growing number of textile companies in Bekasi is also leading to an increase in human rights violations as the government has no obligation to protect them. The United States government and business leaders should respect, protect and defend the human rights of workers. The article discusses the human rights violations faced by garment factory workers in the context of the law, as well as ideas for improving the protection of workers' rights. The connection between development and human rights has long been the subject of academic debate. Therefore, to understand the dynamics between these two concepts, a number of principles have been adopted, ranging from the right to development to a human rights-based approach to development. Despite these attempts, the precise connection between development and human rights is not yet fully understood. However, the inherent interdependence between these two concepts and the idea that development efforts must respect human rights guarantees has gained momentum in recent years. It will then be examined whether the right to sustainable development is recognized.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Technology on Human Rights Principles and Obligations

Haisam Abdou Tawfik Nasralla

Abstract— Many of the fundamental ideas driving the human rights movement developed after World War II and the events of the Holocaust[6] and culminated in the United Nations General Assembly's adoption of the Universal Declaration of Human Rights in Paris in 1948. [6] [12] The ancients did not have the same contemporary conception of universal human rights.[13] The true precursor to human rights discourse was the concept of natural rights, which emerged as part of the medieval natural law tradition in and gained prominence during the European Enlightenment with philosophers such as John Locke, Francis Hutcheson, and Jean-Jacques Burlamaqui. , and which played an important role in the political discourse of the American and French revolutions.[6] On this basis, modern human rights arguments emerged in the second half of the 20th century,[14] perhaps in response to slavery, torture, genocide and enslavement. War crimes[14] [6] as an awareness of the intrinsic vulnerability of humans and as a prerequisite for the possibility of a just society. [5] The commitment to human rights continues into the early 21st century and focuses on achieving greater economic and political freedom.[5].

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

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The Impact of Artificial Intelligence on Human Rights Principles and Obligations

Mina Rashad Saad Abdelnoor

Abstract— The interface between development and human rights has long been the subject of academic debate. Therefore, to understand the dynamics between the two concepts, a number of principles have been adopted, ranging from the right to development to a human rights-based approach to development. Despite these attempts, the exact connection between development and human rights is not yet fully understood. However, the inherent interdependence between these two concepts and the idea that development efforts should be undertaken with respect for human rights guarantees have gained momentum in recent years. It will then be examined whether the right to sustainable development is recognized. The article therefore concludes that the principles of sustainable development are recognized, directly or indirectly, in various human rights instruments, which represents a positive answer to the question posed above. Therefore, this work discusses international and regional human rights instruments as well as case law and interpretative guidelines from human rights bodies to demonstrate this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Artificial Intelligence on Human Rights Principles and Obligations

Adel Atta Youssef Rezkalla

Abstract— Russia's invasion of Ukraine tested the international community and prompted not only states but also non-state actors to take deterrent measures in response. In fact, international sports federations, notably FIFA and UEFA, have managed to shift the power dynamic quite effectively by imposing a blanket ban on Russian national teams and clubs. The purpose of this article is to examine the human rights consequences of such actions by international sports organizations. First, the article moves away from assessing the legal status of FIFA and UEFA under international law and examines the question of how a legal connection can be established with their human rights obligations. Secondly, the human rights aspects of the controversial FIFA and UEFA measures against Russian athletes are examined and these are analyzed in more detail using the proportionality test than the principle of non-discrimination under international human rights law. Finally, the main avenues for redress for possible human rights violations related to the actions taken by these organizations are identified and the challenges of arbitration and litigation in Switzerland are highlighted.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Artificial Intelligence on Human Rights Development

Romany Wagih Farag Zaky

Abstract— The relationship between development and human rights has long been the subject of academic debate. To understand the dynamics between these two concepts, various principles are adopted, from the right to development to development-based human rights. Despite the initiatives taken, the relationship between development and human rights remains unclear. However, the overlap between these two views and the idea that efforts should be made in the field of human rights have increased in recent years. It is then evaluated whether the right to sustainable development is acceptable or not. The article concludes that the principles of sustainable development are directly or indirectly recognized in various human rights instruments, which is a good answer to the question posed above. This book therefore cites regional and international human rights agreements such as , as well as the jurisprudence and interpretative guidelines of human rights institutions, to prove this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Artificial Intelligence on Human Rights Development and Obligations

Bola George Asaad Bekledas

Abstract— Relationship between development and human rights has long been the subject of academic debate. To understand the dynamics between these two concepts, various principles are adopted, from the right to development to development-based human rights. Despite the initiatives taken, the relationship between development and human rights remains unclear. However, the compatibility between these two concepts and the idea that these efforts should be made to respect human rights guarantees have gained momentum in recent years. It is then evaluated whether the right to sustainable development is acceptable or not. The article concludes that the principles of sustainable development are directly or indirectly recognized in various human rights instruments, which is a good answer to the question posed above. This study, therefore, cites regional and international human rights agreements such as, as well as the jurisprudence and interpretative guidelines of human rights institutions, to prove this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Effect of Artificial Intelligence on Human Rights Obligations and Theories

Sameh Sarwat Melek Mikheal

Abstract— The relationship between development and human rights has long been the subject of academic debate. To understand the dynamics between these two concepts, various principles are adopted, from the right to development to development-based human rights. Despite the initiatives taken, the relationship between development and human rights remains unclear. However, the overlap between these two views and the idea that efforts should be made in the field of human rights have increased in recent years. It is then evaluated whether the right to sustainable development is acceptable or not. This article concludes that the principles of sustainable development are directly or indirectly recognized in various human rights instruments, and this is a good answer to the question posed above. This book therefore cites regional and international human rights agreements such as , as well as the jurisprudence and interpretative guidelines of human rights institutions, to prove this hypothesis.

Keywords— balance, counter-terrorism, cyber-terrorism, human rights, security, violation sustainable development, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

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The Impact of Artificial Intelligence on Human Rights Resources

Yasser Girgis Farag Girgis

Abstract— The link between development and human rights has long been the subject of scholarly debate. As a result, a number of principles have been adopted, from the right to development to the human rights-based development approach, to understand the dynamics between the two concepts. Despite the initiatives taken, the exact relationship between development and human rights remains unclear. However, the rapprochement between the two concepts and the need for development efforts regarding human rights have increased in recent years. On the other hand, the emergence of sustainable development as an acceptable method in development goals and policies makes this consensus even more unstable. The place of sustainable development in the legal debate on human rights and its role in promoting sustainable development programs require further research. Therefore, this article attempts to map the relationship between development and human rights, with particular emphasis on the place given to sustainable development principles in international human rights law. It will continue to investigate whether it recognizes sustainable development rights. The article will therefore give a positive answer to question mentioned here. The jurisprudence and interpretive guidelines of human rights institutions travel to confirm this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Effect of Artificial Intelligence on Human Rights Resources and Development

Tharwat Girgis Farag Girgis

Abstract— The link between development and human rights has long been the subject of scholarly debate. As a result, a number of principles have been adopted, from the right to development to the human rights-based development approach, to understand the dynamics between the two concepts. Despite the initiatives taken, the exact relationship between development and human rights remains unclear. However, the rapprochement between the two concepts and the need for development efforts regarding human rights have increased in recent years. On the other hand, the emergence of sustainable development as an acceptable method in development goals and policies makes this consensus even more unstable. The place of sustainable development in the legal debate on human rights and its role in promoting sustainable development programs require further research. Therefore, this article attempts to map the relationship between development and human rights, with particular emphasis on the place given to sustainable development principles in international human rights law. It will continue to investigate whether it recognizes sustainable development rights. The article will therefore give a positive answer to question mentioned here. The jurisprudence and interpretive guidelines of human rights institutions travel to confirm this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Artificial Intelligence on Human Rights Development

Kerols Seif Said Botros

Abstract— The relationship between development and human rights has been debated for a long time. Various principles, from the right to development to development-based human rights, are applied to understand the dynamics between these two concepts. Despite the measures calculated, the connection between enhancement and human rights remains vague. Despite, the connection between these two opinions and the need to strengthen human rights have increased in recent years. It will then be examined whether the right to sustainable development is acceptable or not. In various human rights instruments and this is a good vibe to the request cited above. The book then cites domestic and international human rights treaties, as well as jurisprudence and regulations defining human rights institutions, to support this view.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

The Impact of Technology on Human Rights Obligations and Theories

Mariam Kamal Sawares Gerges

Abstract— The interface between development and human rights has long been Although there has been an improvement in the protection of human rights in the region, human rights violations continue to occur. Although the government has adopted human rights laws, labor laws, and international agreements ratified by the United States, human rights violations are rare. The number of companies in debt is increasing in Bekasi, and human rights violations are increasing because the government is not obliged to protect them. The United States government and business leaders must respect, protect and defend the human rights of workers. This article discusses the human rights violations that garment workers face under the law, as well as ideas to improve workers' rights. Many theories have been developed to understand the impact between these two concepts, from rights to development to the development of human rights. Despite efforts, the relationship between development and human rights is not fully understood. But the connection between these two ideas is the idea that development efforts must respect human rights guarantees that have increased in recent years. It is then examined whether the right to sustainable development is acceptable or not.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

Technology Impact on the Challenge between Human Rights and Cyber Terrorism

Abanoub Zare Zakaria Herzalla

Abstract— The link between terrorism and human rights has become a major challenge in the fight against terrorism around the world. This is based on the fact that terrorism and human rights are so closely linked that when the former starts, the latter are violated. This direct connection was recognized in the Vienna Declaration and Program of Action adopted by the World Conference on Human Rights in Vienna on June 25, 1993, which recognizes that acts of terrorism in all their forms and manifestations aim to destroy the human rights of people. Terrorism therefore represents an attack on our most basic human rights. To this end, the first part of this article focuses on the connections between terrorism and human rights and seeks to highlight the interdependence between these two concepts. The second part discusses the emerging concept of cyberterrorism and its manifestations. An analysis of the fight against cyberterrorism in the context of human rights is also carried out.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

Human Rights Violation in Modern Society

Shenouda Salib Hosni Rofail

Abstract— The interface between development and human rights has long been the subject of scholarly debate. As a result, a set of principles ranging from the right to development to a human rights-based approach to development has been adopted to understand the dynamics between the two concepts. Despite these attempts, the exact link between development and human rights is not yet fully understood. However, the inevitable interdependence between the two concepts and the idea that development efforts must be made while respecting human rights have gained prominence in recent years. On the other hand, the emergence of sustainable development as a widely accepted approach to development goals and policies further complicates this unresolved convergence. The place of sustainable development in the human rights discourse and its role in ensuring the sustainability of development programs require systematic research. The aim of this article is, therefore, to examine the relationship between development and human rights, with a particular focus on the place of the principles of sustainable development in international human rights law. It will continue to examine whether it recognizes the right to sustainable development. Thus, the Article states that the principles of sustainable development are recognized directly or implicitly in various human rights instruments, which is an affirmative answer to the question posed above. Accordingly, this document scrutinizes international and regional human rights instruments, as well as the case law and interpretations of human rights bodies, to support this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security..

Efficiency and Performance of Legal Institutions in the Middle East in the 21st Century

Marco Khalaf Ayad Milhaail

Abstract— In thinking about the role of legal rules and their impact on social ethics and social structures, scholars have explored many issues related to gender, power, and ideology. First, it provides a framework for defining feminist legal studies through an overview of the field's evolution in terms of equality, rights, and justice. Secondly, it encourages those interested in equality, rights, and justice regarding women's issues to participate in international comparative law research. Third, we must emphasize that those seeking solutions to disability and discrimination must be aware of the need to confront the so-called undermining of culture. Therefore, an effective way for women to solve this problem is to rely heavily on international law, which establishes basic legal principles such as gender equality, rights, and justice and can help create a domestic environment. Woman has gained many advantages by adopting the law of Divorce in the Islamic Sharea. Any Egyptian woman can get divorce by letting her rightful rights and wealth to her husband in return for her freedom.

Keywords— stability, harsh environments, techniques, thermal, properties, materials, applications, brittleness, fragility, disadvantages, bank, branches, profitability, setting prediction, effective target, measurement, evaluation, performance, commercial, business, profitability, sustainability, financial, system, banks.

Artificial Intelligence Impact on Strategic Stability

Darius Jakimavicius

Abstract— Artificial intelligence is the subject of intense debate in the international arena, identified both as a technological breakthrough and as a component of the strategic stability effect. Both the kinetic and non-kinetic development of AI and its application in the national strategies of the great powers may trigger a change in the security situation. Artificial intelligence is generally faster, more capable and more efficient than humans, and there is a temptation to transfer decision-making and control responsibilities to artificial intelligence. Artificial intelligence, which, once activated, can select and act on targets without further intervention by a human operator, blurs the boundary between human or robot (machine) warfare, or perhaps human and robot together. Artificial intelligence acts as a force multiplier that speeds up decision-making and reaction times on the battlefield. The role of humans is increasingly moving away from direct decision-making and away from command and control processes involving the use of force. It is worth noting that the autonomy and precision of AI systems make the process of strategic stability more complex. Deterrence theory is currently in a phase of development in which deterrence is undergoing further strain and crisis due to the complexity of the evolving models enabled by artificial intelligence. Based on the concept of strategic stability and deterrence theory, it is appropriate to develop further research on the development and impact of AI in order to assess AI from both a scientific and technical perspective: to capture a new niche in the scientific literature and academic terminology, to clarify the conditions for deterrence, and to identify the potential uses, impacts and possibly quantities of AI. The research problem is the impact of artificial intelligence developed by great powers on strategic stability. This thesis seeks to assess the impact of AI on strategic stability and deterrence principles, with human exclusion from the decision-making and control loop as a key axis. The interaction between AI and human actions and interests can determine fundamental changes in great powers' defense and deterrence, and the development and application of AI-based great powers strategies can lead to a change in strategic stability.

Keywords— artificial intelligence, strategic stability, deterrence theory, decision making loop.

The Effect of Technology on Human Rights Rules

Adel Fathy Sadek Abdalla

Abstract— The issue of respect for human rights in Southeast Asia has become a major concern and is attracting the attention of the international community. Basically, the Association of Southeast Asian Nations (ASEAN) made human rights one of its main issues and in the ASEAN Charter in 2008. Subsequently, the Intergovernmental Commission on Human Rights ASEAN Human Rights (AICHR) was established. AICHR is the Southeast Asia Human Rights Enforcement Commission charged with the responsibilities, functions and powers to promote and protect human rights. However, at the end of 2016, the protective function assigned to the AICHR was not yet fulfilled. This is shown by several cases of human rights violations that are still ongoing and have not yet been solved. One case that has recently come to light is human rights violations against the Rohingya people in Myanmar. Using a legal-normative approach, the study examines the urgency of establishing a human rights tribunal in Southeast Asia capable of making a decision binding on ASEAN members or guilty parties. Data shows ASEAN needs regional courts to deal with human rights abuses in the ASEAN region. In addition, the study also highlights three important factors that ASEAN should consider when establishing a human rights tribunal, namely: Volume. a significant difference in terms of democracy and human rights development among the members, a consistent implementation of the principle of non-interference and the financial issue of the continuation of the court.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security.

Criminal Attitude vs Transparency in the Arab World

Keroles Akram Saed Ghatas

Abstract—The political violence that characterized 1992 continued into 1993, creating a major security crisis for President Hosni Mubarak's government as the death toll and human rights abuses soared. Increasingly sensitive to criticism of 's human rights activities, the government established human rights departments in key ministries, beginning with the Foreign Office in February. Similar offices have been set up in the Justice and Agriculture Ministries, and plans to set up an office in the Home Office have been announced. It turned out that the main task of the law unit was to overturn the conclusions of international human rights organizations. President Mubarak was elected in a national referendum on October 4 for a third six-year term after being appointed on July 21 by the People's Assembly, an elected parliament overwhelmingly dominated by the in-power National Democratic Party will Mr. Mubarak ran unhindered. The Interior Ministry announced that nearly 16 million people cast their votes (84% of eligible voters), of which 96.28% voted for presidential re-election. In 1993, armed Islamic extremists escalated their attacks on Christian citizens, government officials, police officers and senior security officials, resulting in casualties among the intended victims and bystanders. Sporadic attacks on buses, boats and tourist attractions also occurred throughout the year. From March 1992 to October 28, 1993, a total of 222 people lost their lives in the riots: 36 Coptic Christians and 38 other citizens; If one is a foreigner; sixty-six members of the Security Forces; and seventy-six known or suspected activists who were killed while resisting arrest. The latter was killed in airstrikes and firefights with security forces and at the site of planned attacks. On March 9-10, a series of airstrikes in Cairo, Giza, Qalyubiya province north of the capital and Aswan killed fifteen suspected militants and five members of the security forces. One of the airstrikes in Giza, part of Greater Cairo, killed the wife and son of Khalifa Mahmoud Ramadan, a suspected militant who was himself killed. The government agency Middle East News Agency reported on March 10 that the raids were part of a "broad confrontational plan aimed at offerrorist elements" The state of emergency declared in October 1981 after the assassination of President Anwar el-Sadat was still in force in Egypt. The law, previously in effect continuously from June 1967 to May 1980, continued to grant the executive branch unique legal powers that effectively overrode the human rights guarantees of the Egyptian constitution. These provisions included wide discretionary powers in arresting and detaining individuals, as well as the ability to try civilians in military courts. The Cairo-based Independent Organization for Human Rights said so in a document sent to the United Nations in July 1993 The human rights committee said the continued imposition of the state of emergency had resulted in "another constitution for the country" and "led to widespread misconduct by the security apparatus"..

Keywords—constitution, human rights, legal power, President, Anwar, el-Sadat, assassination, state of emergency, Middle East, News, Agency, confrontational, arresting, fugitive, leaders, terrorist, elements, armed Islamic extremists.

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The Impact of Artificial Intelligence on The Development of Human Rights Regulations and Rules

Ehab Atta Youssef Rezkallah

Abstract— The interface between development and human rights has long been the subject of academic debate. Therefore, to understand the dynamics between the two concepts, a number of principles have been adopted, ranging from the right to development to a human rights-based approach to development. Despite these attempts, the exact connection between development and human rights is not yet fully understood. However, the inherent interdependence between these two concepts and the idea that development efforts should be undertaken with respect for human rights guarantees have gained momentum in recent years. It will then be examined whether the right to sustainable development is recognized. The article therefore concludes that the principles of sustainable development are recognized, directly or indirectly, in various human rights instruments, which represents a positive answer to the question posed above. Therefore, this work discusses international and regional human rights instruments as well as case law and interpretative guidelines from human rights bodies to demonstrate this hypothesis.

Keywords— sustainable development, human rights, the right to development, the human rights-based approach to development, environmental rights, economic development, social sustainability human rights protection, human rights violations, workers' rights, justice, security..

Destructive Groups: The Impact on Adolescent Mental Health and Social Integration

Dušica Kovačević

Abstract— This study explores the influence of destructive groups on the mental health and social integration of high school students in Loznica, Serbia. Despite increasing concerns, there is a significant lack of research on the impact of these groups on adolescents in this region. This qualitative study aims to fill this gap by examining the prevalence of destructive groups, their psychological effects on students, and their broader social implications. Data were collected through surveys and in-depth interviews with high school students, educators, and mental health professionals. The study focuses on key mental health indicators, such as anxiety, depression, and identity formation, alongside social factors, including peer relationships and community engagement. Additionally, it defines coping mechanisms and supporting strategies employed by students affected by these groups. The findings reveal substantial psychological and social challenges faced by students exposed to destructive groups, including increased levels of anxiety and depression, disrupted identity development, and impaired social integration. Insights into the personal experiences of these students provide a detailed understanding of the groups' impact, underscoring the need for targeted interventions. This research offers evidence-based recommendations for educators, mental health practitioners, and policymakers. It emphasizes the importance of developing effective educational programs and support services to enhance the well-being of high school advocates for proactive measures to protect adolescent mental health and promote healthy social values within educational and community settings.

Keywords— adolescents, mental health, destructive groups, social integration, qualitative study, high school students, Serbia.

Implementing Online Applications to Allow Marketing Personnel to Share Their Experiences

Ishak Kamal Baskhayroun

Abstract— This study examines consumer attitudes toward mobile marketing, especially toward SMS marketing. Unlike similar studies, this study does not focus on the young, but includes consumers who are in the 18-70 age range to the field research. According to the results, it has been concluded that most participants think SMS marketing is disturbing. Most important problems with SMS marketing are about getting subscribed to message lists without the permission of the receiver; the high number of messages sent; and the irrelevancy of the message content. The emergence of sponsorship as a new marketing communication tool and a source of competitive advantage in the marketplace has changed the entire marketing communication process. Sponsorship has overtaken other marketing communication tools in terms of growth and expenditure. This paper seeks to evaluate the role of sponsorship in marketing communication tools. The study recommends that proper measures be taken before the company embarks into sponsorship programs. This is necessary because investment in sponsorship does not always guarantee sustainable competitive advantage in the marketplace. Mobile phones are one of the direct marketing tools that can be used to reach today's hard to reach consumers. Mobile phones are very personal devices and they are always carried with the consumer, where ever they go. This creates an opportunity for marketers to create personalized marketing communications messages and send them on the right time and place.

Keywords— employee organizational performance, internal marketing, internal customer, direct marketing, mobile phones mobile marketing, sms advertising, marketing sponsorship, marketing communication theories, marketing communication tools corporate responsibility.

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The Impact of Artificial Intelligence on Journalism and Mass Communication

Saad Zagloul Shokri Melika

Abstract— The London College of Communication is one of the only universities in the world to offer a lifestyle journalism master's degree. A hybrid originally constructed largely out of a generic journalism program crossed with numerous cultural studies approaches, the degree has developed into a leading lifestyle journalism education attracting students worldwide. This research project seeks to present a framework for structuring the degree as well as to understand how students in this emerging field of study value the program. While some researchers have addressed questions about journalism and higher education, none have looked specifically at the increasingly important genre of lifestyle journalism, which Folker Hanusch defines as including notions of consumerism and critique among other identifying traits. Lifestyle journalism, itself poorly researched by scholars, can relate to topics including travel, fitness, and entertainment, and as such, arguably a lifestyle journalism degree should prepare students to engage with these topics. This research uses the existing Masters of Arts and Lifestyle Journalism at the London College of Communications as a case study to examine the school's approach. Furthering Hanusch's original definition, this master's program attempts to characterize lifestyle journalism by a specific voice or approach, as reflected in the diversity of student's final projects. This framework echoes the ethos and ideas of the university, which focuses on creativity, design, and experimentation. By analyzing the current degree as well as student feedback, this research aims to assist future educators in pursuing the often neglected field of lifestyle journalism. Through a discovery of the unique mix of practical coursework, theoretical lessons, and broad scope of student work presented in this degree program, researchers strive to develop a framework for lifestyle journalism education, referring to Mark Deuze's ten questions for journalism education development. While Hanusch began the discussion to legitimize the study of lifestyle journalism, this project strives to go one step further and open up a discussion about teaching of lifestyle journalism at the university level.

Keywords— Journalism, accountability, education, television, publicearth, investigative, journalism, Nigeria, journalismeducation, lifestyle, university.

A Generative Pretrained Transformer-Based Question-Answer Chatbot and Phantom-Less Quantitative Computed Tomography Bone Mineral Density Measurement System for Osteoporosis

Mian Huang, Chi Ma, Junyu Lin, William Lu

Abstract—

Introduction:

Bone health attracts more attention recently and an intelligent question and answer (QA) chatbot for osteoporosis is helpful for science popularization. With Generative Pretrained Transformer (GPT) technology developing, we build an osteoporosis corpus dataset and then fine-tune LLaMA, a famous open-source GPT foundation large language model(LLM), on our self-constructed osteoporosis corpus. Evaluated by clinical orthopedic experts, our fine-tuned model outperforms vanilla LLaMA on osteoporosis QA task in Chinese.

Three-dimensional quantitative computed tomography (QCT) measured bone mineral density (BMD) is considered as more accurate than DXA for BMD measurement in recent years. We develop an automatic Phantom-less QCT(PL-QCT) that is more efficient for BMD measurement since no need of an external phantom for calibration.

Combined with LLM on osteoporosis, our PL-QCT provides efficient and accurate BMD measurement for our chatbot users.

Material and Methods:

We build an osteoporosis corpus containing about 30,000 Chinese literatures whose titles are related to osteoporosis. The whole process is done automatically, including crawling literatures in .pdf format, localizing text/figure/table region by layout segmentation algorithm and recognizing text by OCR algorithm. We train our model by continuous pre-training with Low-rank Adaptation (LoRA, rank=10) technology to adapt LLaMA-7B model to osteoporosis domain, whose basic principle is to mask the next word in the text and make the model predict that word. The loss function is defined as cross-entropy between the predicted and ground-truth word. Experiment is implemented on single NVIDIA A800 GPU for 15 days.

Our automatic PL-QCT BMD measurement adopt AI-associated region-of-interest (ROI) generation algorithm for localizing vertebrae-parallel cylinder in cancellous bone. Due to no phantom for BMD calibration, we calculate ROI BMD by CT-BMD of personal muscle and fat.

Results & Discussion:

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Clinical orthopaedic experts are invited to design 5 osteoporosis questions in Chinese, evaluating performance of vanilla LLaMA and our fine-tuned model. Our model outperforms LLaMA on over 80% of these questions, understanding ‘Expert Consensus on Osteoporosis’, ‘QCT for osteoporosis diagnosis’ and ‘Effect of age on osteoporosis’. Detailed results are shown in appendix. Future work may be done by training a larger LLM on the whole orthopaedics with more high-quality domain data, or a multi-modal GPT combining and understanding X-ray and medical text for orthopaedic computer-aided-diagnosis. However, GPT model gives unexpected outputs sometimes, such as repetitive text or seemingly normal but wrong answer (called ‘hallucination’). Even though GPT give correct answers, it cannot be considered as valid clinical diagnoses instead of clinical doctors.

The PL-QCT BMD system provided by Bone’s QCT(Bone’s Technology(Shenzhen) Limited) achieves 0.1448mg/cm²(spine) and 0.0002 mg/cm²(hip) mean absolute error(MAE) and linear correlation coefficient R²=0.9970(spine) and R²=0.9991(hip)(compared to QCT-Pro(Mindways)) on 155 patients in three-center clinical trial in Guangzhou, China.

Conclusion:

This study builds a Chinese osteoporosis corpus and develops a fine-tuned and domain-adapted LLM as well as a PL-QCT BMD measurement system. Our fine-tuned GPT model shows better capability than LLaMA model on most testing questions on osteoporosis. Combined with our PL-QCT BMD system, we are looking forward to providing science popularization and early morning screening for potential osteoporotic patients.

Keywords—Generative Pretrained Transformer (GPT), Large Language Model (LLM), Osteoporosis, Phantom-less Quantitative CT.

Implant Operation Guiding Device for Dental Surgeons

Daniel Hyun

Abstract— Dental implants are one of the top 3 reasons to sue a dentist for malpractice. It involves dental implant complications, usually because of the angle of the implant from the surgery. At present, surgeons usually use a 3D-printed navigator that is customized for the patient's teeth. However, those can't be reused for other patients as they require time. Therefore, I made a guiding device to assist the surgeon in implant operations. The surgeon can input the objective of the operation, and the device constantly checks if the surgery is heading towards the objective within the set range, telling the surgeon by manipulating the LED. We tested the prototypes' consistency and accuracy by checking the graph, average standard deviation, and the average change of the calculated angles. The accuracy of performance was also acquired by running the device and checking the outputs. My first prototype used accelerometer and gyroscope sensors from the Arduino MPU6050 sensor, getting a changeable graph, achieving 0.0295 of standard deviations, 0.25 of average change, and 66.6% accuracy of performance. The second prototype used only the gyroscope, and it got a constant graph, achieved 0.0062 of standard deviation, 0.075 of average change, and 100% accuracy of performance, indicating that the accelerometer sensor aggravated the functionality of the device. Using the gyroscope sensor allowed it to measure the orientations of separate axes without affecting each other and also increased the stability and accuracy of the measurements.

Keywords— implant, guide, accelerometer, gyroscope, handpiece.

Deep Learning in Epilepsy Neuroimaging

Parisa Mansour

Abstract— In recent times, artificial intelligence (AI), especially deep learning, has demonstrated potential in various medical sectors. Although traditional machine learning cannot learn features from unprocessed data, deep learning (DL) uses neural networks to accomplish this task. Although most studies have dealt with identifying and forecasting seizures from EEG data, there is a growing body of research utilizing different neuroimaging techniques such as MRI, DWI, and PET scans. This is advantageous for evaluating patients with epilepsy.

We analyze the use of DL in neural imaging (sMRI, fMRI, DWI and PET) for focal epilepsy, particularly in the pre-surgical assessment of drug-resistant epilepsy. Initially, a concise theoretical introduction to artificial neural networks and deep learning is provided. Afterwards, we examine how deep learning is utilized in neuroimaging for epilepsy: diagnosing and determining the side affected, identifying lesions automatically, assessing before surgery, and forecasting after surgery results. Lastly, the article addresses the restrictions, obstacles, and potential future paths for utilizing these methods in epilepsy research. This method has the potential to be a crucial instrument in medical practice, especially for assessing images that appear normal to the naked eye, for personalized therapies, and for addressing epilepsy as a disorder of interconnected networks. Greater collaboration among multiple centers is needed to acquire enough quantity and quality of data collection, and to ensure that the resulting codes and tools are accessible to the public.

Keywords— epilepsy, deep learning and artificial neural networks, neuro imaging, artificial intelligence.

Effective Budget Utilization for the Production of Better Health Professionals

Tesfahiwt Abay Weldearegay

Abstract— Ethiopian Federal ministry of health, in collaboration with different partners, provides financial support from sustainable development grants and global fund budget sources to Regional health science colleges through the regional health bureau to improve the quality of training and avail professionals based on the regional health bureau demand from the year of 2012 to 2019EC. It was mainly focused on health extension workers (HEW) Level III&IV, Health Information technicians (HIT), Emergency Medical technicians (EMT), laboratory technicians, Pharmacy technicians, Anesthesia Level V, Radiography, midwifery, Environmental health and biomedical equipment technician. Laboratory technician, Radiography and Pharmacy technician, was retooling program. The study aims at assessing the Utilization and outcome of budgets transferred through regional health bureau to regional health science colleges. The study used both quantitative and qualitative approaches to develop sufficient data to explain the utilization of the budget, and outcomes obtained from the transferred budget and to identify the gaps. The data for the study were obtained through structured questionnaires and interviews was conducted to increase the reliability of the data. Nationally, students enrolled in different disciplines at RHSC through budget support for RHB to improve the quality of training were 87 840 students and the total Budget transferred, according to MOU was 895,752,038 Ethiopian birr. Among the students enrolled nationally in different disciplines at RHSC through budget support only 72% of students have graduated from different disciplines. In Hareri and Addis Ababa, all enrolled students were graduated (100%). At the same time, Oromia 69%, Amara 77%, SNNP 58% students graduated, respectively. The demand of the regional health bureau and the enrollment capacity of health science colleges increased from year to year. The financial support added great value to the HSCs to cop with problems related to student fees, skill lab materials and renovation.

Keywords— emergency medical technician, radiography, Biomedical, health extension.

Usage of Cord Blood Stem Cells of Asphyxia Infants for Treatment

Ahmad Shah Farhat

Abstract—

Background: Prenatal asphyxia or birth asphyxia is the medical situation resulting from a newborn infant that lasts long enough during the birth process to cause physical harm, usually to the brain. Human umbilical cord blood (UCB) is a well-established source of hematopoietic stem/progenitor cells (HSPCs) for allogeneic stem cell transplantation. These can be used clinically to care for children with malignant diseases. Low O₂ can cause in proliferation and differentiation of stem cells.

Method: the cord blood of 11 infants with 3-5 Apgar scores or need to cardiac pulmonary Resuscitation as an asphyxia group and ten normal infants with more than 8 Apgar scores as the normal group was collected, and after isolating hematopoietic stem cells, the cells were cultured in enriched media for 14 days to compare the numbers of colonies by microscope.

Results: There was a significant difference in the number of RBC precursor colonies (red colonies) in cultured media with 107 cord blood hematopoietic stem cells of infants who were exposed to hypoxemia in two wells of palate. There was not a significant difference in the number of white cell colonies in the two groups in the two wells of the plate.

Conclusion: Hypoxia in the perinatal period can cause the increase of hematopoietic stem cells of cord blood, special red precursor stem cells in vitro, like an increase of red blood cells in the body when exposed to low oxygen conditions. Thus, it will be usable.

Keywords— asphyxia, neonre, stem cell, red cell.

Iron Metabolism and Ferroptosis in Polycystic Ovary Syndrome: A Systematic Review and Meta-Analysis

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Abstract

Background

Ferroptosis, a recently discovered form of programmed cell death characterized by iron-dependent lipid peroxidation, may be linked to polycystic ovary syndrome (PCOS). Diseases marked by iron overload have been correlated with ferroptosis. Coincidentally, investigations have revealed anomalies in iron metabolism among women with PCOS; however, there were inconsistencies in the evidence.

Objective and Rationale

This review aimed to comprehensively explore the potential relationship between ferroptosis and PCOS, by investigating the differences in iron metabolism among women with PCOS in comparison to a control group. Additionally, a narrative synthesis was provided on the past research status regarding the association between PCOS and ferroptosis.

Methods

A systematic search of the literature was performed using PubMed, Embase, Web of Science from inception up to December 2022. Search terms relating to assisted PCOS, ferroptosis and iron metabolism were used. PRISMA guidance was followed. RevMan 5.4 was utilized for conducting the meta-analysis, wherein the investigated outcomes included iron status (ferritin, iron, transferrin saturation) and a systemic iron-regulatory hormone (hepcidin). Narrative synthesis was performed to explore the correlation between PCOS and ferroptosis.

Results

In the meta-analysis comprising a total of 16 studies, significant differences in serum ferritin levels between the PCOS group and the control group were observed (15 studies, standardized mean difference (SMD): 0.41, 95% CI: 0.22 to 0.59, $P < 0.01$). This indicates elevated serum ferritin levels in PCOS patients compared to women without PCOS. The transferrin saturation in PCOS patients was significantly higher than that in

the control group (3 studies, mean difference (MD): 4.39, 95% CI: 1.67 to 7.11, $P < 0.01$). Regarding serum iron (6 studies, SMD: 0.05, 95% CI: -0.24 to 0.33, $P = 0.75$) and serum hepcidin (4 studies, SMD: -0.44, 95% CI: -1.41 to 0.52, $P = 0.37$), no statistically significant differences were observed between the PCOS group and the control group. Other studies have found that ferroptosis is involved in the occurrence and development of PCOS, offering valuable insights for guiding potential treatment measures and prognosis evaluation of PCOS. In addition, ferroptosis is involved in the miscarriage of PCOS-like rat, thus controlling ferroptosis might improve pregnancy outcomes in PCOS.

Conclusions

The observation of a significant elevation in serum ferritin and transferrin saturation levels in women with PCOS may suggest an underlying disturbance in iron metabolism, potentially induce the activation of ferroptosis. Further research is imperative to elucidate the underlying pathophysiology, providing insights for potential preventive measures and therapeutic strategies.

Limitation

There are some limitations as follow: First, due to limited extractable information, we excluded purely abstract publications and non-English publications. Second, the majority of original articles were case-control studies, making it difficult to determine the causal relationship between iron metabolism abnormalities and the onset of PCOS. Third, there is substantial heterogeneity in the definition of PCOS.

Keywords: Polycystic Ovary Syndrome; Ferroptosis; Iron Metabolism.

Precise Identification of CRISPR-induced Mutations via Hidden Markov Model-based Sequence Alignment

Jingyuan Hu and Zhandong Liu

Abstract—CRISPR genome editing technology has transformed molecular biology by accurately targeting and altering an organism’s DNA. Despite the state-of-art precision of CRISPR genome editing, the imprecise mutation outcome and off-target effects present considerable risk, potentially leading to unintended genetic changes. Targeted deep sequencing, combined with bioinformatics sequence alignment, can detect such unwanted mutations. Nevertheless, the classical method, Needleman-Wunsch (NW) algorithm may produce false alignment outcomes, resulting in inaccurate mutation identification. The key to precisely identifying CRISPR-induced mutations lies in determining optimal parameters for the sequence alignment algorithm. Hidden Markov models (HMM) are ideally suited for this task, offering flexibility across CRISPR systems by leveraging forward-backward algorithms for parameter estimation. In this study, we introduce CRISPR-HMM, a statistical software to precisely call CRISPR-induced mutations. We demonstrate that the software significantly improves precision in identifying CRISPR-induced mutations compared to NW-based alignment, thereby enhancing the overall understanding of the CRISPR gene-editing process.

Keywords—CRISPR, HMM, Sequence Alignment, Gene Editing

I. INTRODUCTION

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) genome editing technology has emerged as a groundbreaking innovation in the realm of molecular biology

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and genetics. The CRISPR-Cas9 system permits scientists to modify an organism’s DNA with remarkable precision, efficiency, and versatility [1]. CRISPR technology has shown great promise in the treatment of various diseases, particularly those with a genetic basis [2], [3]. By targeting specific genes or genetic sequences, CRISPR-Cas9 can edit an organism’s DNA directly, offering the potential to correct or modify the genetic defects that underlie many diseases. However, CRISPR gene editing often produces unwanted byproducts that rise significant clinical risks [4], [5]. Moreover, the efficiency of CRISPR gene editing can vary, leading to a mixed population of cells with different edits, which can make it challenging to interpret results in research or limit the efficacy of treatments in medical applications. Additionally, the CRISPR-Cas9 system may occasionally bind to and cut DNA sequences that are similar but not identical to the intended target, resulting in unintended mutations called off-target effects. [6].

The mechanism of CRISPR gene editing determines the likelihood of specific mutations. The initial step in CRISPR genome editing involves designing a custom sgRNA that contains a 20-nucleotide sequence complementary to the target genomic locus. Subsequently, the sgRNA forms a ribonucleoprotein complex with the Cas9 protein, which functions as a nuclease. This CRISPR-Cas9 complex locates the target DNA sequence, adjacent to a protospacer adjacent motif

(PAM) sequence required for Cas9 recognition and binding. Upon binding, the Cas9 protein unwinds the double-stranded DNA, allowing the sgRNA to form base pairs with the complementary target DNA strand, thereby activating Cas9 to cleave the DNA. The resulting double-strand break (DSB) triggers the cell's DNA repair mechanisms, including template-free non-homologous end joining (NHEJ) and template-based homology-directed repair (HDR). NHEJ repairs the broken DNA and introduces random insertions and deletions (indels) at the cleavage site. The most frequent mutation outcomes of NHEJ-mediated gene editing are deletions and 1-bp insertions [7]. HDR, on the other hand, is a template-based gene editing that repairs the DSB with specific templates. However, unintentionally, HDR competing with the more error-prone NHEJ pathway can lead to a mix of precisely edited cells and cells with insertions or deletions (indels) introduced by NHEJ [8]. Another domain of CRISPR genome editing is the base editor and prime editor, which only breaks a single strand of DNA and replaces a target nucleotide. Despite its state-of-art precision, the base editor also introduced unwanted indels to the system [9]. Both HDR and base editor by-products can complicate CRISPR-induced mutations and limit the efficacy of therapeutic applications.

Targeted deep sequencing is one of the primary methods employed to detect CRISPR-induced mutations. Namely, the target sites or off-target sites are PCR-amplified and sequenced at high depth, enabling sensitive detection of CRISPR-induced mutations. The Needleman-Wunsch (NW) global sequence alignment algorithm is a classical method for comparing nucleotide sequences and identifying mutations by determining similarities between a reference and a query sequence [10]. However, NW has several significant limitations. Firstly, under the affine penalty score, the NW alignment may produce multiple optimal alignments indistinguishable by penalty score, primarily due to repeated flanking sequences. Secondly, NW

is not flexible across different CRISPR systems because the hyperparameters are predetermined, and there is no systematic method exists to infer these parameters. Thirdly, in more complex CRISPR editing systems, (e.g., the CRISPR lineage tracing system that implements consecutive CRISPR target arrays), induced mutations exhibit more intricate patterns, such as inter-target deletions that are difficult to deconvolve with the NW algorithm [11], [12]. Although CRISPResso2 [13] (modified from the NW alignment) can distinguish multiple alignments under NW by predefining a site-specific penalty score, the software still lacks flexibility across all CRISPR gene editing systems.

We believe the key to accurately identifying CRISPR-induced mutations is determining optimal parameters for the sequence alignment algorithm. The hidden Markov model (HMM) is inherently well-suited for this task. Paired HMM is a powerful models to align biological sequences [14], [15]. A great advantage of using HMM is that the marginal probability of state transition can be computed from the forward-backward algorithm. Consequently, the HMM alignment model can flexibly adapt to any variant of the CRISPR system. We assumes that the transition probability varies at each position (Fig. 1), effectively capturing the probability of CRISPR mutagenesis. By leveraging the strengths of the HMM model and its ability to adapt to various CRISPR systems, we achieved greater precision in identifying CRISPR-induced mutations.

II. METHODS

A. Definitions

The HMM used for sequence alignment involves two observed sequences and one hidden sequence [14], [15]. We denote the original reference sequence as $X_{1:T} = x_1x_2\dots x_T$, the mutated sequence as $Y_{1:T'} = y_1y_2\dots y_{T'}$, and the hidden sequence (alignment path) as Z . The set of hidden states is defined as

$S = \{S, E\} \cup \{M_1, M_2, \dots, M_T\} \cup \{I_0, I_1, \dots, I_T\} \cup \{D_1, D_2, \dots, D_T\}$, where the subscript indicates the position on the reference sequence. Our profile HMM model is parameterized by the position-specific transition probability between hidden states $P(Z_{t+1}|Z_t)$. The transition model and parameter symbols are shown in Figure 1A. The states S and E denote the start and end states, respectively, while the states M_t , I_t , and D_t represent the match, insertion, and deletion of reference sequences at index t . Finally, the emission probability in this HMM model is parameterized to differentiate between a match probability p and a mismatch probability $1 - p$ if the hidden state is M . The emission probability of gapped state from D or I is set to q .

B. Finding the optimal alignment path with the Viterbi algorithm

The Viterbi algorithm (Algorithm 1) finds the hidden sequence with the maximum posterior probability, $P(Z|X, Y, \Theta)$, where Θ represents the set of all parameters. If the parameters are given, the posterior probability is proportional to $P(X, Y, Z|\Theta)$, which represents the probability of observing both sequences X and Y given the alignment path Z and the model parameters Θ . The optimal alignment path Z^* is given by the hidden sequence that maximizes the joint probability.

$$Z^* = \underset{Z}{\operatorname{argmax}} : \log(P(X, Y, Z|\Theta)) \quad (1)$$

The Viterbi algorithm is a dynamic programming approach that iteratively updates three matrices $\mathcal{M}, \mathcal{D}, \mathcal{I}$ to find the maximum joint probability of three sequences. Specifically, $\mathcal{M}[i, j]$ is the maximum joint probability of alignment between subsequences $X_{1:i}$ and $Y_{1:j}$ with the last characters (X_i and Y_j) matched. $\mathcal{D}[i, j]$ and $\mathcal{I}[i, j]$ represent the last characters deletion (gap in Y_j) and insertion (gap in X_i).

The Viterbi algorithm allows us to efficiently compute the optimal alignment path with computational complexity $O(TT')$, where T and T' are the lengths of the sequence X and Y .

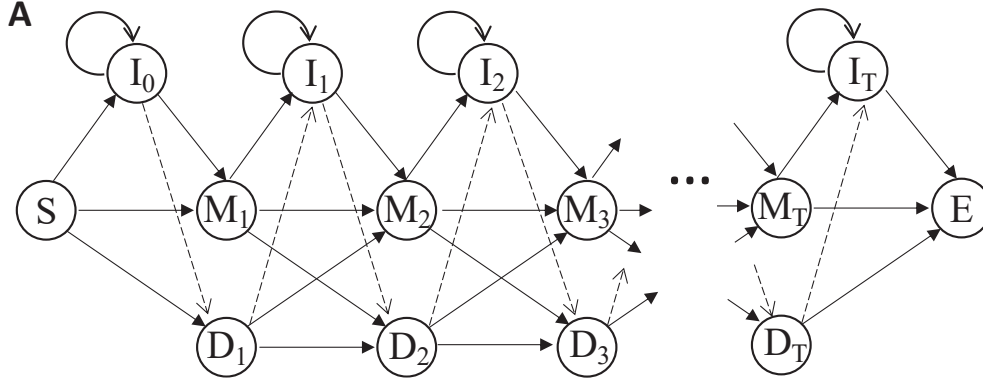
C. Parameter Estimation with the forward-backward algorithm

A major attraction of the hidden Markov model is the marginal probability of the hidden states can be computed via the forward-backward algorithm. The update rule of the dynamic programming of the forward-backward algorithm resembles the Viterbi algorithm except the max operator is replaced by the sum. Using the forward-backward algorithm (Algorithm 2 3), we can acquire two matrices A and B , which can be used to compute expected transition probability between the hidden states (transition) $\xi(z, z')$:

$$\xi_{z,z'} = P(Z_t = z, Z_{t+1} = z'|X, Y, \Theta^{(t)}) = \frac{A_{Z_t=z} \theta_i e(x, y|z') B_{Z_{t+1}=z'}}{P(X, Y|\Theta^{(t)})} \quad (2)$$

Although the Baum-Welch algorithm for hidden Markov models is frequently used for parameter estimation in HMMs, directly applying the Baum-Welch algorithm to HMMs can result in overfitting. For instance, when fitting the NHEJ-mediated CRISPR query sequences, many parameters distant from the DSB reduce to near-zero values with the Baum-Welch algorithm because mutations seldom occur in those sites. Furthermore, in the Baum-Welch settings, the parameter estimate in each iteration is updated to be the conditional probability $P(Z_{t+1}|Z_t, \cdot) = P(Z_{t+1}, Z_t|\cdot)/P(Z_t|\cdot)$, which could be inaccurate when $P(Z_t|\cdot)$ is small.

Our algorithm addresses the limitations of Baum-Welch by utilizing $\xi_{z,z'}$, which accurately represents the probability of state transitions. To stabilize the estimation, we employ min-max normalization to prevent the parameters from becoming



$P(M_1 S)$	$1 - \tau_0 - \delta_0$
$P(I_0 S)$	τ_0
$P(D_1 S)$	δ_0
$P(M_{t+1} M_t)$	$1 - \tau_t - \delta_t$
$P(I_t M_t)$	τ_t
$P(D_{t+1} M_t)$	δ_t
$P(D_{t+1} D_t)$	ε_t
$P(I_t D_t)$	ρ

$P(M_{t+1} D_t)$	$1 - \varepsilon_t - \rho$
$P(I_t I_t)$	γ_t
$P(D_{t+1} I_t)$	π
$P(M_{t+1} I_t)$	$1 - \gamma_t - \pi$
$P(E M_T)$	$1 - \tau_T$
$P(E I_T)$	$1 - \gamma_T$
$P(E D_T)$	1

B

A	T	A	-	A	T	A
A	G	A	A	G	A	-

Fig. 1: Parameterization of the profile-HMM model. **A** CRISPR-HMM uses site-specific transition probability across the hidden states. **B** Two examples of CRISPR-HMM sequence alignment.

exceedingly small. Given a minimum value a and b for the parameter θ , we linearly transform the parameter as follows:

$$\theta_i^* = \frac{\hat{\theta}_i - a}{b - a} \quad (3)$$

This transformation restricts the range of transition proba-

bility.

The primary advantage of CRISPR-HMM over NW-based alignment is its ability to learn site-specific transition probabilities from the data. So, the model can find one optimal

III. RESULTS

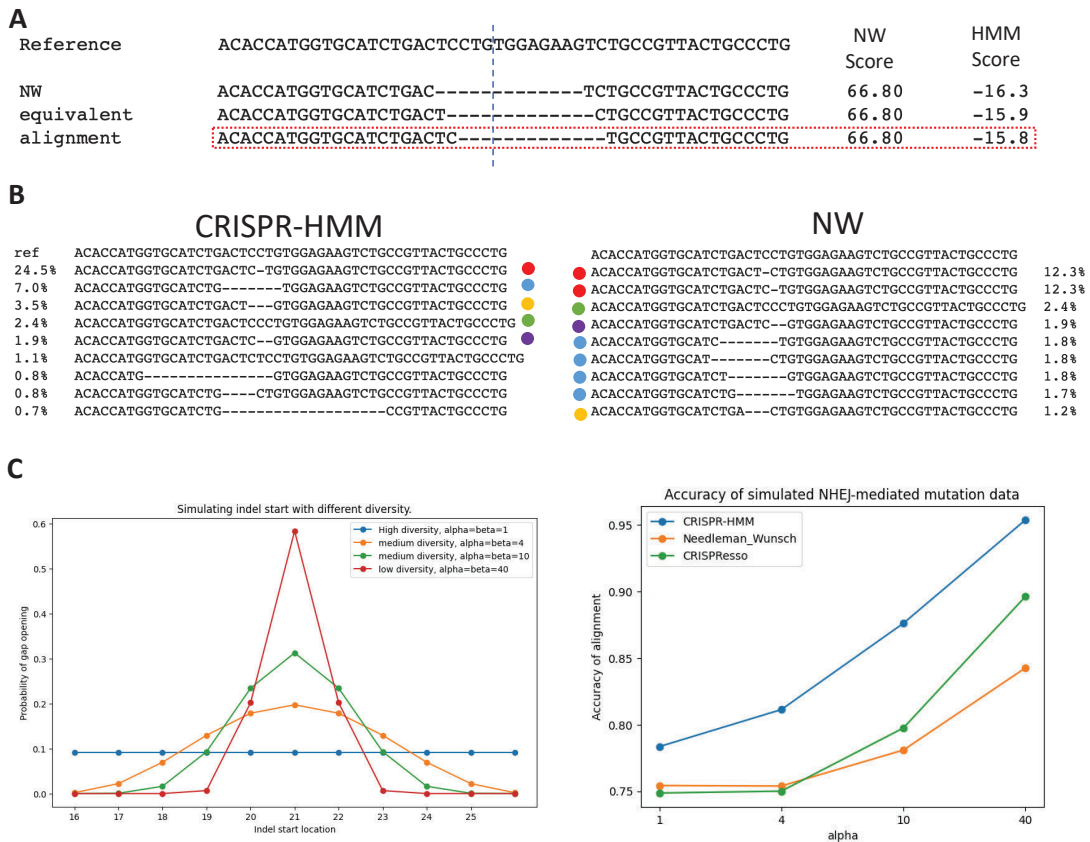


Fig. 2: Comparison of CRISPR-HMM to NW alignment on the NHEJ-mediated repair dataset. **A.** CRISPR-HMM identifies the optimal alignment that is undistinguishable from the NW algorithm. **B.** The top 10 most abundant sequences identified by CRISPR-HMM are unique, but NW are duplicated. **C.** Simulation of NHEJ-mediated editing. The deletion start is a sample from a discretized beta distribution with parameter alpha equal to beta equals 1, 4, 10, 40. This gives the different distribution of the deletion start site. Position 21 (highest on the graph) is 3-bp up to the PAM site. Across different simulation parameters, CRISPR-HMM outperforms NW and CRISPResso in alignment accuracy.

alignment out of many that the NW algorithm cannot distinguish (see Fig. 2 A, B).

We trained our model on five distinct CRISPR gene editing datasets to assess CRISPR-HMM’s performance. These datasets are: 1) Canonical CRISPR with NHEJ-mediated editing, 2) Homing-guide CRISPR with NHEJ-mediated editing [16], 3) Canonical CRISPR with enriched HDR-mediated editing, 4) Base editor, 5) CRISPR target array for lineage tracing [12]. Across all these datasets, we observed that indels contribute a significant part of mutations, even within the base editor dataset (Table 1).

In the canonical CRISPR dataset associated with NHEJ-mediated and HDR-mediated repair, CRISPR-HMM pinpointed the most probable indel location as three bp up to the PAM. This location aligns with the anticipated DSB site (see Fig. 4 A). Thus, CRISPR-HMM has revealed a more focused distribution of indel openings at the DSB site than the NW method identifies (see Fig. 4 B).

While CRISPResso2 relies on pre-defined scoring, our observations suggest that the software doesn’t perform robustly across varying CRISPR system variants. To exemplify this, we examined the homing-guide CRISPR system, where the guide

TABLE 1: The main product and byproduct different CRISPR genome editing platform.

Technique	Main Product	Byproduct
NHEJ	Random indels at DSB	/
HDR	Specific mutations based on the template	Incomplete HDR, Competition with NHEJ
Base Editor	Point substitution	By-strand mutation, Random indels

RNA is engineered to target its specific locus. Contrary to the usual expectations, deletion patterns in this system don't typically start from the 3bp up to the PAM. Therefore, across all the observed deletion patterns generated by the homing guide CRISPR, we found that CRISPResso2 is less consistent than CRISPR-HMM, showing a variation of deletion start sites (Fig. 5).

The precise location where an indel begins can provide insights into the distinct DNA repair mechanisms. The mutations manifest in two distinct categories when considering template-free genome editing via NHEJ. The first, known as conventional NHEJ (c-NHEJ), primarily involves the straightforward ligation of broken DNA ends that require sequence homology. The second type, alternative-NHEJ (alt-NHEJ), operates as a somewhat error-prone repair pathway. However, what distinguishes alt-NHEJ from c-NHEJ is the necessity for short-matching sequences at the breakpoints of the DNA [17]. Observing the indel opening positions can distinguish between these two repair mechanisms. In our studies utilizing CRISPR, we observed an increasing prevalence of alt-NHEJ than NW alignment, attributed to the ambiguous equivalent alignments generated by the NW algorithm (Fig. 4 C).

To evaluate the performance of CRISPR-HMM in comparison to two other alignment methods, Needleman-Wunsch (NW) and CRISPResso2, we simulated CRISPR mutations that mimic NHEJ-mediated editing. In these simulations, the most probable indel site is located 3-bp upstream of the PAM sequence. We used the reference sequence from canonical NHEJ data. To reflect the variety of outcomes in CRISPR genome editing, we determined the indel start site using four

beta distributions with varying variances. The indel opening can only occur 5-bp before or after the anticipated DSB site. We sampled the indel length from a Poisson distribution. Our results show that CRISPR-HMM consistently outperforms both NW and CRISPResso2 across all simulations, regardless of the diversity thresholds applied. This indicates that CRISPR-HMM's ability to learn from data enhances its performance in accurately identifying the most likely indel sites and achieving correct alignment (Fig. 5 C).

To further assess the performance of CRISPR-HMM with complex indel patterns, we evaluated its capabilities on a CRISPR target array system designed for lineage tracing [12]. We observed that indel patterns consistently remained 2-4 bp until the PAM. In stark contrast, the NW algorithm struggled to pinpoint the optimal alignment due to the intricate equivalent alignments presented by this complex system (Fig. 6). Collectively, our observations confirm CRISPR-HMM's capability to identify optimal indel patterns across both simple and complex CRISPR systems in an unsupervised manner.

The base editor emerges as one of the most pivotal CRISPR-based gene therapy techniques, primarily because it can induce single nucleotide gene changes. Within the C to T base editor, the single strand incurs an editing window upstream of the PAM, followed by a single base replacement (Fig. 3 A). Notwithstanding the cutting-edge efficiency of this method, indels emerge as the primary unwanted by-products (Fig. 3 B). Intriguingly, CRISPR-HMM discerns the single-strand break site as the predominant location for both single-nucleotide alterations and indels. On the contrary, CRISPResso2 does not consistently identify indel openings considered equivalent



Fig. 3: Comparison of CRISPR-HMM and CRISPResso2 on the base editor dataset. **A** The proportion of insertions, deletions, and substitutions in this base editor dataset. **B** The frequency of observed C to T base editing. **C** CRISPR-HMM identifies a concordant optimal indel start site that aligns with the most frequent base editing site, while CRISPResso2’s indel start site appears discordant. **D** CRISPR-HMM discerns that the most common deletion start coincides with the C to T base editing site, a correlation that CRISPResso2 fails to establish.

under the NW algorithm. Furthermore, it doesn’t recognize the most frequent C to T editing site as the primary indel opening site (Fig. 3 C, D).

IV. CONCLUSION

In recent years, the volume of CRISPR-based sequencing data has grown dramatically. Consequently, detecting CRISPR-induced mutations has become an essential step in the analysis of these data sets. To address this need, we

have developed CRISPR-HMM, a software tool that accurately identifies mutations arising from four distinct CRISPR gene editing systems. The methodology behind CRISPR-HMM hinges solely on unsupervised learning from sequence data, negating the need for users to make any prior assumptions about the DSB site. Moreover, the forward-backward estimator for HMM provides the flexibility necessary for fitting the parameter model to any CRISPR system.

At present, CRISPR-HMM is designed for targeted deep

sequencing data. We believe its application can be expanded to accommodate whole-genome sequencing (WGS) and whole-exome sequencing, two alternative strategies for detecting off-target effects of CRISPR editing when multiple guide-RNA sequences are utilized to target different genomic regions. We anticipate that CRISPR-HMM will offer a better characterization of these mutations compared to the traditional NW method.

APPENDIX A
ALGORITHMS

Algorithm 1 The Viterbi algorithm for sequence alignment between $X_{1:T}$ and $Y_{1:T'}$

Initialization:
 $M[0, 0] \leftarrow 0$, otherwise $-\infty$
 $\mathcal{D}[0, 0] \leftarrow -\infty$, $\mathcal{D}[i, 0] \leftarrow \log(\delta_0) + \sum_{k=1}^{i-1} \log(q\epsilon_k)$ for $i > 0$, otherwise $-\infty$
 $\mathcal{I}[0, 0] \leftarrow -\infty$, $\mathcal{I}[0, j] \leftarrow \log(\tau_0) + \sum_{k=1}^{j-1} \log(q\gamma_k)$ for $j > 0$, otherwise $-\infty$
for $i = 1, 2, \dots, T$; $j = 1, 2, \dots, T'$ **do**
 $M[i, j] = \log e(x_i, y_j) + \max$
 $\begin{cases} \mathcal{M}[i-1, j-1] + \log(1 - \delta_{i-1} - \tau_{i-1}) \\ \mathcal{D}[i-1, j-1] + \log(1 - \epsilon_{i-1} - \rho) \\ \mathcal{I}[i-1, j-1] + \log(1 - \gamma_{i-1} - \pi) \end{cases}$
 $\mathcal{D}[i, j] = \log(q) + \max$
 $\begin{cases} \mathcal{M}[i-1, j] + \log(\delta_{i-1}) \\ \mathcal{D}[i-1, j] + \log(\epsilon_{i-1}) \\ \mathcal{I}[i-1, j] + \log(\pi) \end{cases}$
 $\mathcal{I}[i, j] = \log(q) + \max$
 $\begin{cases} \mathcal{M}[i, j-1] + \log(\tau_i) \\ \mathcal{D}[i, j-1] + \log(\rho) \\ \mathcal{I}[i, j-1] + \log(\gamma_i) \end{cases}$
end for
Termination:
 $max_score = \max$
 $\begin{cases} \mathcal{M}[T, T'] + \log(1 - \tau_T) \\ \mathcal{D}[T, T'] \\ \mathcal{I}[T, T'] + \log(1 - \gamma_T) \end{cases}$

APPENDIX B

CODE AND DATA AVAILABILITY

The CRISPR-HMM Python package is available at [18]. The code for regenerating the analysis results of this manuscript is available at [19]. All raw sequencing data in

Algorithm 2 Forward Algorithm

Initialization:
 $A_M[0, 0] \leftarrow 1$, otherwise 0
 $A_D[0, 0] \leftarrow 0$, $A_D[i, 0] \leftarrow (\delta_0 q) \prod_{k=1}^{i-1} (\epsilon_k q)$ for $i > 0$, otherwise 0
 $A_I[0, 0] \leftarrow 0$, $A_I[0, j] \leftarrow (\tau_0 q) \prod_{k=1}^{j-1} (\gamma_k q)$ for $j > 0$, otherwise 0
for $i = 1, 2, \dots, T$; $j = 1, 2, \dots, T'$ **do**
 $A_M[i, j] = e(x_i, y_j)(A_M[i-1, j-1](1 - \delta_{i-1} - \tau_{i-1}) + A_D[i-1, j-1](1 - \epsilon_{i-1} - \rho) + A_I[i-1, j-1](1 - \gamma_{i-1} - \pi))$
 $A_D[i, j] = q(A_M[i-1, j]\delta_{i-1} + A_D[i-1, j]\epsilon_{i-1} + A_I[i-1, j]\pi)$
 $A_I[i, j] = q(A_M[i, j-1]\tau_i + A_D[i, j-1]\rho + A_I[i, j-1]\gamma_i)$
end for

Algorithm 3 Backward Algorithm

Initialization:
 $B_M[T, T'] \leftarrow 1 - \tau_T$, otherwise 0
 $B_D[T, T'] \leftarrow 1$
 $B_I[T, T'] \leftarrow 1 - \gamma_T$
for $i = T-1, \dots, 1$; $j = T'-1, \dots, 1$ **do**
 $B_M[i, j] = e(x_{i+1}, y_{j+1})B_M[i+1, j+1](1 - \delta_i - \tau_i) + qB_D[i+1, j]\delta_i + qB_I[i, j+1]\tau_i$
 $B_D[i, j] = e(x_{i+1}, y_{j+1})B_M[i+1, j+1](1 - \epsilon_i - \rho) + qB_D[i+1, j]\epsilon_i + qB_I[i, j+1]\rho$
 $B_I[i, j] = e(x_{i+1}, y_{j+1})B_M[i+1, j+1](1 - \gamma_i - \pi) + qB_D[i+1, j]\pi + qB_I[i, j+1]\gamma_i$
end for

this study is publicly available and can be downloaded from GEO with the following accession number:

Data	Accession
NHEJ	SRR3192757
HDR	SRR4842590
hgRNA	SRR4842571
Carlin	SRR11311824
Base editor	SRR3305545

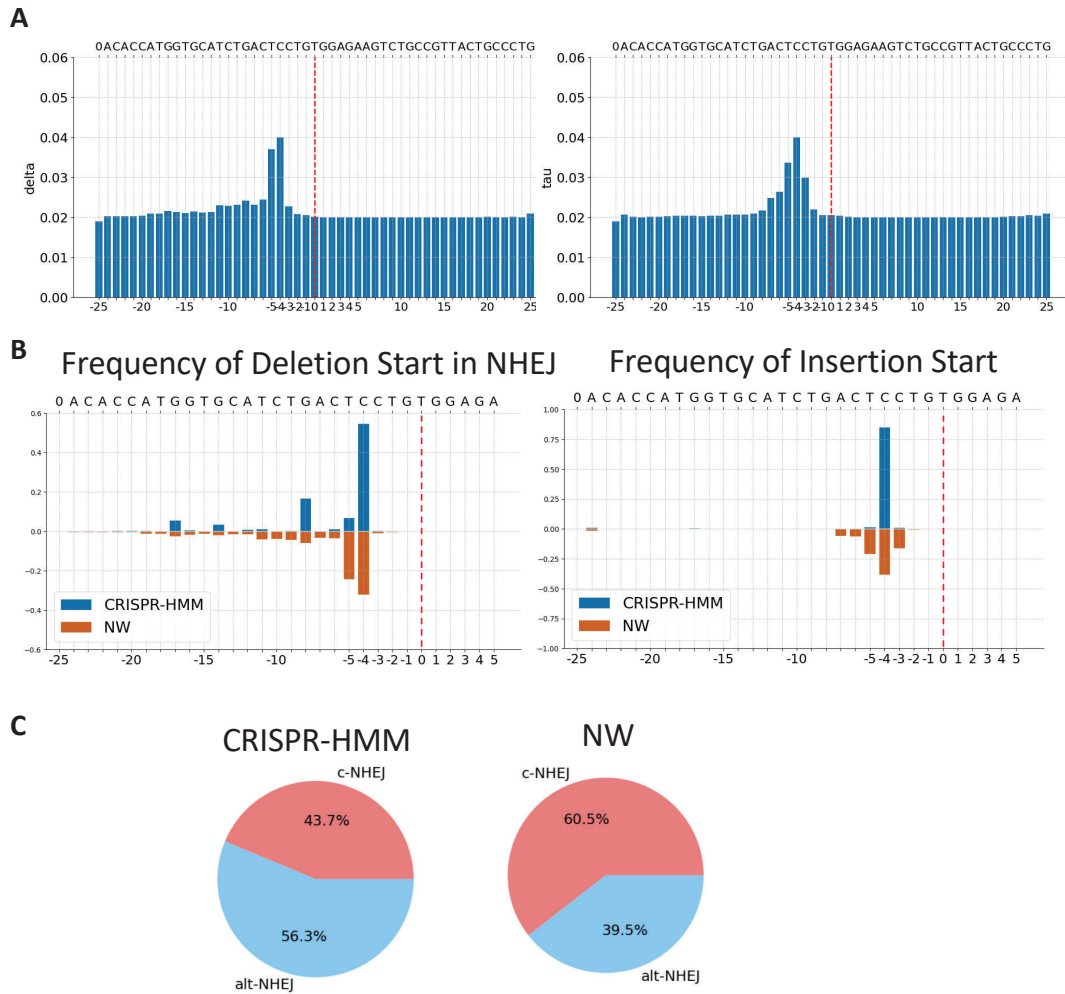


Fig. 4: **A** The deletion (delta) and insertion (tau) probability learned by CRISPR-HMM. **B** CRISPR-HMM identifies more reasonable indel start sites than NW in the CRISPR target array. The vertical line indicates the PAM site of each target. CRISPR-HMM finds the most likely indel start is within 2-4 bp before PAM. **C** The distribution of c-NHEJ vs alt-NHEJ identified by CRISPR-HMM or NW.

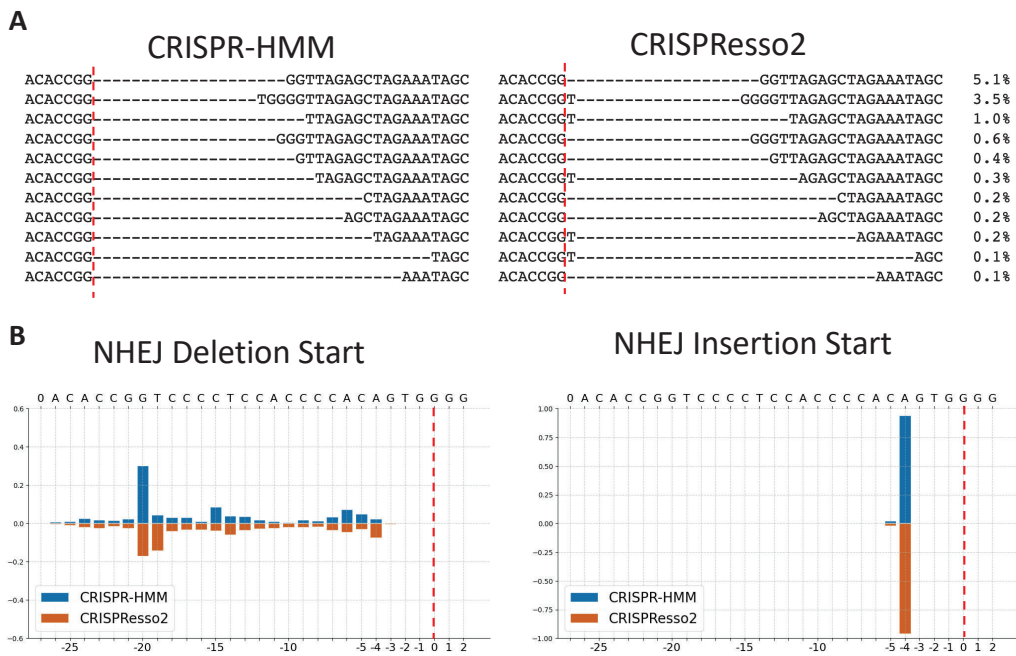


Fig. 5: The distribution of indel start identified by CRISPR-HMM is more consistent than CRISPResso2 in non-canonical homing guide CRISPR system. **A** Selected sequences that have the same starting position according to CRISPR-HMM but are not according to CRISPResso2. **B** The frequency of indel start identified by CRISPR-HMM and CRISPResso2.

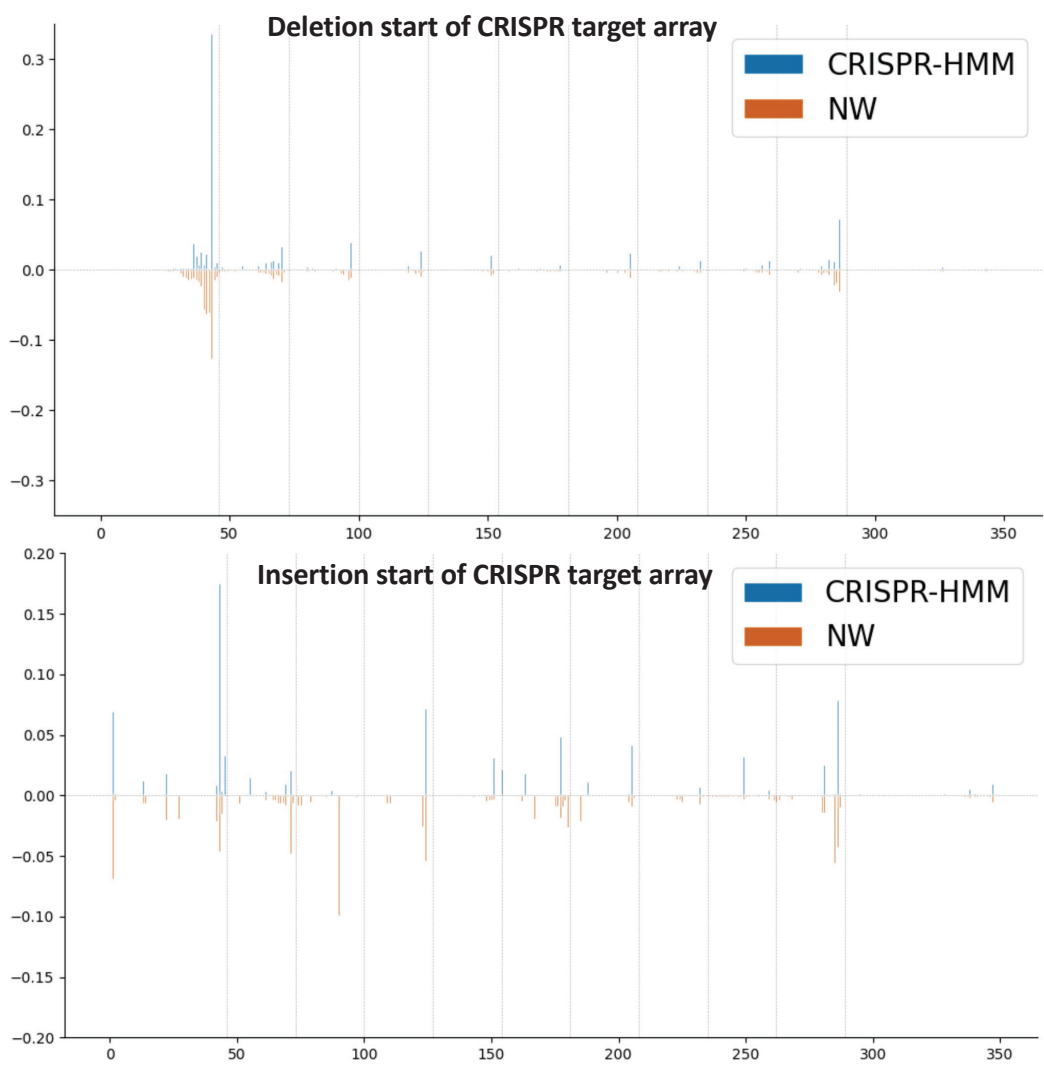


Fig. 6: The distribution of indel start identified by CRISPR-HMM is different NW in CRISPR-target array for lineage tracing.

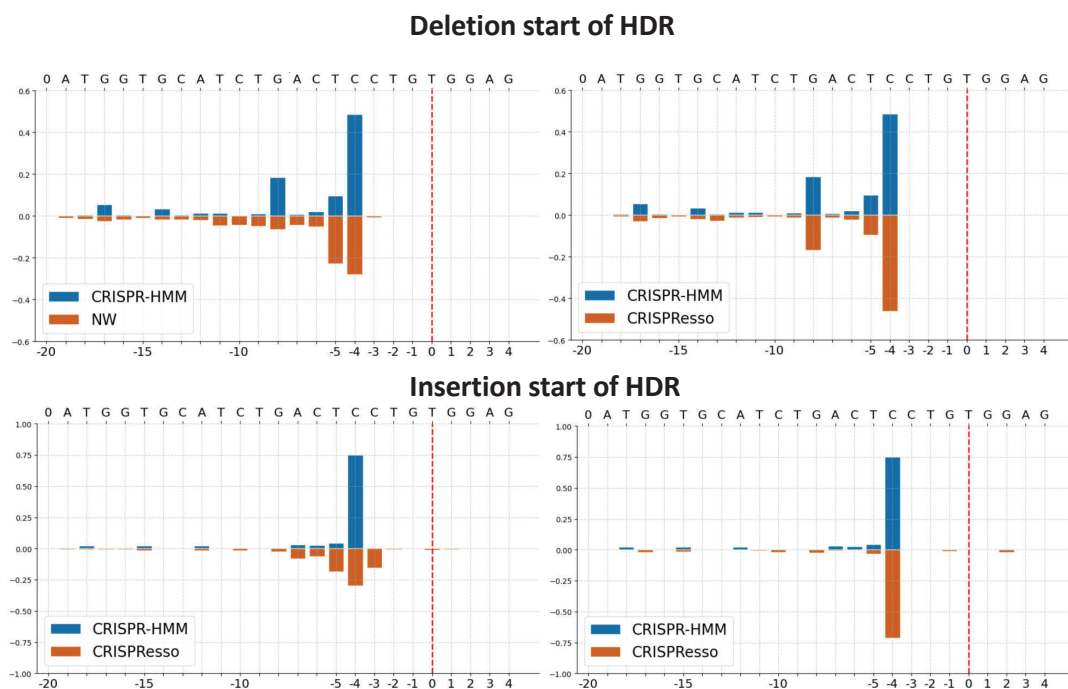


Fig. 7: The distribution of indel start identified by CRISPR-HMM is different NW in HDR-mediated CRISPR system.

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Measurement of Blood Phenobarbital Concentration Within Newborns Admitted to the NICU of Imam Reza Hospital and Received the Drug by Intravenous Mode

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Abstract—

Introduction: Newborns may be treated with phenobarbital for many reasons. Because in each region, depending on different races and genetic factors, different pharmacokinetic conditions govern the drug. It is essential to control blood levels of certain drugs, especially phenobarbital, and maintain these levels during treatment.

Methods: In this study, venous blood was collected from 50 neonates who received intravenous phenobarbital at a loading dose of 20 mg/kg weight and at least three days had passed since the maintenance dose of 5 mg/kg body weight. in 24 hours. and sent to the laboratory. Phenobarbital blood levels were measured, then the results were analyzed descriptively.

Results: In this study, the average weight of newborns was 9.93 ± 2.58 . The mean blood concentration of phenobarbital, three days after starting the maintenance dose in the group of infants weighing more than 2.5 kg, was 3.33 ± 9.1 micrograms/liter in the group of infants weighing less than 2 kg. and half a kilogram or LBW was 5.9 ± 9.5 micrograms/liter and in the group weighing less than 1.5 kg VLBW was 14.4 ± 15.46 micrograms/liter. There was no significant difference between groups ($p > 0.05$). Three days after starting the maintenance dose in all three groups, the mean blood phenobarbital concentration was 9.86 ± 0.86 micrograms/liter.

Conclusion: Blood phenobarbital levels in our newborns are below therapeutic levels, so phenobarbital levels should be evaluated.

Keywords: Newborn-Phenobarbital-Drug

The Effect of Artificial Intelligence on Autism Treatment

Nabil Youssef Masoud Girgis

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way to improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the study of autism in children, who have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

Autism Awareness Among School Students and the Violent Reaction of the Autist Toward Society in Egypt

Naglaa Baskhroun Thabet Wasef

Abstract— Specific education services for students with Autism remains in its early developmental stages in Egypt. In spite of many more children with autism are attending schools since The Egyptian government introduced the Education Provision for Students with Disabilities Act in 2010, the services students with autism and their families receive are generally not enough. This pointed study used Attitude and Reaction to Teach Students with Autism Scale to investigate 50 primary school teachers' attitude and reaction to teach students with autism in the general education classroom. Statistical analysis of the data found that student behavior was the most noticeable factor in building teachers' wrong attitudes students with autism. The minority of teachers also indicated that their service education did not prepare them to meet the learning needs of children with autism in special, those who are non-vocal. The study is descriptive and provides direction for increasing teacher awareness for inclusivity in Egypt.

Keywords— attitude, autism, teachers, sports activates, movement skills, motor skills, autism attitude.

The Impact of Autism on Child's behavior and Attitude

Mariam Atef Zakaria Faltas

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

The Effect of Autism Attitudes and Laws and Restrictions

Eva Maged Hosni Sadek

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism).In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

The Impact of Artificial Intelligence on Autism Attitudes and Laws

Randa Reda Luke Waheeb

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

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The Impact of Artificial Intelligence on Autism Attitudes and Laws

Narges Arsanious Kamel Arsanious

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

The Impact of Technology and Artificial Intelligence on Children in Autism

Dina Moheb Rashid Michael

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

The Impact of Artificial Intelligence on Children with Autism

Rania Melad Kamel Hakim

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. These have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these ‘syndrome’ forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or ‘non-syndrome’ autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way to improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co-morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties (‘sticky attention’), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

The Impact of Autism on Children Behavior

Marina Wagdy Nageeb Eskander

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

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The Impact of Artificial Intelligence on Autism Attitude and Skills

Samwail Fahmi Francis Yacoub

Abstract— Inclusive education services for students with Autism remains in its early developmental stages in Thailand. Despite many more children with autism are attending schools since the Thai government introduced the Education Provision for People with Disabilities Act in 2008, the services students with autism and their families receive are generally lacking. This quantitative study used Attitude and Preparedness to Teach Students with Autism Scale (APTSAS) to investigate 110 primary school teachers' attitude and preparedness to teach students with autism in the general education classroom. Descriptive statistical analysis of the data found that student behavior was the most significant factor in building teachers' negative attitudes students with autism. The majority of teachers also indicated that their pre-service education did not prepare them to meet the learning needs of children with autism in particular, those who are non-verbal. The study is significant and provides direction for enhancing teacher education for inclusivity in Thailand.

Keywords— attitude, autism, teachers, movement skills, motor skills, children, behavior.

The Impact of Artificial Intelligence on Autism Attitudes

Sara Asham Mahrous Kamel

Abstract— A descriptive statistical analysis of the data showed that the most important factor evoking negative attitudes among teachers is student behavior. have been presented as useful models for understanding the risk factors and protective factors associated with the emergence of autistic traits. Although these "syndrome" forms of autism reach clinical thresholds, they appear to be distinctly different from the idiopathic or "non-syndrome" autism phenotype. Most teachers reported that kindergartens did not prepare them for the educational needs of children with autism, particularly in relation to non-verbal skills. The study is important and points the way for improving teacher inclusion education in Thailand. Inclusive education for students with autism is still in its infancy in Thailand. Although the number of autistic children in schools has increased significantly since the Thai government introduced the Education Regulations for Persons with Disabilities Act in 2008, there is a general lack of services for autistic students and their families. This quantitative study used the Teaching Skills and Readiness Scale for Students with Autism (APTSAS) to test the attitudes and readiness of 110 elementary school teachers when teaching students with autism in general education classrooms. To uncover the true nature of these co morbidities, it is necessary to expand the definition of autism to include the cognitive features of the disorder, and then apply this expanded conceptualization to examine patterns of autistic syndromes. This study used various established eye-tracking paradigms to assess the visual and attention performance of children with DS and FXS who meet the autism thresholds defined in the Social Communication Questionnaire. To study whether the autistic profiles of these children are associated with visual orientation difficulties ("sticky attention"), decreased social attention, and increased visual search performance, all of which are hallmarks of the idiopathic autistic child phenotype. Data will be collected from children with DS and FXS, aged 6 to 10 years, and two control groups matched for age and intellectual ability (i.e., children with idiopathic autism). In order to enable a comparison of visual attention profiles, cross-sectional analyzes of developmental trajectories are carried out. Significant differences in the visual-attentive processes underlying the presentation of autism in children with FXS and DS have been suggested, supporting the concept of syndrome specificity. The study provides insights into the complex heterogeneity associated with autism syndrome symptoms and autism itself, with clinical implications for the utility of autism intervention programs in DS and FXS populations.

Keywords— attitude, autism, teachers, sports activities, movement skills, motor skills.

When Helping Hurts: Addressing Violence in Healthcare Settings

Jason Maffia, Maria D'urso, Robert Crupi, Margaret Cartmell

Abstract— The emotional aspects of traumatic events such as workplace violence are often ignored, causing low productivity, disillusionment, and resentment within an organization. As a result, if workplace violence, particularly in healthcare settings, is not adequately addressed, it will become a phenomenon, undermining the peace and stability among the active communities while also posing a risk to the population's health and well-being. This review intends to identify the risk factors and the implications of workplace violence in healthcare settings and highlight the collaborative efforts needed in sustaining control and prevention measures against workplace violence. It is essential that health care organizations are prepared physically and emotionally for traumatic situations. This study explores the theoretical nature of addressing work-related violence in healthcare settings as well as traumatic stress reactivity and the context within which reactions occur and recovery takes place. Cognitive, social, and organizational influences on response are identified and used to tentatively offer explanations for identifying security risks, development, and implementation of de-escalation teams, CISM programs and training staff in violence prevention are among strategies hospitals are employing to keep workers and patients safe. General conclusion regarding the implications for intervention effectiveness and design are discussed.

Keywords— Healthcare settings, stress reactions, traumatic events, workplace violence.

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Improving Patient Outcomes for Aspiration Pneumonia

Mary Farrell, Maria Soubra, Sandra Vega, Dorothy Kakraba, Joanne Fontanilla, Moira Kendra, Danielle Tonzola, Stephanie Chiu

Abstract—

Introduction

Pneumonia is the most common infectious cause of hospitalizations in the United States, with more than one million admissions annually with costs at approximately \$10 billion every year, making it the 8th leading cause of death. (Lindenauer et al., 2017). Aspiration pneumonia is an aggressive type of pneumonia that results from inhalation of oropharyngeal secretions and/or gastric contents and is preventable. Patients that have comorbidities that impair swallowing, consciousness and pulmonary clearance of secretions are at an increased risk leading to the mortality rates for aspiration pneumonia being higher than non-aspiration pneumonia. (Gupte et al., 2022). The authors hypothesized that an evidence-based clinical care pathway, focused on aspiration pneumonia, could reduce 30-day hospital readmissions, 30-day mortality rates, and improve the overall care of patients.

Methodology

We conducted a retrospective chart review on 979 patients discharged with aspiration pneumonia from January 2021 to December 2022 at Overlook Medical Center. The outcomes collected include patient demographics, admission location on the index hospitalization (home vs. skilled nursing facility (SNF), smoking status, final coded diagnosis on the index hospitalization, comorbidities, 30-day aspiration pneumonia readmission, and mortality rates.

The authors identified patients who were coded with aspiration pneumonia and/or stable sepsis. Secondly, we identified 30-day readmission rates for aspiration pneumonia from a SNF. Baseline demographics were summarized using descriptive statistics. We examined comorbid risk factors including conditions that impaired consciousness and swallowing that have been previously established to be associated with clinical aspiration pneumonia. We reviewed aspiration pneumonia-associated mortality rates for age, gender, ethnicity, race, and smoking history. Statistical analysis was conducted using MINITAB version 21.

Intervention

The Aspiration Pneumonia Clinical Care Pathway starts in the emergency department (ED) with the initiation of antimicrobials within 4 hours of admission and early recognition of aspiration. Once this is identified, a swallow test is initiated by the bedside nurse, and if the patient demonstrates dysphagia, they are maintained on strict nothing by mouth (NPO) followed by a speech and language pathologist (SLP) referral for an appropriate modified diet recommendation. Patients diagnosed with aspiration are placed onto a modified diet using the International Dysphagia Diet Standardization Initiative (IDDSI) framework that guides the food textures and drink thicknesses to improve swallowing safety.

Oral hygiene and lip moisturizing was initiated on patients to remove dental plaque and cleanse the oral cavity. Swabbing the oral cavity with an antiseptic rinse was initiated to assist with the remove of oral debris, secretions, and to stimulate the oral mucosa. Moisturizing was initiated to soothe and hydrate the lips and oral cavity. Patients who are dependent are given an oral care kit consisting of oral antiseptic rinse, a suction toothbrush, a soft oral applicator swab and a mouth moisturizer to be used after every meal and prn. For the patients who are NPO, this regimen was initiated

three times a day (TID) and prn. Patients diagnosed with dysphagia or are at risk for aspiration receive the aspiration wrist band to alert the healthcare team and visitors. The wrist band remained in place at the time of discharge to a SNF to alert the healthcare team and visitors that the patient was at risk for aspiration. Additional aspiration prevention techniques included the avoidance of straws, 45-degree positioning, no talking during meals, taking small bites, and consuming meals out of the bed in a chair. Lastly, the authors created an annual online learning module that provided education for nurses about aspiration pneumonia.

Results

After analysis, the authors identified 979 patients, with an average age of 73.5 years old, who were diagnosed with aspiration pneumonia on the index hospitalization. These patients were reviewed for a 30-day readmission for aspiration pneumonia or stable sepsis, and mortality rates from January 2021 to December 2022 at Overlook Medical Center (OMC).

The 30-day readmission rates were significantly lower in the cohort that received the clinical care pathway (35.0% vs. 27.5%, $p = 0.011$). The 30-day readmission rate for patients admitted from a SNF decreased although not statistically significant, it is trending in the right direction (32.0% vs. 28.5%).

When evaluating the mortality rates in the pre and post intervention cohort the authors discovered the mortality rates were lower in the post intervention cohort (23.7% vs 22.4%, $p = 0.61$) While this was not found to be statistically significant, the decrease in the mortality rates is trending in the right direction. Mortality among non-white (self-reported as non-white) patients were lower in the post intervention cohort (34.4% vs. 21.0% , $p = 0.05$).

Patients who reported as a current smoker/vaper in the pre and post cohorts had increased mortality rates (5.9% vs 22%). The authors reviewed the most frequently occurring comorbidities and their correlation with the mortality rates and readmission rates. The comorbidities in the preintervention cohort associated with mortality were hypertension (HTN), coronary artery disease (CAD) followed by atrial fibrillation (A-Fib), and hyperlipidemia (HLD). Similarly, in this cohort, the authors found that HTN, A-Fib, HLD, Dementia, and DM Type II were associated with increased readmission rates in 2021. In the post intervention cohort, the comorbidities associated with mortality were HTN, HLD, followed by A-fib and Diabetes Mellitus (DM) Type II. Subsequently the authors found that HTN, A-Fib, HLD, and Dysphagia were associated with readmissions in 2022. There was a decrease in mortality for the male population but an increase in mortality for women in the pre and post cohorts (19% vs. 25%). The authors attributed this increase in mortality in the post intervention cohort to more active smokers, more former smokers, and more being admitted from a SNF.

Conclusion

This research identified that implementation of an evidence-based Aspiration Pneumonia Clinical Care Pathway showed a statistically significant decrease in readmission rates and a clinically significant decrease in mortality rates in self-reported non-whites. There was an increased in mortality in patients who were smoking/vaping in our study. The 30-day readmission rates were significantly lower in the cohort that received the clinical care pathway (35.0% vs. 27.5%, $p = 0.011$). The 30-day readmission rate for patients admitted from a SNF decreased although not statistically

significant, it is trending in the right direction (32.0% vs. 28.5%). The results of this study have led the authors to implement a modified Aspiration Pneumonia Clinical Care Pathway in our hospital's preferred SNFs by collaborating with our post-acute care coordinator. Future studies should consider implementing this measure to evaluate post hospital aspiration pneumonia outcomes.

There were several limitations to our study, and these included unknown readmissions and mortality rates occurring at hospitals outside our healthcare system and those who do not use Epic. Additionally, our research included only one hospital rather than multiple hospitals and may limit the generalizability of our findings.

Keywords— aspiration pneumonia, mortality, quality improvement, 30-day pneumonia readmissions.

Assessment of Routine Health Information System (RHIS) Quality Assurance Practices in Tarkwa Sub-Municipal Health Directorate, Ghana

Richard Okyere Boadu, Judith Obiri-Yeboah, Kwame Adu Okyere Boadu, Nathan Kumasenu Mensah, Grace Amoh-Agyei

Abstract— Routine health information system (RHIS) quality assurance has become an important issue, not only because of its significance in promoting a high standard of patient care but also because of its impact on government budgets for the maintenance of health services. A routine health information system comprises healthcare data collection, compilation, storage, analysis, report generation, and dissemination on a routine basis in various healthcare settings. The data from RHIS give a representation of health status, health services, and health resources. The sources of RHIS data are normally individual health records, records of services delivered, and records of health resources. Using reliable information from routine health information systems is fundamental in the healthcare delivery system. Quality assurance practices are measures that are put in place to ensure the health data that are collected meet required quality standards. Routine health information system quality assurance practices ensure that data that are generated from the system are fit for use. This study considered quality assurance practices in the RHIS processes. **Methods:** A cross-sectional study was conducted in eight health facilities in Tarkwa Sub-Municipal Health Service in the western region of Ghana. The study involved routine quality assurance practices among the 90 health staff and management selected from facilities in Tarkwa Sub-Municipal who collected or used data routinely from 24th December 2019 to 20th January 2020. **Results:** Generally, Tarkwa Sub-Municipal health service appears to practice quality assurance during data collection, compilation, storage, analysis and dissemination. The results show some achievement in quality control performance in report dissemination (77.6%), data analysis (68.0%), data compilation (67.4%), report compilation (66.3%), data storage (66.3%) and collection (61.1%). **Conclusions:** Even though the Tarkwa Sub-Municipal Health Directorate engages in some control measures to ensure data quality, there is a need to strengthen the process to achieve the targeted percentage of performance (90.0%). There was a significant shortfall in quality assurance practices performance, especially during data collection, with respect to the expected performance.

Keywords— quality assurance practices, assessment of routine health information system quality, routine health information system, data quality.

Cancer Screening in the Middle of Separatist Violence in the North West Region of Cameroon

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Abstract

Cancer is a global issue, and it is expected to have a major impact on our continuing global health crisis. As populations age, we can see an increased incidence in cancer rates, but considerable variation is observed in survival rates across different geographical regions and cancer types. Breast, cervical and prostate cancer are leading causes of morbidity and mortality worldwide. Although cancer statistics indicate some improvements breast, cervical and prostate cancer prevention, diagnosis, and treatment, such statistics clearly convey the need for improvements in our understanding of the disease, risk factors, and interventions to improve our life span and quality of life for all patients, and hopefully to effect a cure for people living in developed and developing countries. Assessing their incidence by regions and municipalities is important to guide evidence-based health policy, Our aim was to describe the incidence and trends for breast, cervical, and prostate cancer across the northwest region of Cameroon

Keywords: Breast cancer, cervical cancer, prostate cancer, HPV, early diagnosis.

Purpose and objective(s): To determine the incidence of most common cancers in the Northwest region Cameroon in the middle of a separatist violence since 2017.

Materials and methods: A month before the screening was to be conducted, a health screening in all surrounding churches and on the local community radio as well as on relevant WhatsApp groups were advertised. A general health talk was delivered by the head of the screening unit to all attendees who were all educated on the procedure to be carried out with benefits and any possible discomforts after which the attendee's consent was obtained. Evaluation of the participants for any leads to the cancers selected for the screening was done by the following methods; palpation of the breasts, visual inspection of the cervix, digital rectal examination of the prostate and a qualitative test for prostate surface antigen

Results:

Results of the physical examination of the breast of the female participants were available for 230 female participants which indicate that 2.60 % of the female participants were found with a breast lesion on physical examination. Results of visual inspection of the vagina and cervix after application of Acetic Acid then Lugol Iodine were available for 230 female participants indicating that 23.04% of the female participants were suspicious for cervical cancer. Results of digital rectal examination of the prostate were available for 74 male participants. PSA results revealed 24.34% of male participants were suspicious for prostate cancer

Conclusion: The screening had succeeded to pick up lesions that have not been reported by the participants. This has confirmed screening as a tool for the early diagnosis of cancer.

1.Introduction

Cancer is a group of diseases involving abnormal growth of cells which have the ability to invade or spread to other parts of the body.^{1} ^{2}. There are two types of tumours, the benign tumours and the malignant tumors. ^{2} Possible signs and symptoms may include a lump, abnormal bleeding, unexplained weight loss, and a change in bowel movements. ^{3} Cancer screening aims to detect cancer before symptoms appear. ^{4}

This may involve blood test, urine test, DNA test, or Medical Imaging. [4] The benefits of screening in terms of cancer prevention, early detection and subsequent treatment must be weighed against any harms. Cancer ranks as a leading cause of death and an important barrier to increasing life expectancy in every country of the world [5]. According to records from the World Health Organization (WHO) in 2019[6], cancer is the first or second leading cause of death before the age of 70 years in 112 of 183 countries and ranks third or fourth in a further 23 countries. Cancer's rising prominence as a leading cause of death partly reflects a drastically decline in mortality rates of stroke and coronary heart disease, relative to cancer in many countries[5]. The overall burden of cancer incidence and mortality is rapidly growing worldwide and this reflects both in the aging and growth of the population as well as changes in the prevalence and distribution of the main risk factors for cancer, several of which are associated with socioeconomic development.[6][7]. Approximately 6000 Cameroonian women died of cancer in 2018, and the breast is the most affected with 2625 new cases. The aging of populations is a real demographic revolution. Since the middle of the eighteenth century, the progress made by humanity in the fields of medicine, housing and nutrition has contributed to the improvement of the quality of life of the populations and, consequently, to the aging of the population.[8]. However, the increase of the life span of women is followed by many health problems, called diseases of aging. Some authors have shown that these changes in the lifestyle is associated with urbanization and the concomitant loss of traditional protective factors in our African societies are positively correlated with the increased incidence of cancer[9]

2. Methods and Material

The medical and para-medical personnel of COC in collaboration with Micro health Global and Diagnostic Medical Center {MGDMC} carried out a pilot study in the form of a voluntary cancer screening campaign from the 21st and 22nd October 2023. A total of 304 persons participated in the screening of breast, cervical and prostate cancer in which 230 (75.65%) were female and only 74(24.34%) were males. The high number of participants was mainly due to an inadequate sensitization campaign which was effectively communicated to the heads of various households and associations a month prior to the screening exercise. Another reason was due to early authorization from the government to conduct the screening exercise. Each screening attendee was educated by a trained nursing staff on the procedure, benefits and any possible discomforts after which the attendee's consent was obtained. This was followed by assessment of the attendee's vital signs. A gender specific education was offered on both cervical and breast cancers for women, and a gender specific education for both breast and prostate cancer for men with a specific focus on self-examination. Evaluation of the participants for any leads to the cancers selected for the screening was done by Palpation of the breasts, Visual inspection of the cervix before and after applying Acetic acid and again on adding Lugol Iodine, Digital rectal examination of the prostate, and Qualitative test for Prostate Surface Antigen. Further investigations were requested for any person found with a suspicious lesion upon screening.

Cervical examinations were carried out after educating the clients on the procedure and taking consent from clients. Each client was kept behind a screen and was adequately exposed from the waist down. The client was then made to lie on a couch with her back facing downwards, usually with legs bent, feet together and knees apart. A small amount of lubricant was applied on speculum before inserting into the vagina. The speculum was opened for proper visualization while 2-3mls of acetic acid solution was applied using a 5mls syringe to the cervix and observed for any changes after 2minutes. 3mls of Lugol's iodine was then applied using a different 5mls syringe to confirm the cervical changes. Visual inspection of the cervix with acetic acid (VIA) is a simple, inexpensive test with moderate sensitivity and specificity for screening that can be combined with simple treatment procedures for early cervical lesions. Cervical cancer may also be suspected if you have symptoms like abnormal vaginal bleeding, pain during sexual intercourse, abnormal HPV (human papillomavirus) or Pap test result. The Pap test and HPV test are screening tests and not diagnostic tests. An abnormal Pap test or HPV test result may mean more testing is needed to see if a cancer or a pre-cancer is present. The tests that are used include colposcopy (with biopsy), endocervical scraping and cone biopsies. If you have certain symptoms that could mean cancer with abnormal Pap smear test results and a positive HPV test, you will most likely need to have a test called colposcopy. You will lie on the exam table as you do for a pelvic exam. A speculum will be placed in the vagina to help the doctor see the cervix more easily with a colposcope. The colposcope is an instrument that stays outside the body and has magnifying lenses. It lets the doctor see the surface of the cervix up close and clearly. Colposcopy itself usually causes no more discomfort than any other speculum exam. It can be done

safely even if you are pregnant. At the time of the procedure, the doctor will apply a weak solution of acetic acid (similar to vinegar) to your cervix to make any abnormal areas easier to see. If an abnormal area is seen, a small section of the abnormal area is removed using biopsy forceps. A biopsy is the best way to tell for certain if an abnormal area is a pre-cancer, a true cancer, or neither. If colposcopy does not show any abnormal areas or if the transformation zone (the area at risk for HPV infection and pre-cancer) cannot be seen with the colposcope, another method must be used to check that area for cancer. A narrow instrument (either a curette or brush) is inserted into the endocervical canal (the part of the cervix closest to the uterus). The curette or brush is used to scrape the inside of the canal to remove some of the tissue, which is then sent to the lab to be checked. In this procedure, also known as conization, the doctor removes a cone-shaped piece of tissue from the cervix. The tissue removed in the cone includes the transformation zone where cervical pre-cancers and cancers are most likely to start. A cone biopsy is not only used to diagnose pre-cancers and cancers. It can also be used as a treatment since it can sometimes completely remove pre-cancers and some very early cancers. Two common types of cone biopsies Loop electrosurgical procedure (LEEP or LLETZ) and the cold knife cone biopsy. In LEEP method, the tissue is removed with a thin wire loop that is heated by electricity and acts as a small knife under a local anesthesia which can be done in the doctor's office • Cold knife cone biopsy makes use of a surgical scalpel or a laser instead of a heated wire to remove tissue. You will receive anesthesia during the operation (either a general anesthesia {where you are asleep} or a spinal or epidural anesthesia {where an injection into the area around the spinal cord makes you numb below the waist) and it is done in a hospital. Possible complications of cone biopsies include bleeding, infection and narrowing of the cervix. Having any type of cone biopsy will not prevent most women from getting pregnant, but if a large amount of tissue has been removed, women may have a higher risk of giving birth prematurely.

Breast examinations were carried out after educating the clients on the procedure and taking consent from clients. Each client was kept behind a screen to provide privacy and adequate exposure only where required was allowed. If the patient had presented due to concerns about a **lump** or pain proceeding clinical examination. Its location will be helpful during the initial inspection as palpation on the asymptomatic breast is of prior importance. With the patient sitting on the side of the couch, the client was to place their hands on their thighs to relax the pectoral muscles. Breast were inspected for scars, asymmetry, masses, nipple abnormalities, skin changes {scaling, puckering, erythema, peau d'orange}. The inspection is repeated with the patient pressing their hands into their hips to contract the pectoralis muscles. A visible mass is observed moving **when** the pectoralis muscle contracts which suggests tethering to the underlying tissue (e.g., invasive breast malignancy). The man oeuvre may also accentuate puckering if a mass invading the suspensory ligaments of the breast is also tethered to the pectoralis muscle. Finally, inspection was completed by asking the patient to place their hands behind their head and leaning forward so that the breasts becomes pendulous.

This position exposes the entire breast and will exaggerate any asymmetry, skin dimpling or puckering. The clients head on the couch was adjusted to 45° with the patient to lying down. Begin palpation on the asymptomatic breast first and then repeat all examination steps on the contralateral breast. Ask the patient to place the hand on the side being examined behind their head to fully expose the breast.

A systematic approach was used to palpate all areas of the breast with several different techniques all of which are equally appropriate when it is done correctly: Clock face method {view the breast as a clock face and examine each 'hour' from the outside towards the nipple} Spiral method {begin palpation at the nipple and work outwards in a concentric circular motion}, Quadrants method {divide the breast into quadrants and examine each thoroughly}, the flats of the three middle fingers were used to compress thoroughly the breast tissue against the chest wall to feel for any masses. If a mass is detected, assess the Location, Size, Shape, Consistency, mobility, fluctuance, overlying skin changes. The regional lymph nodes are palpated which are responsible for lymphatic drainage of the breast to identify evidence of breast cancer metastases. Enlarged, hard, irregular lymph nodes are suggestive of metastatic spread. The medical or paramedical personnel then thanks the clients and provide them with privacy to get dressed. Suggested further assessments and investigations such as mammography {typically used in patients over the age of 35}, Ultrasound {typically used in patients under the age of 35 due to increased density of breast tissue making mammography less effective}, Biopsy {fine-needle aspiration or core biopsy may be considered if a breast lump needs further histological assessment}

Prostate examinations were carried out after educating the clients on the procedure and taking consent from clients. Each client was kept behind a screen for adequate exposure from the waist down and was given a gown or cloth to cover himself. The client was made to stand and lean forward over the examination table or lie on

your side on the exam table with his knees pulled up into his chest. The anus was examined from outside first to check for hemorrhoids or anal fissures with the patient relaxed and taking a deep breath. A gloved lubricated finger was sent finger into the rectum to feel for any bumps or hard areas on the prostate that might be cancer. This exam can be uncomfortable (especially for men who have hemorrhoids), but it usually isn't painful and only takes a short time. This screening tests here was used to look for possible signs of prostate cancer but can't tell for sure if you have cancer. If the result of one of these tests is abnormal, a Prostate specific antigen {PSA} test is done. The PSA level in blood is measured in units called nanograms per milliliter (ng/mL). The chance of having prostate cancer goes up as the PSA level goes up, but there is no set cutoff point that can tell for sure if a man does or doesn't have prostate cancer. Most men without prostate cancer have PSA levels under 4 ng/mL of blood. When prostate cancer develops, the PSA level often goes above 4. Still, a level below 4 is not a guarantee that a man doesn't have cancer. About 15% of men with a PSA below 4 will have prostate cancer if a biopsy is done. If your PSA level is high, you might need further tests to look for prostate cancer. Several factors affect the PSA level such as an enlarged prostate, older age, prostatitis, ejaculation, riding a bicycle but the usefulness of age-specific PSA ranges is not well proven, so most doctors and professional organizations (as well as the makers of the PSA tests) do not recommend their use at this time.

3. Results

2.1.0 Characteristics of the participants

2.1.1 Age distribution of participants.

Age data was available for 304 screening participants, and showed a variation from 20 years (a female) to 60years and above (male and female). Most of the participants were in the age group 60 and above of completed years of age. Most male and female participants were 60years and above. The Tables below details the age distribution of participation.

Table 1: Distribution of participants in age groups

Age group	FEMALE [230]		MALE [74]	
	Number of Persons	Percentage	Number of Persons	Percentage
20-29yrs	10	4.32	0	0
30-39yrs	18	7.82	0	0
40-49yrs	59	21.7	9	12.16
50-59yrs	66	28.6	20	27.02
60 and above	86	37.3	45	60.81
total	230	100	74	100

Table 1: Distribution of Participants in age groups

2.1.2 Matrimonial status of participants.

Information on matrimonial status was recorded for 304 participants. Table 3 depicts the distribution of the 304 participants according to the matrimonial status. As depicted by the table, a large majority of men and likewise women are married

Marital status	FEMALE [230]		MALE [70]	
	Number of Persons	Percentage	Number of Persons	Percentage
Single	16	6.95	2	2.7
Married	147	63.9	69	93.74
Divorced	2	1.73	1	1.35
Widow/Widower	65	28.2	2	2.70
Total	230	100	74	100

Table 2: Matrimonial status of participants

2.1.3. Highest attained level of education of participants

Information on highest level of education attained was recorded for 304 participants. Table below depicts the distribution of the 304 participants according to highest level of education attained. As depicted by the table, a large majority of the female and male participants had attained primary school level of education

LEVEL OF EDUCATION	FEMALE [230]		MALE [74]	
	Number of Persons	Percentage	Number of Persons	Percentage
None	37	16.08	11	14.86
Primary	120	52.17	19	25.6
Secondary	23	10	11	14.86
High school	25	10.86	18	24.32
University	25	10.86	15	20.27
Total	230	100	74	100

Table 3: Level of education of participants

2.2.0. Health behavior of participants

2.2.1. Ever diagnosed of genital wart

Data on the past or present history of warts was recorded for 230 female and 74 male participants respectively. Table below distributes the participants according to responses.

A substantial proportion of the female participants declared not having had genital warts as against 35.13% of the male participants having no idea about genital warts

Question	Answer	FEMALE [230]		MALE {74}	
		Number of Persons	Percentage	Number of Persons	Percentage
Have you ever been diagnosed with Genital warts	Yes	51	22.17	4	5.40
	No	147	63.91	9	11.16
	No idea	32	13.91	61	26.52
Total		230	100	74	100

Table 4: Health behavior of participants

2.2.2. Participation in past cancer screening

Data on the past use of cancer screening services was recorded for 304 participants. Table below distributes the participants according to responses.

A large majority (75%) of the male participants had never attended a cancer screening session. This proportion dropped to 66% for the women even though the sample size was larger. It is possible that the proportion will be lower with an increase in the male sample size

FEMALE [230}				MALE [74]	
Question	Answer	Number of Persons	Percentage	Number of Persons	Percentage
Any family history of cancer	Yes	51	22.17	4	5.40
	No	147	63.91	9	3.91
	No idea	32	13.91	61	82.43
Total		230	100	74	100

Table 5: Distribution of participants according to use of past cancer screening services

2.2.3. Former participation in HIV screening

Data on our clients having done at least a test for HIV was recorded for 304 participants. Table below distributes the participants according to responses. A good majority of both male and female participants had at least an HIV test done. Only a small percentage of the female and male participants respectively had not obtained at least a test for HIV. This is a reflection of the wide spread and repeated campaigns on ‘know your HIV status’.

FEMALE [230]				MALE [74]	
Question	Answer	Number of Persons	Percentage	Number of Persons	Percentage
Have you ever been screened for HIV	Yes	227	19.6	71	95.94
	No	3	1.30	3	4.05
Total		230	100	74	100

Table 6: Distribution of participants according to ever tested for HIV

2.2.4 Use of a provider-dependent method of contraception

Data on the use of at least a provider dependent method of contraception was recorded for 230 female participants. Table below distributes the participants according to responses.

FEMALE [230]

Question	Answer	Number of Persons	Percentage
Have you ever used any of the following contraceptive methods	Tablets	56	24.34
	Implant	10	4.34
	IUCD	8	3.47
	Injectables	20	8.69
	None	136	57.13
Total		230	100

Table 7: Distribution of participants according ever use of a provider-dependent method of contraceptive

2.2.5. Preventability of cancer

Data assessing the participant’s knowledge on the preventability of cancer was recorded from 304s participants.

FEMALE [230]				MALE {74]	
Question	Answer	Number of Persons	Percentage	Number of Persons	Percentage
Is cancer preventable	Yes	154	69.95	43	51.8
	No	70	30.4	5	6.75
	No idea	6	2.60	26	35.13
Total		230	100	74	100

Table 8: Distributes the participants according to responses

2.2.6. Awareness on the human papilloma virus (HPV)

Data as to awareness on the Human Papilloma Virus (HPV) was recorded from 304 participants. All the male participants who had recorded responses had never heard of HPV

FEMALE [230]				MALE [74]	
Questions	Answer	Number of Persons	Percentage	Number of persons	Percentage
Ever heard of HPV	Yes	69	30	0	0
	No	161	70	74	100
Total		230	100	74	100

Table 9: Distribution of participants according to awareness on HPV

2.2.7. Awareness on any link between the human papilloma virus (HPV) and cervical cancer

Data as to awareness on any link between the Human Papilloma Virus (HPV) and cervical cancer was recorded from 304 participants.

Questions	Answers	FEMALE {230}		MALE {74}	
		Number of Persons	Percentage	Number of Persons	percentage
Is there any link between HPV and cervical cancer	Yes	50	21.7	0	0
	No	107	46.52	70	94.5
	No idea	70	30.43	4	5.40
Total		230	100	74	100

Table 10: Distributes the participants according to responses

2.2.8. Action if diagnosed of cancer

Data on the strategy to adopt if diagnosed of cancer was recorded for 304 participants

Strategy adopted after diagnosis	FEMALE [230]		MALE [74]	
	Number of Persons	Percentage	Number of Persons	percentage
Seek modern treatment	226	98.2	70	94.59
Wait for death	2	0.86	1	1.35
Search for deliverance	2	0.86	3	4.05
Total	230	100	74	100

Table 11: Distribution of participants according action that would be implemented if diagnosed of cancer

2.2.9. Willingness to allow girls 11-12 years receive HPV vaccine

Majority of participants (26.25% for females and 83.78% for males) would not accept girls aged 11 and 12 years to be vaccinated against HP

FEMALE [230]

MALE [70}

Questions	Answer	Number of Persons	Percentage	Number of Persons	Percentage
Should girls btw 11-12yrs take HPV vaccine	Yes	141	61.3	4	5.40
	No	61	26.25	62	83.78
	No idea	28	12.17	10	13.51
Total		230	100	74	100

Table 12: Distribution of participants according to willingness to allow girls 11-12 years receive HPV vaccine.

3.Results and discussion.

3.1Results of female participants

3.1.1. Breast physical examination of the women

Results of the physical examination of the breast of the female participants were available for 230 female participants. Table 13 distributes the participants according to responses.

FEMALE [230}

Breast Exam	Number of Persons	Percentage
Normal	222	96.52
Nipple discharge	2	0.86
Breast lump	6	2.60
Nipple discharge + lump	0	0
Total	230	100

Table 13: Distribution of the female participants according to results of breast physical examination

3.1.2. State of cervix before acetic acid or Lugol application

Results of the clinical examination of the cervix of the female participants was available for 230 female participants. 10 (4.34%) of the participants were on their menses and so both clinical examination and visual inspection after acetic acid or Lugol iodine application was not done. The table indicates that 9.12 % of the women had abnormal findings.

FEMALE [230]

Results	Number of Persons	Percentage
Normal	209	98.86
Structural abnormality	11	4.78
Bleeding contact	10	4.34
Total	230	100

Table 14 distributes the participants according to responses.

3.1.3. Results of visual inspection with acetic acid then Lugol solution

Results of visual inspection of the vagina and cervix after application of Acetic Acid then Lugol Iodine were available for 230 female participants. Table 18 shows that 23.04% of the participant had abnormal visual inspection results after application of Acetic acid and Lugol. Iodine application

FEMALE [230]

Villi Test	Number of Persons	Percentage
Negative	177	76.95
suspicious	53	23.04
Total	230	100

Table 15; distributes the participants according to responses

4.1.1 Results of male participants

4.1.2. Results of digital examination of the prostate

Results of digital examination of the prostate were available for 74 male participants. table 16 distributes the participants according to responses

MALE [74]

PSA Exam	Number of Persons	Percentage
Normal	53	71.62
Enlarged	21	28.23
Total	74	100

Table 16: Distribution of the male participants according results of digital examination of the prostate

3.1.1. PSA results

PSA results were available for 74 male participants. Table 17 distributes the participants according to responses.

MALE [74]

PSA Results	Number of Persons	Percentage
Negative	56	75.67
Positive	18	24.34
Total	74	100

Table 17: Distribution of the male participants according to results of the prostate specific antigen

Conclusion.

The screening succeeded to pick up lesions that were not reported by the participants which confirms that screening is a very important tool for early diagnosis of cancer

Conflicts of Interest; There were no conflicts of interest in this study

Ethical approval; not applicable

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MANAGING BURNOUT IN NURSING Burnout is a Widespread Phenomenon Characterized by a Reduction in Energy That Manifests in Exhaustion, Lack of Inspiration, and Feelings of Frustration Which May Lead to Reduced Work Efficacy and Multiple Absences

Dr. Karen Starnes Bell

Abstract— Strategies to Reduce Nursing Burnout: An Integrative Review

Learning Outcome: Identify evidence-based interventions to reduce nurse burnout in ambulatory care settings.

Purpose

The purpose of this integrative review is to identify variables that contribute to nurse burnout and discover strategies organizations can implement to reduce or prevent nurse burnout.

Background

Burnout is a widespread phenomenon characterized by a reduction in energy that manifests in exhaustion, lack of inspiration, and feelings of frustration which may lead to reduced work performance and multiple absences. In the nursing profession, long hours, decision-making, and the physical and emotional stress of caring for complex patients may contribute to burnout. Findings from numerous studies demonstrate that a higher nurse-to-patient ratio is directly related to negative nurse outcomes, worsening quality of care, decreased patient satisfaction, and decreased productivity.

In two years, 30% plan to leave nursing resulting in a shortage of 9 million nurses in 2030. This is a call to action!!

Method

The systematic literature search consisted of Cumulative Index to Nursing and Allied Health Literature, EBSCO, and the Cochrane Library. Key words included nurse satisfaction, stress, and burnout. Over 65,000 articles were identified; after applying inclusion/exclusion criteria, 13 articles from the last decade were examined. Application of Melnyk's framework revealed level I, III, V and VI levels of evidence strength.

Findings

Thematic Analysis revealed the following strategies to mitigate burnout:

- Self-care influences nurses' ability to care for others.

Encourage:

- o Personal Health Improvement programs
- o Cognitive Behavioral Therapy
- o Deep breathing
- o Increased physical activity
- o Adequate breaks
- o Retreats addressing self-care strategies

- Foster personal coping skills
- Increasing nurse self-efficacy

- Positive work environments
- Implications for preventing burnout in ambulatory care nursing
- Provide opportunities and encouragement for staff to engage staff in holistic self-care to include:
 - o Reflection: time alone or small group interaction
 - o Personal Interests & pleasurable activities-onsite and off shift
 - o Therapy
- Provide personal health improvement programming at work and opportunities for enjoyable physical activity
- Ensure staff receive regular breaks to uplift mood and moderate fatigue
- Analyze and assign an appropriate nursing workload
- Allow nurses to work at the top of their license
- Create a culture of teamwork amongst nursing and interdisciplinary staff members.

Keywords— Nurse satisfaction, turnover, burnout, work efficacy, absences, stress interventions, ambulatory care nurses and stress, stress and nurses, stress and burnout, nursing absences, preventing nurse absences, nurse burnout.

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The Impact of Artificial Intelligence on Pharmacy and Pharmacology

Mamdouh Milad Adly Morkos

Abstract— Despite having the greatest rates of mortality and morbidity in the world, low- and middle-income (LMIC) nations trail high-income nations in terms of the number of clinical trials, the number of qualified researchers, and the amount of research information specific to their people. Health inequities and the use of precision medicine may be hampered by a lack of local genomic data, clinical pharmacology and pharmacometrics competence, and training opportunities. These issues can be solved by carrying out health care infrastructure development, which includes data gathering and well-designed clinical pharmacology training in LMICs. It will be advantageous if there is international cooperation focused at enhancing education and infrastructure and promoting locally motivated clinical trials and research. This paper outlines various instances where clinical pharmacology knowledge could be put to use, including pharmacogenomic opportunities that could lead to better clinical guideline recommendations. Examples of how clinical pharmacology training can be successfully implemented in LMICs are also provided, including clinical pharmacology and pharmacometrics training programmes in Africa and a Tanzanian researcher's personal experience while on a training sabbatical in the United States. These training initiatives will profit from advocacy for clinical pharmacologists' employment prospects and career development pathways, which are gradually becoming acknowledged and established in LMICs. The advancement of training and research infrastructure to increase clinical pharmacologists' knowledge in LMICs would be extremely beneficial because they have a significant role to play in global health.

Keywords— electromagnetic solar system, nano-material, nano pharmacology, pharmacovigilance, quantum theoryclinical simulation, education, pharmacology, simulation, virtual learning low- and middle-income, clinical pharmacology, pharmacometrics, career development pathways.

Simulation-based Decision Making on Intra-hospital Patient Referral in a Collaborative Medical Alliance

Yuguang Gao, Mingtao Deng

Abstract—The integration of independently operating hospitals into a unified healthcare service system has become a strategic imperative in the pursuit of hospitals' high-quality development. Central to the concept of group governance over such transformation, exemplified by a collaborative medical alliance, is the delineation of shared value, vision, and goals. Given the inherent disparity in capabilities among hospitals within the alliance, particularly in the treatment of different diseases characterized by Disease Related Group (DRG) in terms of effectiveness, efficiency and resource utilization, this study aims to address the centralized decision making of intra-hospital patient referral within the medical alliance to enhance the overall production and quality of service provided.

We first introduce the notion of production utility, where a higher production utility for a hospital implies better performance in treating patients diagnosed with that specific DRG group of diseases. Then a Discrete-Event Simulation (DES) framework is established for patient referral among hospitals, where patient flow modeling incorporates a queuing system with fixed capacities for each hospital. The simulation study begins with a two-member alliance. The pivotal strategy examined is a "whether-to-refer" decision, triggered when the bed usage rate surpasses a predefined threshold for either hospital. Then the decision encompasses referring patients to the other hospital based on DRG groups' production utility differentials as well as bed availability. The objective is to maximize the total production utility of the alliance while minimizing patients' average length of stay and turnover rate. Thus the parameter under scrutiny is the bed usage rate threshold, influencing the efficacy of the referral strategy. Extending the study to a three-member alliance which could readily be generalized to multi-member alliances, we maintain the core setup while introducing an additional "which-to-refer" decision that involves referring patients with specific DRG groups to the member hospital according to their respective production utility rankings. The overarching goal remains consistent, for which the bed usage rate threshold is once again a focal point for analysis.

For the two-member alliance scenario, our simulation results indicate that the optimal bed usage rate threshold hinges on discrepancy in the number of beds between member hospitals, the distribution of DRG groups among incoming patients, and variations in production utilities across hospitals. Transitioning to the three-member alliance, we observe similar dependencies on these parameters. Additionally, it becomes evident that an imbalanced distribution of DRG diagnoses and further disparity in production utilities among member hospitals may lead to an increase in the turnover rate.

In general, it was found out that the intra-hospital referral mechanism enhances the overall production utility of the medical alliance

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compared to individual hospitals without partnership. Patients' average length of stay is also reduced, showcasing the positive impact of the collaborative approach. However, the turnover rate exhibits variability based on parameter setups, particularly when patients are redirected within the alliance.

In conclusion, the re-structuring of diagnostic disease groups within the medical alliance proves instrumental in improving overall healthcare service outcomes, providing a compelling rationale for the government's promotion of patient referrals within collaborative medical alliances.

Keywords—Collaborative medical alliance, Disease Related Group, Patient referral, Simulation.

Advancing Healthcare Excellence in China: Crafting a Strategic Operational Evaluation Index System for Chinese Hospital Departments amid Payment Reform Initiatives

Jing Jiang, Yuguang Gao, Yang Yu

Abstract—Facing increasingly challenging insurance payment pressures, the Chinese healthcare system is undergoing significant transformations, akin to the implementation of DRG payment models by the United States' Medicare. Consequently, there is a pressing need for Chinese hospitals to establish optimizations in departmental operations tailored to the ongoing healthcare payment reforms. This abstract delineates the meticulous construction of a scientifically rigorous and comprehensive index system at the departmental level in China, strategically aligned with the evolving landscape of healthcare payment reforms. Methodologically, it integrates key process areas and maturity assessment theories, synthesizing relevant literature and industry standards to construct a robust framework and indicator pool. Employing the Delphi method, consultations with 21 experts were conducted, revealing a collective demonstration of high enthusiasm, authority, and coordination in designing the index system. The resulting model comprises four primary indicators – technical capabilities, cost-effectiveness, operational efficiency, and disciplinary potential – supported by 14 secondary indicators and 23 tertiary indicators with varied coefficient adjustment for department types (platform or surgical). The application of this evaluation system in a Chinese hospital within the northeastern region yielded results aligning seamlessly with the actual operational scenario. In conclusion, the index system comprehensively considers the integrity and effectiveness of structural, process, and outcome indicators, and stands as a comprehensive reflection of the collective expertise of the engaged experts, manifesting in a model designed to elevate the operational management of hospital departments. Its strategic alignment with healthcare payment reforms holds practical significance in guiding departmental development positioning, brand cultivation, and talent development.

Keywords—Chinese Healthcare System, Delphi Method, Departmental Management, Evaluation Indicators, Hospital Operations, Weight Coefficients.

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Data-driven Performance Evaluation of Surgical Doctors based on Fuzzy Analytic Hierarchy Processes

Yuguang Gao, Qiang Yang, Yanpeng Zhang, Mingtao Deng

Abstract—To enhance the safety, quality and efficiency of healthcare service provided by surgical doctors, we propose a comprehensive approach to the performance evaluation of individual doctors by incorporating insights from performance data as well as views of different stakeholders in the hospital. Exploratory factor analysis was first performed on collective multidimensional performance data of surgical doctors, where key factors were extracted that encompass assessment of professional experience and service performance. A two-level indicator system was then constructed for which we developed a weighted interval-valued spherical fuzzy analytic hierarchy process to analyze the relative importance of the indicators while handling subjectivity and disparity in decision making of multiple parties involved. Our analytical results reveal that, for the key factors identified as instrumental for evaluating surgical doctors' performance, the overall importance of clinical workload and complexity of service are valued more than capacity of service and professional experience, while efficiency of resource consumption ranks comparatively the lowest in importance. We also provide a retrospective case study to illustrate the effectiveness and robustness of our quantitative evaluation model by assigning meaningful performance ratings to individual doctors based on the weights developed through our approach.

Keywords—Analytic hierarchy processes, Factor analysis, Fuzzy logic, Performance evaluation.

I. INTRODUCTION

PERFORMANCE evaluation of surgical doctors plays a crucial role in ensuring the delivery of high-quality healthcare service [1]–[3]. The strategic importance of performance evaluation in this context cannot be overstated, as it directly impacts patient outcomes, hospital reputation, and overall organizational success. It serves as an essential tool for managing human resources [4] and guaranteeing that surgical doctors under evaluation uphold the highest standards of practice.

An effective performance evaluation system for surgical doctors serves multiple purposes. By assessing doctor's clinical workload, surgical skills, decision making capabilities, and patient outcomes, surgical departments can identify areas for improvement and provide targeted training and support [5]. Performance evaluation also helps in determining financial incentives such as performance bonuses. Doctors who

consistently deliver excellent performance may be rewarded for their dedication and expertise. Additionally, these evaluations serve as a key component in decisions on career advancement, helping to identify individuals who are ready for promotion or increased responsibilities within the department.

However, due to the inherent complexity and high stakes involved in surgical doctors' daily procedures, it has been a challenging task to establish an effective performance evaluation system in terms of safety, quality, and efficiency of healthcare service. Traditionally, performance evaluation has mostly been "opinion-driven", relying on subjective measures such as peer reviews and patient satisfaction surveys [6]–[8], which could introduce biases and inaccuracies. As data mining and statistical analysis techniques advance with vast amount of performance data becoming available, there has been a shift towards utilizing data-driven approaches in performance evaluation, including analysis of both structured, e.g., tabular EHR and workload data, and unstructured data, e.g., clinical notes and survey data, to further improve the accuracy and reliability of evaluations [9]–[11].

In this paper, we propose a comprehensive approach to the performance evaluation of surgical doctors by incorporating insights gained from both data- and opinion-driven methodology. We employ exploratory factor analysis to extract key factors from multidimensional performance data of surgical doctors, focusing on risk-adjusted Diagnosis Related Group (DRG) specific indicators concerning capacity, complexity and efficiency metrics of medical service [12]–[14]. The extracted key factors and indicators were constructed as a two-level indicator system, where we explore the use of a variant of Fuzzy Analytic Hierarchy Processes (FAHP) to derive the relative importance and respective weights of these indicators for final overall evaluation of individual doctors. FAHP are a robust multicriteria decision making framework widely used in various areas (see, e.g., [15] and references therein), which is particularly effective in dealing with uncertainty and disparity as multiple parties are involved in providing views on relative importance of the indicators. Our FAHP-based performance evaluation weights are developed from opinions of different stakeholders, including hospital and departmental management officials, fellow doctors, and patient representatives.

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The rest of the paper is organized as follows. In Section II, we provide data source for performance evaluation and elucidate the framing of the evaluation problem within a multicriteria decision making framework. Section III describes our performance evaluation approach, incorporating details on exploratory factor analysis and the weighted interval-valued spherical FAHP method. Section IV presents results of our performance evaluation approach, accompanied by an in-depth pragmatic retrospective case study that demonstrates the effectiveness and robustness of the evaluation model. Section V discusses the findings and implications of the study. Finally, Section VI concludes the paper and suggests avenues for future research.

II. PRELIMINARIES AND DATA SOURCE

Performance evaluation of surgical doctors plays a vital role in ensuring the quality of healthcare service and assisting management officials to make informed decisions regarding compensation, promotion and resource allocation within healthcare organizations. We address the challenge of developing a data-driven performance evaluation approach that integrates views of different stakeholders in the hospital by formulating the evaluation problem as a multicriteria decision making problem, wherein a set of performance indicators, including aspects of clinical workload, capacity and complexity of medical service, and other metrics, serve as input criteria.

To facilitate data-driven performance evaluation, a set of $N = 98$ surgical doctors' multidimensional performance data of the year 2022 were sampled from our database which compiles staff information sourced from several tertiary public hospitals in China. The data drawn encompass performance data of surgical doctors within the orthopedic department, ensuring specificity and representativeness in the evaluation process. After data cleansing and preprocessing, a total of $m = 18$ performance indicators (Table. I) were included in the analysis, capturing demographics and annual performance results of the doctors.

TABLE I
PERFORMANCE INDICATORS OF SURGICAL DOCTORS ($N = 98$) IN THE ORTHOPEDICS DEPARTMENT FOR THE YEAR OF 2022 INCLUDED IN THE ANALYSIS

Indicator	Value	Remark
	Numerical: mean, IQR Categorical: categories, n (%)	
Age	42.6, [36.3, 47.0]	
Years of professional experience	17.5, [10, 24]	
Executive title	Director, 8 (6.1%) Associate director, 14 (14.3%) None, 78 (79.6%)	
Professional title	Chief physician, 20 (20.4%) Associate chief physician, 37 (37.8%) Attending physician, 33 (33.7%) Resident physician, 8 (8.2%)	

Highest degree	Doctors, 27 (27.5%) Masters, 48 (49.0%) Bachelors, 23 (23.5%)
Number of inpatient discharged cases	252.4, [106, 375]
Number of DRG groups covered	28.1, [19, 38]
Total weight of DRGs	350.3, [133.0, 508.0]

Total weight of DRGs refers to the total output of inpatient service after risk adjustment for DRG groups, which allows for a more accurate reflection of the medical service output compared to the number of discharged cases [16].

Case-Mix Index (CMI)	1.4, [1.3, 1.5]
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The CMI represents the weight per case, and is calculated by dividing the total weight by the total number of cases. CMI reflects the overall technical difficulty of discharged cases in an assessment unit [17].

Time consumption index	1.1, [0.9, 1.2]
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Time consumption index is calculated by standardizing length of hospital stay to facilitate comparison between diseases. An index of value 1 indicates that the time consumption for treating the same type of diseases in the assessment unit is equivalent to that of the average in the region [16].

Charge consumption index	1.2, [1.0, 1.4]
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Charge consumption index is calculated by standardizing medical expense to facilitate comparison between diseases. An index of value 1 indicates that the resource consumption for treating the same type of diseases in the assessment unit is equivalent to that of the average in the region [16].

Number of surgeries	269.9, [32, 454]
Number of Level-4 surgeries	83.2, [0, 63]

Level-4 surgeries include surgeries with high risks, highly complex procedures and high technical difficulty. The surgical difficulty categories (Level-1 through Level-4) [17] are published by the National Health Commission of China based on degree of technical difficulty, complexity and risk according to the hierarchical management of surgical procedures.

Number of minimal invasive surgeries	33.6, [0, 15]
Number of regular outpatient visits	1779.1, [544, 2547]

Number of specialist visits	68.2, [35, 125]
Number of ER visits	221.6, [15, 272]
Number of online outpatient visits	1.8, [0, 2]

In addition to the performance data, our FAHP framework incorporates subjective opinions from different stakeholders in the hospital while evaluating multiple aspects of medical practice provided. For this purpose, a survey that constitutes comparative items (Appendix. A) was conducted, collecting opinions from three groups of respondents most relevant to and familiar with the performance aspects of the medical service. The survey respondents included 5 hospital management officials (3 department head, 1 president and 1 vice president of a hospital) who possess expertise in healthcare administration; 15 fellow doctors from the orthopedic department with firsthand experience working alongside the subject doctors; and 15 patient representatives who offer insights into the quality of care from a patient's perspective. They were asked to select the answer that best describes the relative importance between two factors or indicators, and their responses provided valuable qualitative data that supplement the quantitative performance metrics, empowering a more holistic and balanced view of surgical doctors' performance.

The relative importance scales of the factors associated with evaluating surgical doctors' performance were derived based on factor analysis, which helps to uncover the latent dimensions that underlie the performance data and represent the key constructs that contribute to their performance. The respondents' input, coupled with the results of the factor analysis, allows us to assign importance values to each of these factors, reflecting their relative impact on the performance evaluation. These relative importance scales are pivotal in our subsequent application of the FAHP method to weigh the factors and alternatives within the evaluation framework.

III. PROPOSED APPROACH

A. Exploratory Factor Analysis

To unveil the underlying structure of the performance data and extract latent factors inherently associated with surgical doctors' performance, an exploratory factor analysis [19], [20] can be used to identify patterns of shared variance among the indicators, which can then be attributed to common latent factors. This process serves to reveal the fundamental dimensions $\{C_1, C_2, \dots, C_{m^*}\}$, $m^* \in [1:m]$, that contribute to performance evaluations.

The determination of the optimal number m^* of latent factors is a crucial step in factor analysis. To ensure appropriateness of factor extraction, we employ multiple criteria, including the change in standardized root mean square residual (SRMR), the Tucker-Lewis index, and the percentage of variances explained by factors as a function of the number of factors considered. Furthermore, consultation with domain experts is instrumental in assessing the practical implications of the factors.

Once the number of factors is established, a varimax rotation technique can be applied to optimize the interpretability of these

latent factors. Varimax rotation minimizes the complexity of factor loadings by maximizing the variance of the squared loadings within each factor. These identified factors provide the foundation for the subsequent FAHP development.

B. Interval-valued Spherical Fuzzy Logic

Fuzzy logic was first proposed by Zadeh in 1965 to handle the ambiguity and uncertainty in the set theory [21], [22], where each element has a chance of belonging to that set. The extent to which an element x belongs to a set S is measured by a membership function $U_S(x)$, standardized between 0 and 1, where 0 suggests $x \notin S$ and 1 suggests $x \in S$. In order to incorporate uncertainty and disparity in the survey respondents' decision making process, we utilized spherical fuzzy logic written in the form $\{U, N, I\}$ that involves three functions describing membership relations [23], [24]:

- (1) $U_S(x)$, the membership function, measures to what extent x is in S ;
- (2) $N_S(x)$, the non-membership function, measures the non-membership degree of x in S ;
- (3) $I_S(x)$, the neutrality function, measures the neutrality about x in S .

All functions take values between 0 and 1. The spherical fuzzy logic further imposes a constraint on the functions that $U_S(x)^2 + N_S(x)^2 + I_S(x)^2 \leq 1$.

Interval-valued spherical fuzzy logic is an extension of spherical fuzzy logic that permits the use of intervals to represent the values for each function, which can be written in the form $\{[U^-, U^+], [N^-, N^+], [I^-, I^+]\}$. The inclusion of intervals in the formulation of fuzzy sets adds greater flexibility and thus could produce more reliable results. Table. II shows the comparative linguistic term representation we used in this study as interval-valued spherical fuzzy sets [25]. For example, the response to a survey item, "Compared to Number of Level-4 surgeries, Number of minimal invasive surgeries has absolutely high importance", can be mapped to the fuzzy set $\{[0.85, 0.95], [0.10, 0.15], [0.05, 0.15]\}$.

TABLE II
LINGUISTIC TERMS USED FOR PAIRWISE COMPARISON AND ASSOCIATED FUZZY SETS

Linguistic terms	$\{[U_1^-, U_1^+], [N_1^-, N_1^+], [I_1^-, I_1^+]\}$	Score index
Absolutely High Importance	$\{[0.85, 0.95], [0.10, 0.15], [0.05, 0.15]\}$	9
Very High Importance	$\{[0.75, 0.85], [0.15, 0.20], [0.15, 0.20]\}$	7
High Importance	$\{[0.65, 0.75], [0.20, 0.25], [0.20, 0.25]\}$	5
Slightly High importance	$\{[0.55, 0.65], [0.25, 0.30], [0.25, 0.30]\}$	3
Equal Importance	$\{[0.50, 0.55], [0.45, 0.55], [0.30, 0.40]\}$	1
Slightly Low Importance	$\{[0.25, 0.30], [0.55, 0.65], [0.25, 0.30]\}$	1/3
Low Importance	$\{[0.20, 0.25], [0.65, 0.75], [0.20, 0.25]\}$	1/5
Very Low Importance	$\{[0.15, 0.20], [0.75, 0.85], [0.15, 0.20]\}$	1/7
Absolutely Low Importance	$\{[0.10, 0.15], [0.85, 0.95], [0.05, 0.15]\}$	1/9

For two interval-valued spherical fuzzy sets $A = \{[U_1^-, U_1^+], [N_1^-, N_1^+], [I_1^-, I_1^+]\}$ and $B =$

$\{[U_2^-, U_2^+], [N_2^-, N_2^+], [I_2^-, I_2^+]\}$, we define direct sum of A and B as:

$$A \oplus B = \left(\begin{array}{c} [\sqrt{(U_1^-)^2 + (U_2^-)^2 - (U_1^-)^2(U_2^-)^2}, \\ \sqrt{(U_1^+)^2 + (U_2^+)^2 - (U_1^+)^2(U_2^+)^2}] \\ [N_1^- N_2^-, N_1^+ N_2^+] \\ [\sqrt{(1 - (U_2^-)^2)(I_1^-)^2 + (1 - (U_1^-)^2)(I_2^-)^2 - (I_1^-)^2(I_2^-)^2}, \\ \sqrt{(1 - (U_2^+)^2)(I_1^+)^2 + (1 - (U_1^+)^2)(I_2^+)^2 - (I_1^+)^2(I_2^+)^2}] \end{array} \right) \quad (1)$$

In combining interval-valued fuzzy set representations $\{A_j\}_{j=1}^n$ of a group of responses to a survey item, where $A_j = \{[U_j^-, U_j^+], [N_j^-, N_j^+], [I_j^-, I_j^+]\}$ and n is the number of group members, we define the interval-valued spherical weighted arithmetic mean $\bar{A} = \{[(U_{\bar{A}}^-, U_{\bar{A}}^+), [(N_{\bar{A}}^-, N_{\bar{A}}^+), [I_{\bar{A}}^-, I_{\bar{A}}^+]]\}$ as:

$$\bar{A} = w_1 A_1 \oplus w_2 A_2 \oplus w_3 A_3 \oplus \dots \oplus w_n A_n = \left(\begin{array}{c} [\sqrt{1 - \prod_{j=1}^n (1 - (U_j^-)^2)^{w_j}}, \\ \sqrt{1 - \prod_{j=1}^n (1 - (U_j^+)^2)^{w_j}}] \\ [\prod_{j=1}^n (N_j^-)^{w_j}, \prod_{j=1}^n (N_j^+)^{w_j}] \\ [\sqrt{\prod_{j=1}^n (1 - (U_j^-)^2)^{w_j} - \prod_{j=1}^n (1 - (U_j^-)^2 - (I_j^-)^2)^{w_j}}, \\ \sqrt{\prod_{j=1}^n (1 - (U_j^+)^2)^{w_j} - \prod_{j=1}^n (1 - (U_j^+)^2 - (I_j^+)^2)^{w_j}}] \end{array} \right) \quad (2)$$

where w_j indicates the weight assigned to response j in the group. Then, the defuzzification of the aggregated fuzzy set representations can be defined as:

$$Defuzz(\bar{A}) = \frac{(U_{\bar{A}}^-)^2 + (U_{\bar{A}}^+)^2 - (N_{\bar{A}}^-)^2 - (N_{\bar{A}}^+)^2 - (I_{\bar{A}}^-/2)^2 - (I_{\bar{A}}^+/2)^2}{2} + 1 \quad (3)$$

C. The Interval-valued Spherical FAHP Approach

The AHP decision making framework, introduced by Satty in 1970 and refined over the past decades [25], [26], has gained considerable attention, particularly in the context of selecting the best alternative across multiple measures or criteria. In contrast to traditional decision making methodology, AHP centers on pairwise comparisons between criteria expressed in linguistic terms, promoting improved usability and comprehension of survey data. Rather than assigning individual weights to each criterion, AHP utilizes a validated score index system (Table. II) to quantify linguistic responses. This system facilitates the construction of a pairwise comparison matrix, capturing the scores between each pair of criteria and providing a structured basis for decision making.

Built upon the foundations of AHP, the FAHP method incorporates fuzzy numbers as mappings of linguistic terms and serves as a robust and adaptable technique for determining the relative weights of criteria and alternatives. This method operates on the premise that the eigenvector associated with the largest eigenvalue of a pairwise comparison matrix indicates the relative priorities of the criteria. It upholds the ordinal preferences among alternatives, where a higher eigenvector

component signifies the preference of one alternative over another. This vector of weights, derived from the pairwise comparison matrix, plays a crucial role in illustrating the relative importance of different factors and indicators in our performance evaluation process.

In this study, we utilize interval-valued spherical fuzzy logic within the FAHP framework to enhance the scaling scheme in constructing the pairwise comparison matrices, which is essential in accommodating the inherent subjectivity and disparity often associated with performance evaluation of surgical doctors. Our FAHP process is described as follows:

Step 1: Map linguistic survey responses to interval-valued spherical fuzzy set representations

The linguistic terms of the survey responses (see Appendix. A), which reflect the relative importance between two factors or indicators, are mapped to interval-valued spherical fuzzy set representations in the form of $\{[U^-, U^+], [N^-, N^+], [I^-, I^+]\}$ (Table. II).

Step 2: Construct the fuzzy comparison matrices

The interval-valued spherical fuzzy set representations are set to be the elements of the pairwise comparison matrices which encapsulate scales of relative importance between factors or indicators, demonstrating the perceived relationships and preferences expressed by each survey respondent. To ensure consistency, a consistency ratio test can be performed on the pairwise comparison matrices using the score indices provided in Table. II, and a consistency ratio under 0.1 is accepted as a valid comparison matrix [25].

Step 3: Form the group-wise fuzzy comparison matrices

Group-wise fuzzy comparison matrices are formed for each factor and indicator by aggregating individual fuzzy comparison matrices for each of the three groups of survey respondents, i.e., hospital management officials, fellow doctors, and patient representatives. The aggregation, achieved through the interval-valued spherical weighted arithmetic mean (1), synthesizes the collective viewpoints and preferences of a respective group, contributing its unique perspectives to the evaluation process.

In this study, for the groups of fellow doctors and patient representatives, the aggregation weights were assigned uniformly; and for the group of hospital management officials comprising 5 members, weight of 1/6 was assigned to each department head and vice president, and weight of 1/3 was assigned to the president of the hospital.

Step 4: Defuzzify the group-wise fuzzy comparison matrices

Defuzzification is applied on the group-wise fuzzy comparison matrices (3) to obtain single-valued comparison matrices that represent the consensus preferences within each group. The defuzzification process ensures a proper conversion from fuzzy to crisp values, rendering a more straightforward interpretation of the relative importance scales.

Step 5: Apply matrix eigenvalue decomposition to derive group-wise weights

Eigenvalue decomposition is employed to extract the eigenvector from the defuzzified group-wise comparison matrices. The extracted normalized eigenvector represents the weights assigned to each factor and indicator within the context

of each group's preferences.

Step 6: Combine group-wise weights to generate global weights

The final step involves combining the weights obtained from all three groups to generate global weights for each factor and indicator, which provides a comprehensive and balanced set of weights that reflects the overall consensus influencing performance evaluation decisions. Upon thorough discussion and consultation with domain experts, the weights for global weight composition are set to be 0.35, 0.40, and 0.25, for the groups of hospital management officials, fellow doctors, and patient representatives, respectively. Thus the global weights serve as a unified basis for performance evaluation of surgical doctors, contributing to a holistic and inclusive decision making process.

IV. RESULTS

A. Factors and Weight Development Results

Our data-driven approach to evaluating performance of orthopedic surgical doctors involves exploratory factor analysis on multidimensional performance data $\{x_1, x_2, \dots, x_N\}$, $x_i \in \mathcal{R}^m$, $N = 98$, $m = 18$, where each performance data point x_i comprises indicators capturing both professional and annual performance information (Table. I).

Factor analysis was employed on all $m = 18$ indicators standardized with mean zero and variance one, where Pearson correlations and Polychoric correlations were calculated for numerical and categorical indicators, respectively. The optimal number of latent factors was established to be $m^* = 5$, and a Chi-squared test was conducted to ascertain that five latent factors $\{C_1, C_2, C_3, C_4, C_5\}$ were sufficient to encapsulate the essential dimensions underlying surgical doctors' performance (p-value = 0.87). Varimax rotation was then applied for best interpretations, and the resulting SRMR is 0.04, Tucker-Lewis index is 0.76, and BIC is -122.86. Details of the factor analysis are included in Appendix. B.

Table. III shows the outcome of the factor analysis, displaying all five latent factors that emerged as key contributors to performance evaluation along with indicators associated with each factor. Notably, indicators Professional title, Highest degree and Number of online outpatient visits were excluded from any factor due to their low loadings compared to other indicators already included. The factors are characterized and described below:

Factor C_1 : Professional experience

This factor, which includes Age, Years of professional experience and Executive title, pertains to the experience and seniority of surgical doctors. The associated indicators are linked to the cumulative expertise and leadership roles held in the hospital, contributing to a holistic understanding of doctors' professional background.

Factor C_2 : Clinical workload

This factor, which includes Number of regular outpatient visits, Number of surgeries, Number of specialist visits and Number of ER visits, centers on the volume and diversity of day-to-day clinical activities undertaken by surgical doctors.

By considering the associated indicators, this factor provides a view of doctors' annual clinical engagement in procedural treatments, patient interactions, and responsiveness to emergency cases.

Factor C_3 : Capacity of service

This factor, which includes Number of inpatient discharged cases, Total weight of DRGs and Number of DRG groups covered, focuses on doctors' overall productivity and capability of handling a significant caseload efficiently. The associated indicators collectively gauge the scope of medical service, providing valuable insights into doctors' operational efficiency and breadth of their medical expertise.

Factor C_4 : Complexity of service

This factor, which includes Number of Level-4 surgeries, Case-Mix Index (CMI) and Number of minimal invasive surgeries, delves into the intricacy and sophistication of the medical procedures performed by surgical doctors. The associated factors are crucial for assessing the specialized skills and expertise of doctors in managing challenging cases and employing advanced surgical techniques.

Factor C_5 : Efficiency of resource consumption

This factor, which includes Charge consumption index and Time consumption index, measures doctors' ability to utilize resources judiciously. Evaluating the balance between quality of service provided and resources utilized, the associated indicators aid in assessing doctors' effectiveness in delivering high-quality care while optimizing treatment approaches and time.

TABLE III
LATENT FACTORS EXTRACTED VIA EXPLORATORY FACTOR ANALYSIS

Factor	Standardized factor loading
C_1: Professional experience	
Age	0.99
Years of professional experience	0.99
Executive title	0.88
C_2: Clinical workload	
Number of regular outpatient visits	0.77
Number of surgeries	0.75
Number of specialist visits	0.71
Number of ER visits	0.59
C_3: Capacity of service	
Number of inpatient discharged cases	0.99
Total weight of DRGs	0.89
Number of DRG groups covered	0.86
C_4: Complexity of service	
Number of Level-4 surgeries	0.86
Case-Mix Index (CMI)	0.70
Number of minimal invasive surgeries	0.62
C_5: Efficiency of resource consumption	
Charge consumption index	0.99
Time consumption index	0.74

The identification and interpretation of these factors contribute to a nuanced understanding of the distinct dimensions that significantly influence the performance evaluation of orthopedic surgical doctors, which serve as the basis for the subsequent application of the FAHP method. By constructing a two-level indicator system, where the first level

comprises the five factors extracted and the second level encompasses their associated indicators, we then established a structured performance evaluation framework. This framework facilitates the assignment of relative weights, enabling a systematic approach to obtaining overall evaluation results.

The interval-valued spherical FAHP approach was applied to the survey data collected from three distinct groups of respondents: 5 hospital management officials, 15 fellow doctors and 15 patient representatives. Details of the FAHP weight calculation are described in Appendix. C.

Table. IV presents the resulting group-wise weights of the latent factors derived from defuzzification of the pairwise comparison matrices, as well as global weights as linear combinations of the group-wise weights. We note discrepancy in perspectives among the stakeholders regarding relative importance of latent factors in evaluating medical doctors' performance. Both hospital management officials and fellow doctors ranked Clinical workload as the top influential factor (group-wise weight = 0.30, 0.40, respectively), while patient representatives considered Complexity of service to be paramount (group-wise weight = 0.28). Another inconsistency arises in the view of Professional experience, where patient representatives assigned it the highest weight (group-wise weight = 0.30), contrasting with fellow doctors who gave it the lowest weight (group-wise weight = 0.05), the same for Efficiency of resource consumption. Nevertheless, all three groups concurred in assigning lower priority to Efficiency of resource consumption. These variations underscore the importance of considering diverse perspectives in the evaluation process, enriching the understanding of different factors influencing the performance evaluation of orthopedic surgical doctors.

For the overall significance of the five latent factors determined through group-wise weight combination, Clinical workload (overall weight = 0.31) holds the highest importance, followed closely by Complexity of service (overall weight = 0.28). Capacity of service (overall weight = 0.20) is accorded a medium importance, while Professional experience (overall weight = 0.15) follows with a relatively lower weight. Efficiency of resource consumption (overall weight = 0.06) is valued comparatively the lowest in importance. These weights reflect the collective comprehension drawn for decision-making on surgical doctors' performance evaluation, which enhances the precision and relevance of a quantitative assessment in the studied context.

TABLE IV
GROUP-WISE AND OVERALL WEIGHTS OF LATENT FACTORS

Factor	Weight			Overall
	Hospital management officials	Fellow doctors	Patient representatives	
Professional experience	0.15	0.05	0.30	0.15
Clinical workload	0.30	0.40	0.20	0.31
Capacity of service	0.20	0.20	0.20	0.20
Complexity of service	0.25	0.30	0.28	0.28

Efficiency of resource consumption	0.10	0.05	0.02	0.06
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Table. V presents the group-wise and overall weights of the indicators, which offers valuable insights into the perspectives of hospital management officials, fellow doctors, and patient representatives regarding the relative importance of specific indicators within each latent factor. Some observations are:

1. Within the factor of Professional experience, unanimity is observed among all groups, with Executive title carrying the greatest weight, followed by Years of professional experience and Age. This consistency highlights the collective agreement on the hierarchical importance of these indicators;
2. Diverging opinions become more pronounced within Capacity of service and Complexity of service. While hospital management officials and fellow doctors share a belief in the comparable importance of Number of inpatient discharged cases and Total weight of DRGs, patient representatives place a higher emphasis on the former;
3. Disparities also emerge in Complexity of service, particularly in the relative importance assigned to Number of minimal invasive surgeries and Case-Mix Index (CMI). The divergent views on the significance of these indicators illuminate the diverse perspectives on what constitutes a complex medical service;
4. Clinical workload is shown to be the most inconsistent across all groups, with notable variations in the perceived importance of Number of surgeries, Number of specialist visits, and Number of outpatient visits. While hospital management officials prioritize specialist visits after regular outpatient visits and ER visits, fellow doctors reverse this order. Patient representatives, on the other hand, place the highest importance on specialist visits, highlighting the subjective nature of workload assessment.

Overall weights of the indicators combining group-wise weights (Table. V) showcase the dominance of the factors Clinical workload and Complexity of service factors, with Number of Level-4 surgeries (overall weight = 0.157), Number of surgeries (overall weight = 0.096) and Number of specialist visits (overall weight = 0.081) emerging as the most influential indicators. In contrast, Age (overall weight = 0.024), Charge consumption index (overall weight = 0.028) and Time consumption index (overall weight = 0.032) hold the least weights, underscoring their relatively low significance in the overall evaluation framework. The meticulous analysis of the weight development results provides a comprehensive and balanced understanding of surgical doctors' performance evaluation.

TABLE V
GROUP-WISE AND OVERALL WEIGHTS OF INDICATORS WITHIN EACH LATENT FACTOR

Factor	Weight			Overall
	Hospital management officials	Fellow doctors	Patient representatives	
Professional experience				
Age	0.20	0.15	0.12	0.024
Years of professional experience	0.35	0.40	0.35	0.056

Executive title	0.45	0.45	0.53	0.071
Clinical workload				
Number of regular outpatient visits	0.22	0.23	0.12	0.062
Number of surgeries	0.28	0.17	0.38	0.081
Number of specialist visits	0.30	0.32	0.32	0.096
Number of ER visits	0.20	0.28	0.18	0.071
Capacity of service				
Number of inpatient discharged cases	0.32	0.38	0.45	0.076
Total weight of DRGs	0.27	0.22	0.30	0.052
Number of DRG groups covered	0.41	0.40	0.25	0.076
Complexity of service				
Number of Level-4 surgeries	0.62	0.54	0.50	0.157
Case-Mix Index (CMI)	0.30	0.31	0.20	0.078
Number of minimal invasive surgeries	0.08	0.15	0.30	0.045
Efficiency of resource consumption				
Charge consumption index	0.45	0.52	0.64	0.028
Time consumption index	0.55	0.48	0.36	0.032

B. A Retrospective Case Study

In this case study, we applied the global weights derived from the interval-valued spherical FAHP method (Table. V) to evaluating the performance of 28 orthopedic surgical doctors in the year of 2021, where their official performance scores, comprehensively judged by the departmental management committee, were published. Under the assumption that the evaluation scenarios and situations remained consistent between 2021 and 2022, we sought to assess the effectiveness and robustness of our proposed evaluation framework.

The calculation of these doctors' performance scores based on the global weights of the indicators works as follows: Each indicator's value was mapped between 0 and 1 using minimax normalization, and the final score was aggregated by a weighted linear combination of the indicators' values. The final scores were then mapped to a scale of 0 to 100 to match the published scale.

Comparing the two sets of scores calculated and published revealed intriguing findings. Fig. 1 shows the difference in scores and rankings for each doctor under evaluation. A two-sided matched pair test was conducted to detect any possible difference in scores (p -value = 0.32) and a Wilcoxon signed rank test was conducted to compare the rankings of the doctors for the two evaluation systems (p -value = 0.78). It was noted

that while individual scores could differ between the two evaluation systems, indicating the nuanced nature of the evaluation, the overall rankings of the doctors remained remarkably consistent. This alignment in the overall rankings underscores the reliability of our proposed evaluation framework, demonstrating its capability to capture the essential dimensions influencing doctors' medical performance.

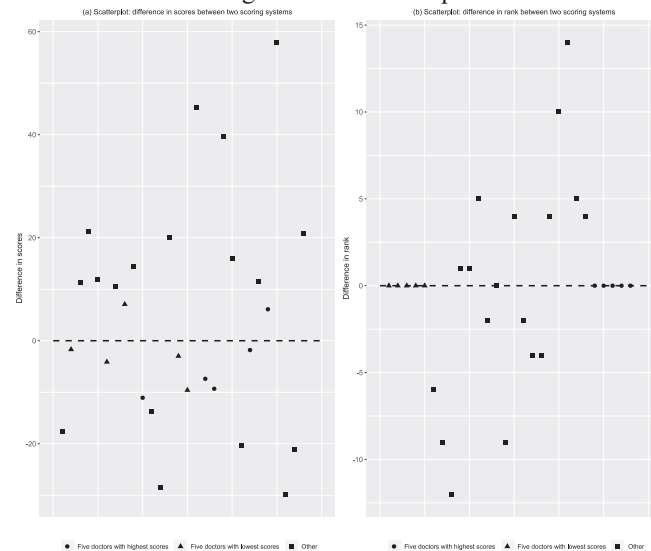


Fig. 1 Differences in scores (a) and rankings (b) between two scoring systems for 28 orthopedic surgical doctors in the year of 2021

Therefore, this study not only validates the applicability of our method but also highlights its potential to offer a structured and objective approach to evaluating surgical doctors' performance, fostering transparency and fairness in the process.

V. DISCUSSION

In contemporary healthcare settings, the evaluation of surgical doctor' performance is often encumbered by intricate and customized formulae, frequently established manually by department heads or management committee. The complexity of these systems poses challenges in terms of transparency and objectivity. This study contributes by presenting a quantitative evaluation framework tailored specifically for assessing the medical performance of surgical doctors. By leveraging the interval-valued spherical FAHP framework, our approach offers a systematic and data-driven means to constructing a more standardized and comprehensive evaluation tool.

The factors as well as indicators within each factor extracted from the performance data through exploratory factor analysis mostly align with expert understanding, reinforcing the validity of the analytical techniques. Our results indicate that there should be five dimensions that need to be considered when evaluating surgical doctors' performance. Fewer than five factors could lead to loss of information, while greater than five could complicate the evaluation process. Compared to the assessment dimensions currently employed across Chinese hospitals, clinical workload, complexity of service and capacity of service have already been applied, but efficiency of resource consumption have rarely been considered yet. The overall alignment with expert knowledge further supports the practical

applicability and relevance of our approach in capturing the multidimensional aspects that contribute to medical performance. The weight development results showcase the nuanced nature of medical performance evaluation. The diverse perspectives considered in the FAHP based evaluation framework contribute to a more inclusive and fair assessment of surgical doctors' performance.

As we contemplate the evolving landscape of healthcare in China, with the move towards DRG type risk adjustment payment systems, hospitals are compelled to focus on controlling healthcare service costs, necessitating an emphasis on the efficiency of resource utilization. Therefore, the potential increasing importance of the factor of Efficiency of resource consumption might become evident. Our evaluation framework, equipped to adapt to changing healthcare dynamics, could provide hospitals with a valuable and easy-to-use tool to ensure that their medical doctors adapt to evolving requirements.

Despite its contributions, there are still limitations to our study. Foremost, the scope of our investigation is confined to the orthopedic department, emphasizing the need for caution when generalizing the results to other medical specialties. The dataset comprises a modest sample size, which may limit the generalizability of our model. Moreover, the study originally incorporated only 18 dimensions that were available and accessible, excluding crucial metrics such as safety indicators and hospital readmission rates, which could be integral components of a performance evaluation. Integrating these dimensions would undoubtedly enhance our model's reliability and its capacity to serve more robust decision making. Additionally, our analysis did not account for regional variations, which is particularly pertinent given the potential diversity in weightings across hospitals in different regions. Finally, the sensitivity of the AHP methodology to the survey data poses a challenge, even with the mitigating effect of fuzzy logic. The potential biases introduced by respondents' knowledge sets, social status, and individual characteristics underscore the need for caution in interpreting these results. Nevertheless, our study lays a foundation for further refinement and expansion, acknowledging the necessity of incorporating a broader array of dimensions and accounting for regional nuances to fortify the model's applicability and robustness.

VI. CONCLUSION

This study introduces a data-driven methodology for evaluating the performance of surgical doctors by leveraging factor analytical techniques and interval-valued spherical FAHP methods. Our multidimensional evaluation framework, encompassing factors including Professional experience, Capacity of service, Clinical workload, Complexity of service, and Efficiency of resource consumption, provides a structured approach to individual doctors' performance evaluation. The FAHP method we utilized yields weight development results across diverse stakeholders, affirming the robustness of our approach. The adaptability of our model to evolving healthcare dynamics positions it as a valuable tool for hospitals seeking a comprehensive and objective evaluation framework. As the healthcare industry undergoes continuous transformation, our study not only contributes to the current understanding of health

service performance evaluation but also opens avenues for further refinement and expansion, emphasizing inclusivity, adaptability, and continuous improvement in the evaluation of surgical doctors.

APPENDIX

A. The Survey

A survey consisting of six sets of questions were sent out to three groups: hospital and departmental managers, fellow doctors and patient representatives who were admitted to the orthopedics department in the past 3 months. One set of questions pertains to pairwise comparison between latent factors, while the other five pertain to pairwise comparison between indicators within each of the five factor. Each question asks the respondent to select an answer that best describes the relative importance between two indicators. A consent form was also sent out to each respondent describing the survey including its purpose, selection criterion, and detailed explanations of each indicator. The following are an exemplified set of questions from the survey.

Please select the answer that best describes the relative importance between two indicators in evaluating a surgical doctor in practice.

Question 1. Compared to age, years of professional experience holds ____.

- a. Absolutely high importance
- b. Very high importance
- c. High importance
- d. Slightly high importance
- e. Equal importance
- f. Slightly low importance
- g. Low importance
- h. Very low importance
- i. Absolutely low importance

Question 2. Compared to age, executive title holds ____.

- a. Absolutely high importance
- b. Very high importance
- c. High importance
- d. Slightly high importance
- e. Equal importance
- f. Slightly low importance
- g. Low importance
- h. Very low importance
- i. Absolutely low importance

Question 3. Compared to years of professional experience, executive title holds ____.

- a. Absolutely high importance
- b. Very high importance
- c. High importance
- d. Slightly high importance
- e. Equal importance
- f. Slightly low importance
- g. Low importance
- h. Very low importance

i. Absolutely low importance

B. Exploratory Factor Analysis

Exploratory factor analysis was applied on the full list of indicators to identify the latent factors. However, the latent factors are unobservable, nevertheless how many of them are truly there. We studied the model performance indices including standardized root mean square residual (SRMR), Tucker-Lewis index and percent of variances explained by factors, Bayesian information criterion as a function of factor counts. We used the elbow approach together with consultation with domain experts about their practical implications to decide how many factors could best summarize the indicators with least information loss as well as parsimony in practical implications.

Fig. 2 plots the model performance indices as a function of the number of factors. All performance indices show consistent big improvements when the number of factors is increased from 1 to 5. The percent of variation explained by newly added factors (Fig. 2(a)) decreases sharply and is stabilized after 5 factors. The plot of standardized root mean square of residuals (SRMR) (Fig. 2(b)) shows a continuous downward trend, which is not clear to decide the optimal number of factors. The Tucker-Lewis index (Fig. 2(c)) shows a large climb when the number of factors is increased from 1 to 5 and oscillates after 5. The Bayesian information criterion (Fig. 2(d)) decreases heavily when the number of factors is increased from 1 to 5 and achieves its minimum at 5. Therefore, five latent factors were chosen in this study.

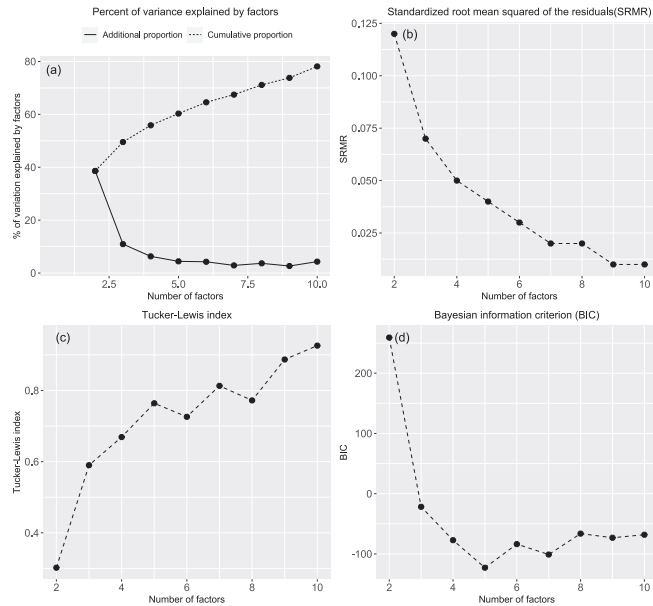


Fig. 2 Model performance in terms of number of factors in the exploratory factor analysis

C. Details on the Interval-valued Spherical FAHP development

We present the detailed process of the mathematical tool that we used to obtain the weights of each factor group and each indicator in the factor group.

In Step 1, we mapped linguistic survey responses to interval-valued spherical fuzzy set representations. Here we use the factor Complexity of service for illustration. One respondent from the group of fellow doctors had some linguistic responses shown in Table. VI. Note that each column indicator is compared to each row one.

TABLE VI
LINGUISTIC RESPONSE SAMPLE

	Number of Level-4 surgeries	Case-Mix Index (CMI)	Number of minimal invasive surgeries
Number of Level-4 surgeries	Equal importance	High importance	Absolutely high importance
Case-Mix Index (CMI)		Equal importance	High importance
Number of minimal invasive surgeries			Equal importance

These linguistic responses were mapped to a pairwise comparison matrix according to Table. II:

$$\begin{pmatrix} 1 & 7 & 9 \\ \frac{1}{7} & 1 & 7 \\ \frac{1}{9} & \frac{1}{7} & 1 \end{pmatrix} \quad (4)$$

We tested the resulting pairwise comparison matrices for consistency, all of which passed the consistency ratio test.

In Step 2, we constructed the fuzzy comparison matrices. For example, the matrix (4) was converted to a fuzzy matrix with first column:

$$\begin{pmatrix} ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \\ ([0.15, 0.20], [0.75, 0.85], [0.10, 0.20]) \\ ([0.10, 0.15], [0.85, 0.95], [0.05, 0.15]) \end{pmatrix}$$

second column:

$$\begin{pmatrix} ([0.75, 0.85], [0.15, 0.20], [0.15, 0.20]) \\ ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \\ ([0.15, 0.20], [0.75, 0.85], [0.10, 0.20]) \end{pmatrix}$$

and third column:

$$\begin{pmatrix} ([0.85, 0.95], [0.10, 0.15], [0.05, 0.15]) \\ ([0.75, 0.85], [0.15, 0.20], [0.15, 0.20]) \\ ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \end{pmatrix}$$

In Step 3, we formed the group-wise fuzzy comparison matrices by applying the aggregation formula (2). For example, the aggregated pairwise comparison matrix for the indicators within the factor Complexity of service derived from the responses of the group of fellow doctors is shown below, with first column:

$$\begin{pmatrix} ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \\ ([0.13, 0.18], [0.77, 0.86], [0.13, 0.19]) \\ ([0.12, 0.16], [0.87, 0.95], [0.05, 0.13]) \end{pmatrix}$$

second column:

$$\begin{pmatrix} ([0.77, 0.87], [0.12, 0.17], [0.13, 0.20]) \\ ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \\ ([0.15, 0.19], [0.76, 0.85], [0.09, 0.20]) \end{pmatrix}$$

and third column:

$$\begin{pmatrix} ([0.83, 0.94], [0.12, 0.15], [0.07, 0.12]) \\ ([0.76, 0.85], [0.14, 0.19], [0.16, 0.21]) \\ ([0.50, 0.55], [0.45, 0.55], [0.30, 0.40]) \end{pmatrix} \quad (5)$$

In Step 4, we defuzzified all the group-wise interval-valued comparison matrices to single-valued ones using (3). For example, the aggregated matrix (5) was converted to be

$$\begin{pmatrix} 0.99 & 1.65 & 1.77 \\ 0.35 & 0.99 & 1.61 \\ 0.19 & 0.37 & 0.99 \end{pmatrix} \quad (6)$$

In Step 5, we applied eigenvalue decomposition on the single-valued comparison matrices. The eigenvector associated with the largest eigenvalue contains the weights for the corresponding indicators. For example, for matrix (6), the eigenvector associated with the largest eigenvalue is (0.85, 0.48, 0.24), which was further normalized to output group-wise weight results. For example, the weights computed for the factor Complexity of service across all groups of respondents are shown in Table. VII. The

TABLE VII
GROUP-WISE WEIGHTS CALCULATED FOR THE FACTOR COMPLEXITY OF SERVICE

Complexity of service	Weights
Group 1: Hospital management officials	
Number of Level-4 surgeries	0.62
Case-Mix Index (CMI)	0.30
Number of minimal invasive surgeries	0.08
Group 2: Fellow doctors	
Number of Level-4 surgeries	0.54
Case-Mix Index (CMI)	0.31
Number of minimal invasive surgeries	0.15
Group 3: Patient representatives	
Number of Level-4 surgeries	0.50
Case-Mix Index (CMI)	0.20
Number of minimal invasive surgeries	0.30

In Step 6, we combined the group-wise weights calculated for each factor and each indicator within the factors to obtain the global weights, where the weights assigned for the groups are 0.35, 0.40 and 0.25 for hospital management officials, fellow doctors and patient representatives, respectively. The global weight results are presented in Table. VI and Table. V.

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Knowledge of the Doctors Regarding International Patient Safety Goal

Abdullah Mudassar, Fatima Saeed

Abstract—

Introduction: In the ever-evolving landscape of healthcare, the imperative to ensure patient safety remains a global priority. At the forefront of this endeavor are the International Patient Safety Goals (IPSGs), a standardized framework designed to mitigate risks and elevate the quality of care. Doctors, positioned as primary caregivers, wield a pivotal role in upholding and adhering to IPSGs, underscoring the critical significance of their knowledge and understanding of these goals. This research embarks on a comprehensive exploration into the depth of doctors' comprehension of IPSGs, aiming to unearth potential gaps and provide insights for targeted educational interventions. Established by influential healthcare bodies, including the World Health Organization (WHO), IPSGs represent a universally applicable set of objectives spanning crucial domains such as medication safety, infection control, surgical site safety, and patient identification. Adherence to these goals has exhibited substantial reductions in adverse events, fostering an overall enhancement in the quality of care. This study operates on the fundamental premise that an informed doctors' workforce is indispensable for the effective implementation of IPSGs. A nuanced understanding of these goals empowers doctors to identify potential risks, advocate for necessary changes, and actively contribute to a safety-centric culture within healthcare institutions. Despite the acknowledged importance of IPSGs, there is a growing concern that nurses may lack the necessary knowledge to seamlessly integrate these goals into their practice.

Methodology: A comprehensive research methodology covering study design, setting, duration, sample size determination, sampling technique, and data analysis. It introduces the philosophical framework guiding the research and details material, methods, and the analysis framework. The study, a descriptive quantitative cross-sectional study in teaching care hospitals, utilized convenient sampling over six months. Data collection involved written informed consent and questionnaires, analyzed with SPSS version 23, presenting results graphically and descriptively. The chapter ensures a clear understanding of the study's design, execution, and analytical processes.

Result: The survey results reveal a substantial distribution across hospitals, with 34.52% in MTKTH and 65.48% in HMC MTI. There is a notable prevalence of patient safety incidents, emphasizing the significance of adherence to IPSGs. Positive trends are observed, including 77.0% affirming the "time-out" procedure, 81.6% acknowledging effective healthcare provider communication, and high recognition (82.7%) of the purpose of IPSGs to improve patient safety. While the survey reflects a good understanding of IPSGs, areas for improvement are identified, suggesting opportunities for targeted interventions.

Discussion: The study underscores the need for tailored care approaches and highlights the bio-socio-cultural context of 'contagion,' suggesting areas for further research amid antimicrobial resistance. Shifting focus to patient safety practices, the survey chapter provides a detailed overview of results, emphasizing workplace distribution, patient safety incidents, and positive reflections on IPSGs. The findings indicate a positive trend in patient safety practices with areas for improvement, emphasizing the ongoing need for reinforcing safety protocols and cultivating a safety-centric culture in healthcare.

Conclusion: In summary, the survey indicates a positive trend in patient safety practices with a good understanding of IPSGs among participants. However, the identification of areas for potential improvement suggests opportunities for targeted interventions to enhance patient safety further. Ongoing efforts to reinforce adherence to safety protocols, address identified gaps, and foster a culture of safety will contribute to continuous improvements in patient care and outcomes.

Keywords— infection control, international patient safety, patient safety practices.

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Fatima Saeed, Abdullah Mudassar

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Keywords— infection control, international patient safety, patient safety practices, proper medication.

Investigation of the Trunk Inclination Positioning Angle on Swallowing and Respiratory Function

Hsin-Yi Kathy Cheng, Yan-Ying JU, Wann-Yun Shieh, Chin-Man Wang

Abstract— Although the coordination of swallowing and respiration has been discussed widely, the influence of the positioning angle on swallowing and respiration during feeding has rarely been investigated. This study aimed to investigate the timing and coordination of swallowing and respiration in different seat inclination angles, with liquid and bolus, to provide suggestions and guidelines for the design and develop a feedback-controlled seat angle adjustment device for the back-adjustable wheelchair. Twenty-six participants aged between 15-30 years old without any signs of swallowing difficulty were included. The combination of seat inclinations and food types was randomly assigned, with three repetitions in each combination. The trunk inclination angle was adjusted by a commercialized positioning wheelchair. A total of 36 swallows were done, with at least 30 seconds of rest between each swallow. We used a self-developed wearable device to measure the submandibular muscle surface EMG, the movement of the thyroid cartilage, and the respiratory status of the nasal cavity. Our program auto-analyzed the onset and offset of duration, and the excursion and strength of thyroid cartilage when it was moving, coordination between breathing and swallowing were also included. Variables measured include the EMG duration (DsEMG), swallowing apnea duration (SAD), total excursion time (TET), duration of 2nd deflection, FSR amplitude, Onset latency, DsEMG onset, DsEMG offset, FSR onset, and FSR offset. These measurements were done in four-seat inclination angles (5°, 15°, 30°, 45°) and three food contents (1ml water, 10ml water, and 5ml pudding bolus) for each subject. The data collected between different contents were compared. Descriptive statistics were used to describe the basic features of the data. Repeated measure ANOVAs were used to analyze the differences for the dependent variables in different seat inclination and food content combinations. The results indicated significant differences in seat inclination, mostly between 5° and 45°, in all variables except FSR amplitude. It also indicated significant differences in food contents almost among all variables. Significant interactions between seat inclination and food contents were only found in FSR offsets. The same protocol will be applied to participants with disabilities. The results of this study would serve as clinical guidance for proper feeding positions with different food contents. The ergonomic data would also provide references for assistive technology professionals and practitioners in device design and development. In summary, the current results indicated that it is easier for a subject to lean backward during swallowing than when sitting upright and swallowing water is easier than swallowing pudding. The results of this study would serve as the clinical guidance for proper feeding position (such as wheelchair back angle adjustment) with different food contents. The same protocol can be applied to elderly participants or participants with physical disabilities. The ergonomic data would also provide references for assistive technology professionals and practitioners in device design and development.

Keywords— swallowing, positioning, assistive device, disability.

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Evaluating Cognition and Movement Coordination of Adolescents with Intellectual Disabilities through Ball Games

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Abstract—Adolescents who have intellectual disabilities often demonstrate maladaptive behaviors in their daily activities due to either physical abnormalities or neurological disorders. These adolescents commonly struggle with their cognition and movement coordination when it comes to executing tasks such as throwing or catching objects smoothly, quickly, and gracefully, in contrast to their typically developing peers. Simply measuring movement time and distance doesn't provide a comprehensive view of their performance challenges. In this study, a ball-playing approach was proposed to assess the cognition and movement coordination of adolescents with intellectual disabilities using a smart ball equipped with an embedded inertial sensor. Four distinct ball games were specifically designed for this smart ball: two focusing on lower limb activities (dribbling along a straight line and navigating a zigzag path) and two centered around upper limb tasks (picking up and throwing and catching the ball). The cognition and movement coordination of 25 adolescents with intellectual disabilities (average age 18.36 ± 2.46 years) with that of 25 typically developing adolescents (average age 18.36 ± 0.49 years) were compared in these four tests. The results clearly revealed significant differences in the cognition and movement coordination between the adolescents with intellectual disabilities and the typically developing adolescents. These differences encompassed aspects such as movement speed, hand-eye coordination, and control over objects across all the tests conducted.

Keywords—cognition, intellectual disabilities, movement coordination, smart ball.

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Parkinson's Disease Hand-Eye Coordination and Dexterity Evaluation System

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Abstract—This study aims to develop an objective scoring system to evaluate hand-eye coordination and hand dexterity for Parkinson's disease. This system contains three boards and each of them is implemented with the sensors to sense a user's finger operations. The operations include the peg test, the block test, and the blind block test. A user has to use the vision, hearing, and tactile abilities to finish these operations, and the board will record the results automatically. These results can help the physicians to evaluate a user's reaction, coordination, dexterity function. The results will be collected to a cloud database for further analysis and statistics. A researcher can use this system to obtain systematic, graphic reports for an individual or a group of users. Particularly, a deep learning model is developed to learn the features of the data from different users. This model will help the physicians to assess the Parkinson's disease symptoms by a more intellectual algorithm.

Keywords—deep learning, hand-eye coordination, reaction, hand dexterity.

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Jungle Justice on Emotional Health Challenges of Residents in Lagos Metropolitan City, Nigeria

Aaron Akinloye

Abstract—this research focuses on the impact of jungle justice on the emotional health challenges experienced by residents in the Lagos metropolitan city in Nigeria. Jungle justice refers to the practice of individuals taking the law into their own hands and administering punishment without proper legal procedures. The aim of this study is to investigate the influence of jungle justice on the emotional challenges faced by residents in Lagos. The specific objectives of the study are to examine the effects of jungle justice on trauma, pressure, fear, and depression among residents. The study adopts a descriptive survey research design and uses a questionnaire as the research instrument. The population of the study consisted of residents in the three senatorial districts that make up Lagos State. A simple random sampling technique was used to select two Local Government Areas (Yaba and Shomolu) from each of the three senatorial districts of Lagos State. Also, a simple random sampling technique was used to select fifty (50) residents from each of the chosen Local Government Areas to make three hundred (300) residents that formed the sample of the study. Accidental sampling technique is employed to select a sample of 300 residents. Data on the variables of interest is collected using a self-developed questionnaire. The research instrument undergoes validation through face, content, and construct validation processes. The reliability coefficient of the instrument is found to be 0.84. The study reveals that jungle justice significantly influences trauma, pressure, fear, and depression among residents in Lagos metropolitan city. The statistical analysis shows significant relationships between jungle justice and these emotional health challenges ($df (298) t = 2.33, p < 0.05$; $df (298) t = 2.16, p < 0.05$; $df (298) t = 2.20, p < 0.05$; $df (298) t = 2.14, p < 0.05$). This study contributes to the literature by highlighting the negative effects of jungle justice on the emotional well-being of residents. It emphasizes the importance of addressing this issue and implementing measures to prevent such vigilante actions. Data is collected through the administration of the self-developed questionnaire to the selected residents. The collected data is then analyzed using inferential statistics, specifically mean analysis, to examine the relationships between jungle justice and the emotional health challenges experienced by the residents. The main question addressed in this study is how jungle justice affects the emotional health challenges faced by residents in Lagos metropolitan city. Conclusion: The study concludes that jungle justice has a significant influence on trauma, pressure, fear, and depression among residents.

To address this issue, recommendations are made, including the implementation of comprehensive awareness campaigns, improvement of law enforcement agencies, development of support systems for victims, and revision of the legal framework to effectively address jungle justice. Overall, this research contributes to the understanding of the consequences of jungle justice and provides recommendations for intervention to protect the emotional well-being of residents in Lagos metropolitan city.

Keywords— Depression, Emotional health challenges, Jungle justice, Trauma.

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Tweets to Touchdowns: Predicting NFL Achievement from Social Media Optimism

Rohan Erasala, Ian McCulloh

Abstract— The NFL Draft is a chance for every NFL team to select their next superstar. As a result, teams heavily invest in scouting, and millions of fans partake in the online discourse surrounding the draft. This paper investigates the potential correlations between positive sentiment in individual draft selection threads from the subreddit r/NFL and if this data can be used to make successful player recommendations. It is hypothesized that there will be limited correlations and nonviable recommendations made from these threads. The hypothesis is tested using sentiment analysis of draft thread comments and analyzing correlation and precision at k of top scores. The results indicate weak correlations between the percentage of positive comments in a draft selection thread and a player's approximate value, but potentially viable recommendations from looking at players whose draft selection threads have the highest percentage of positive comments.

Keywords— National Football League, NFL, NFL Draft, sentiment analysis, Reddit, social media, NLP, sentiment analysis

I. INTRODUCTION

THE National Football League (NFL) is the most popular sports league in the United States of America, followed by over 50% of all sports fans in the United States of America today [1]. Every year, millions of fans also tune into the NFL Draft - a process that allows teams to select their future stars from the eligible pool of college football players [2]. The NFL Draft has seven rounds, and each of the 32 NFL teams has one pick per round. The NFL Draft represents many teams' best opportunity to acquire young players who contribute to the team, increase ticket sales, and increase overall team success. Accordingly, teams have advanced scouting departments that spend hundreds of thousands of dollars conducting private workouts, tests, visits, and research into what players will be successful in the NFL [3]-[5].

The rise of sports betting in the National Football League (NFL) has created financial interest in the NFL Draft. This phenomenon can be traced back to the legal shifts that occurred in the United States following the Supreme Court's decision in *Murphy v. National Collegiate Athletic Association* in 2018, which overturned the Professional and Amateur Sports Protection Act of 1992 (PASPA). This landmark ruling effectively allowed states to legalize sports betting, leading to a rapid expansion of legal sports gambling across the nation. The NFL, once a staunch opponent of sports betting, adapted to this new reality by forming partnerships with betting companies and integrating betting content into its broadcasts and digital platforms. This integration has not only altered the way fans engage with the sport but has also opened new revenue streams for the league. However, it has also

raised concerns about the potential impact on the integrity of the game and the well-being of its players and fans [6].

In the context of the NFL, the proliferation of sports betting has had multifaceted implications. On one hand, it has increased fan engagement, as betting allows fans to have a financial stake in the outcomes of games, thus intensifying their overall experience. On the other hand, it has raised ethical and regulatory questions, particularly regarding the safeguarding of the sport's integrity and the prevention of gambling-related harm among vulnerable populations. Additionally, the NFL's embrace of sports betting has necessitated the development of new policies and educational programs aimed at ensuring responsible gambling practices among both players and fans [7]. The ongoing evolution of this relationship between the NFL and sports betting presents a dynamic area of study, with implications for sports management, marketing, and policy.

The intersection of NFL fantasy football and its impact on sports betting represents a compelling area of study within the broader context of sports economics and consumer behavior. Fantasy football, a game where participants act as owners to build a team that competes against others based on statistical performances of real NFL players, has seen exponential growth over the past two decades. This growth has been paralleled by a significant increase in sports betting, especially following the legalization of sports gambling in many U.S. states. The convergence of fantasy football and sports betting has resulted in a unique dynamic where the two industries both compete and complement each other [8].

From a behavioral standpoint, fantasy football has been shown to influence betting patterns among its participants. According to research by Drayer and Rascher [9], individuals engaged in fantasy sports are more likely to participate in sports betting. This correlation can be attributed to the similar skill sets used in both activities, such as statistical analysis and player performance tracking. Moreover, fantasy sports have been credited with enhancing fan engagement and viewership, indirectly influencing betting behaviors by increasing knowledge and interest in specific games or players. This enhanced engagement can lead to a deeper understanding of the sport, potentially giving bettors an edge in their wagering decisions. However, this synergy also raises concerns regarding problem gambling and the need for robust regulatory frameworks to ensure responsible gambling practices [10].

Given the popularity of the NFL, the rise in sports betting, and the importance of the NFL Draft, millions of people engage in online conversations about future NFL players and

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guessing who will be successful. On the day of the first round of the 2020 draft, X (formerly Twitter) received 4 million posts/tweets related to the draft [11]. A few minutes on any social media platform such as X, Reddit, or Facebook will show someone how many people voice their opinions on team and player performance and how many strongly believe those opinions. These posts garner thousands of views and interactions, and these numbers increase every day. The goal of this paper is to understand if the sentiment of online public opinion has value when projecting the success of NFL players. This is investigated with the following research questions:

- RQ1: Are there correlations between the positivity in social media's reaction to a draft selection and player performance?

- RQ2: Can we use social media's reaction to a draft selection as a recommendation of a future asset to a team?

It is hypothesized that there will be limited correlations between the positivity of social media's reaction to a draft selection and player performance, and recommendations based on these reactions will be poor.

II. BACKGROUND

A. Related Work

There have been several studies done to predict player and team performance in sports. Lutz [12] investigated the prediction of NFL player performance specifically for fantasy football using statistical techniques to analyze player data. He offers a robust model for forecasting future performance based on historical data. Others [13] offer a unique research angle by considering the influence of team context on individual player performance. Their method provides a more nuanced understanding of player performance within the context of team dynamics. King [14] focuses on the quarterback position to analyze decision-making patterns and performance. His work is particularly relevant for understanding the complexities of predicting performance in key positions. Lyons et al. [15] found that past performance was a better prediction of NFL player performance than physical ability. Unfortunately, these models do not perform well for new players entering the NFL, since they all require historic data. Furthermore, they do not necessarily benefit from crowd wisdom that may be able to perceive additional context that has not otherwise been captured in data.

A study by Howe [16] highlights the democratization of data collection through crowdsourcing, emphasizing its potential to gather vast and varied inputs that traditional methods might overlook. This inclusive approach not only enriches the dataset but also fosters a more holistic understanding of the subject matter. Similarly, Brabham [17] discusses the application of crowdsourcing in problem-solving, where the aggregation of diverse viewpoints can lead to innovative solutions and the identification of previously unnoticed features.

The potential of social media as a platform for crowdsourcing predictive insights into sports player performance has garnered increasing interest in academic

circles. Social media platforms, with their vast user bases and diverse demographic profiles, offer a rich, real-time source of data and opinions that can be harnessed for predictive analytics in sports. A study by Clavio and Kian [18] highlights the depth and breadth of sports-related discussions on social media platforms, suggesting their utility as a crowdsourcing tool for gauging public sentiment and opinions about player performances. Similarly, Hambrick [19] notes the propensity of sports fans to share detailed observations and analyses on players and games, which, when aggregated, could provide valuable insights for predictive modeling. This is further supported by Xu et al. [20], who demonstrate the feasibility of using social media data to predict outcomes in sports events, underscoring its potential in assessing individual player performances as well. Reed et al. [21] found that social media networks of discourse between NBA players were a useful proxy for team chemistry and correlated with performance on the court.

Several researchers have investigated the potential of valuing social media opinions in sports. Wiseman [22] created a machine-learning model called DraftSense, aimed at monitoring public sentiment around a draft pick using comments from Reddit. Wiseman was able to achieve 84% accuracy with a support vector machine model trained to categorize comments as positive, negative, or jokes. This attests to viability of understanding sentiment from discussions about the NFL Draft. Silva [23] conducted a study that analyzed the semantic similarity between comments in live game threads of soccer matches and match commentary from reporters, as well as player ratings from the matches played. Silva also conducted sentiment analysis of comments in game threads to see what conclusions could be drawn. They found that comments from Reddit were semantically similar to match commentary and that positive sentiment in comments was correlated with the team that was currently performing well. Sinha et al. [24] studied the relationship between social media output and NFL results using posts from X and statistics from the games. The researchers trained a logistic regression classifier with tweets before, during, and after the game. With this model, they predicted the winner of a game with 63.8% accuracy during the 2012 NFL season. Both of these studies endorse the value of public opinion when projecting player and team performance. This study aims to build on these analyses by investigating the viability of using sentiment analysis of reactions to draft selections to project player performance and recommend successful players.

B. Sentiment Analysis

Sentiment analysis is the process of classifying emotions, opinions, and sentiments in textual data [25], [26]. The goal of sentiment analysis is to provide a way for computers to understand the human emotion behind public opinion, perceptions, and sociological insights. Pieces of text are classified into different categories such as "negative", "positive", "neutral", "angry", "sad", etc. as specified by the model and training data.

C. Approximate Value

One of the challenges of analyzing player performance in a team sport is the difficulty of measuring a player's individual impact. This is especially difficult in football because for every position different statistics are measured (e.g., defensive players make tackles, but offensive players gain yards). To address this, the performance metric for players in this study is the approximate value statistic [27]. This statistic, invented by Pro Football Reference founder Doug Drinen, aims to quantify the seasonal value of a player regardless of position by using a unique combination of awards, individual statistics, and team success [27]. This is one of the few publicly available statistics that allows comparison of football players across positions, making it the ideal choice for this study.

III. DATASET

This work leverages the use of data available on Reddit, an online community platform with millions of users. All comments were collected from the r/NFL subreddit, a subreddit (forum for a specific topic on Reddit) dedicated to discussion of events in the NFL with over 6 million users. Moderators of r/NFL have created threads for users to discuss and react to draft selections since 2017. The dataset for this study consists of comments from these threads for first-round draft selections from 2017 and first and second-round draft selections from 2018-2021. This represents 289 different players/threads and a total of 40,522 comments. The data were collected using the Python Reddit API Wrapper (PRAW), a Python package that allows access to Reddit's API. All data were collected from October 3rd, 2023 to December 4th, 2023.

This work also leverages the use of data available on Stathead Football, a reference site that tracks professional and collegiate football statistics. All data related to NFL players/draftees including name, draft year, position, and approximate value were gathered using this website. Data were aggregated on November 30th, 2023.

IV. METHODS

This study used sentiment analysis to analyze the comment dataset. After cleaning, stemming, lemmatizing, and processing each comment, it was passed into a pre-trained language model from HuggingFace, BERTweet [28]. This model was selected based on the extensive size of the training corpus (over 900 million tweets in total) and because it was trained on data from social media (X, formerly Twitter) [11], [24]. Each comment was assigned one of three labels: negative, neutral, or positive, as well as a floating-point score representing the confidence in the label. The number of comments in each category (negative, neutral, or positive) in each thread was recorded in the data table. The percentage of positive comments in a player's draft selection thread was measured against that player's approximate value to determine potential correlations, and the precision at the top k ($k = 5, 10, 15, 25, 50, 100$) threads with the most positive comments was measured to determine possible recommendations. Some players receive more attention on social media than others. It

is therefore possible that only players with a sufficiently high volume of discourse will present enough data for prediction.

V. RESULTS

A. Sentiment and Player Performance Correlations

Correlation was determined by plotting the percentage of positive comments in each thread against the performance metric (approximate value). From this, visual and quantitative observations were made from the resulting trend line and R-squared value of the trend line. Below are the results of this investigation.

Positive sentiment was plotted against a player's approximate value per game that he played to control for player injuries and other factors that may have limited a player's ability to spend time on the field. Below are the results of this investigation.

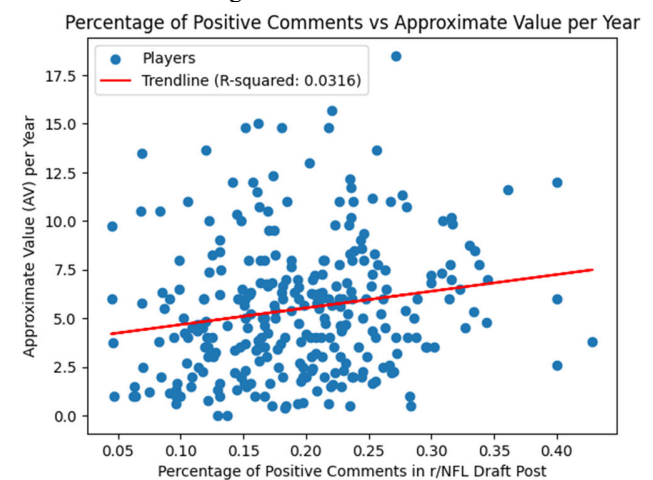


Fig. 1 Percentage of positive comments in each player's r/NFL draft selection thread against each player's approximate value (AV) per year

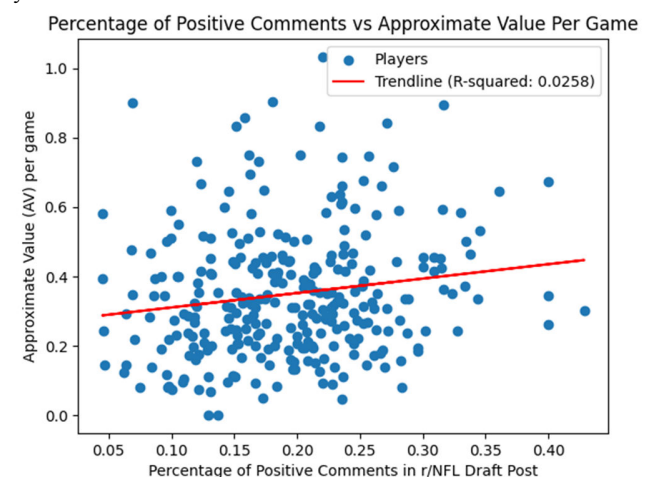


Fig. 2 Percentage of positive comments in each player's r/NFL draft selection thread vs. each player's approximate value (AV) per game.

The R-squared value for both trendlines in these graphs is $< (0.05)$, indicating an extremely weak correlation between the percentage of positive comments in a player's draft thread and the player's approximate value. These results are consistent

with the hypothesis that the correlation between positive comment sentiment in draft threads and player performance is minimal. This lack of correlation is readily explained by the fact that most people on social media are not professional football players, nor do they have experience with professional scouting. They also do not have the same access to player interviews, workouts, film, coaches, and other resources that give valuable information about players.

B. Sentiment as a Recommendation of Player Performance

Potential recommendations of players were aggregated by analyzing the precision at k for the top k draft thread comment percentages. Recommendations were made according to each player's approximate value per year compared to the median approximate value for a player in the dataset. If the player's approximate value was higher than the median approximate value of that group, it was labeled as a good recommendation. Therefore, the expected precision at k for all measures is 0.5. Below is the result of this investigation for first-round selection (R1), second-round selections (R2), and all selections (R1 + R2).

Given that all measures are above or at 0.5, this indicates that the top k recommendations from positive comment sentiment could be a viable recommendation system for successful players on an NFL team, with higher confidence from looking at the top 5-10 recommendations. There are multiple possible explanations for this observation. It can be argued that if social media users react overwhelmingly positively to a draft selection, there may be some tangible ability users can identify in the games that they watch. This could also mean that players are more likely to be successful in the NFL if they have the support and belief of social media users.

TABLE I
PRECISION AT K FOR R1, R2, AND R1 + R2 SELECTIONS

Measures	R1	R2	R1+R2
P@5	0.80	0.60	0.60
P@10	0.80	0.70	0.70
P@25	0.64	0.56	0.72
P@50	0.62	0.50	0.60
P@100	0.54	0.52	0.59

VI. CONCLUSION

The goal of this paper was to investigate potential correlations between positive comment sentiment in draft selection threads from r/NFL and player performance, as well as understand if any recommendations can be made from the analysis of positive comment sentiment. The hypothesis was that there are limited correlations between positive comment sentiment in draft threads and player performance and that there would not be viable recommendations. This hypothesis was confirmed for the first research question, but not confirmed for the second research question. The results of the investigation into potential correlations yielded extremely weak R-squared

values (< 0.05) when plotted against each other. We can safely conclude that this sentiment analysis showed no correlation with player performance. This indicates that the collective opinion of social media is no more accurate than most. In the investigation into viable recommendations, valuable recommendations were identified by looking at the top 5-10 highest percentages of positive comments in a player's draft selection thread. Possible explanations may be that players that have the belief of social media users perform better, or that a strong collective public opinion has value when projecting player performance.

This paper only focused on raw sentiment analysis of r/NFL draft selection threads. Future work that builds on this study could focus on developing advanced natural language processing tools that extract greater meaning from comments than raw sentiment. It is important to remember that the careers of many players in this study are not over, and there are many players who may not currently be in the best situation to succeed. Future work could continue to monitor these players' careers and analyze how correlations and recommendations may change over time.

By focusing on the top 25% of R1 + R2 discussion threads, precision is higher than chance and may provide an effective measure for estimating rookie performance. Many draftees do not have enough discussion to provide any predictive value. Perhaps combining social media related measures with other measures of physical performance will allow even more powerful composite measures. The fact that social media discourse provides value in estimating NFL player performance suggests that there is overlooked value in the wisdom of the fan base.

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