SOCIAL DEVELOPMENT
And
GOVERNANCE

Innovation in Education, Technology and
Management

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Social Development & Governance

Innovations in Education, Technology, and Management

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Preface

In the dynamic landscape of societal progress, this book stands as a testament to the collective exploration of key issues in social development and governance. It is a compendium of insightful chapters authored by scholars, each contributing to our understanding of the multifaceted challenges and opportunities that shape contemporary society.

This book explores the critical aspects in social development and governance, focusing on the socio-economic landscape and challenges prevalent in both rural and urban domains. In addition, it offers insights into comprehending the digital divide, with a specific emphasis on promoting gender-inclusive education for the empowerment of rural communities. The text revisits a cross-study on gender-inclusive education, underscoring the significance of fostering empowerment through a triad of education, technology, and governance. The book includes case studies of agricultural laborers in selected households in India, shedding light on the impact of out-of-pocket health expenditures leading to impoverishment.

The chapter on "Socio-Economic Status of Agricultural Labourers - A study of selected households of Karnal District, Haryana," presents a detailed examination of the socio-economic conditions faced by agricultural laborers, shedding light on the nuances within the households of Karnal District. The subsequent chapter, "Incidence of out-of-pocket health expenditure led impoverishment among rural households: An empirical study in Himachal Pradesh," delves into the empirical realities of rural households in Himachal Pradesh, exploring the impact of out-of-pocket health expenditure on their economic well-being.

The theme of rural empowerment continues with "Empowering Rural Communities: A Cross-Study on Gender-Inclusive Education," emphasizing the pivotal role of education in fostering gender inclusivity and empowerment in rural areas. Shifting focus, the exploration of "Corporate Governance in Banking Sector in India" delves into the critical domain of corporate

practices within the banking sector, dissecting their implications for broader societal development. The subsequent chapter revisits the theme of rural empowerment through a cross-study on gender-inclusive education, highlighting the interconnectedness of education, technology, and governance in shaping sustainable and inclusive societies.

"Industry 5.0 Contribution to Sustainable Development: A Roadmap for Environmental Sustainability" provides a roadmap for aligning industrial advancements with environmental sustainability, bridging the gap between industry and responsible development. The integration of technology takes center stage with "Artificial Intelligence and its application in different areas," exploring the transformative potential of artificial intelligence across diverse domains. "Transformative Strategies: Education, Technology, and Governance for Societal Development," synthesizes the collective insights from the preceding chapters, offering transformative strategies that harmonize education, technology, and governance for holistic societal development. Electronic waste poses a unique challenge in waste management. The chapter on "E-Waste Management: A New Dimension for Waste Management in India" explores a new dimension in waste management by addressing the complexities of e-waste, offering strategies and insights to pave the way for sustainable practices in the Indian context.

As editors, we express our gratitude to the contributors for their valuable insights, fostering a rich and diverse discourse on the pressing issues at the intersection of social development and governance. We hope this volume serves as a catalyst for further exploration, discussion, and action, contributing to the ongoing dialogue on shaping a more inclusive and sustainable future. We must extend our heartfelt thanks to **Adarsh Upadhyay**, (B.Sc. (Hons) Zoology) from **Ramjas College** and **Aastha** (B.A. Geography Major), from **Miranda House, University of Delhi** whose contributions in typesetting and editing in latex have been indispensable. Their dedication and meticulous attention have significantly elevated the quality of this publication. We are profoundly grateful for their efforts, which have been pivotal in bringing this work to its fruition.

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Chapter 1

Transformative Strategies: Education, Technology and Governance for Societal Development

Chhavi Jain[1] 🆔 **and Dr. Atul Sangal**[2] 🆔

Abstract: In the ever-evolving landscape of the 21st century, the interconnected realms of education, technology, and governance stand as pivotal pillars shaping the trajectory of societal development. This abstract delves into transformative strategies that intertwine these three spheres to foster comprehensive progress and sustainable growth. Education, as the cornerstone of societal advancement, requires a paradigm shift to adapt to the demands of the digital era. AI-powered teaching tools, immersive simulations, and personalized online platforms focus and simplify lifelong learning. Educational technology enhances critical thinking, skill development, and global adaptability. Effective governance improves society through education and technology. Inclusion is needed to close the digital divide and promote education and technology. Under collaborative governance, public-private partnerships promote innovation, resource mobilization, and information exchange.

Education, technology, and government collaborate globally. Solving global problems and promoting sustainable development for diverse populations requires international cooperation, knowledge exchange, and collaboration. These innovative methods have considerable potential but face challenges. However, while these transformative strategies hold immense potential, challenges persist. Data privacy, digital literacy, and technology integration require complex

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ethics. Effective, inclusive policies and projects need solid infrastructure, funding, and evaluation.

Lastly, education, technology, and government foster social development. These inventive solutions can empower people, overcome socio-economic inequities, and create a more egalitarian, resilient, and affluent global society by encouraging innovation, collaboration, and inclusivity.

Keywords: Transformative Strategies, Education, Technology, Governance, Societal Development, Digital Era, Lifelong Learning

1.1   Introduction

In an era marked by rapid technological evolution, the intertwined dynamics of education, technology, and governance serve as instrumental forces driving societal progress. This abstract explores transformative strategies that amalgamate these vital domains to chart a course for comprehensive development and enduring growth in the 21st century. The project on Global Leadership in the 21st century, as stated by Jacobs et al. (2020), aims to deepen our comprehension of the conscious social transformation process and broaden our awareness of untapped potentials that are poised to be fulfilled.

Education, as the bedrock of societal advancement, faces the challenge of adapting to the digital epoch. Embracing innovative technological tools and methodologies has become imperative to revolutionize learning experiences. The integration of advanced technologies like artificial intelligence, personalized online platforms, and immersive simulations has the potential to revolutionize education, offering tailored, accessible, and continuous learning opportunities for individuals across diverse landscapes (Tiwari, 2022).

Moreover, effective governance plays a pivotal role in harnessing the potential of education and technology for societal betterment. Collaborative governance models, fostering partnerships between public and private sectors, serve as catalysts for innovation, resource mobilization, and knowledge exchange, thereby facilitating holistic societal development (Jora, 2022).

A comprehensive framework for legitimizing and formulating strategies for transforma-

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tional change was provided by Weber and Rohracher (2012). The market failure, structural failure, and transformational failure are all part of this concept (Gupta & Tiwari, 2023). However, while these transformative strategies hold promise, they also pose challenges. Issues surrounding data privacy, digital literacy, and ethical considerations in technological integration necessitate comprehensive frameworks and ethical guidelines (Asif et al., 2023). Additionally, the successful implementation of policies demands robust infrastructural support, sustainable funding mechanisms, and continuous evaluation to ensure their effectiveness and inclusivity.

- *Education in the Digital Age*: Numerous studies have emphasized the impact of technology on education. From personalized learning platforms to the use of AI in education, scholars have explored how these advancements can enhance student engagement, learning outcomes, and the overall educational experience.

- *Governance and Policy Making*: Literature has discussed the role of governments and policymakers in shaping educational technology initiatives. Research often delves into the development of inclusive policies that aim to bridge the digital divide, ensuring equitable access to technology and quality education for all.

- *Collaborative Models and Partnerships*: These have been identified as crucial drivers for innovation, resource mobilization, and knowledge sharing in the education and technology sectors.

- *Challenges and Ethical Considerations*: Discussions on challenges related to data privacy, digital literacy, and ethical considerations in the integration of technology within educational frameworks have been prevalent. Researchers have examined the need for comprehensive frameworks and guidelines to address these challenges effectively.

- *Global Perspectives and Inclusivity*: Literature often explores global perspectives on education and technology, emphasizing the importance of inclusivity and addressing disparities among different regions and socioeconomic groups. Studies have emphasized the need for international cooperation and knowledge exchange to foster global societal development.

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- *Impact Assessment and Evaluation*: There is a focus on evaluating the effectiveness of policies, initiatives, and technological interventions in education. Researchers have emphasized the importance of robust evaluation mechanisms to ensure the inclusivity, efficacy, and sustainability of implemented strategies.

In essence, the convergence of education, technology, and governance presents an unparalleled opportunity to propel societal development forward. By embracing innovation, fostering collaboration, and ensuring inclusivity, these transformative strategies possess the potential to empower individuals, bridge socioeconomic gaps, and pave the way for a more equitable, resilient, and prosperous global society.

1.2   Literature Review

The literature on "Transformative Strategies: Education, Technology, and Governance for Societal Development" underscores the transformative impact of technology on education, emphasizing AI, personalized learning platforms, and immersive tools as drivers of enhanced learning outcomes and student engagement (Mittal, 2020). Governance and policy discussions focus on the pivotal role of inclusive policies in bridging digital divides and ensuring equitable access to education and technology. Collaboration among diverse stakeholders is highlighted as essential for driving innovation, resource sharing, and addressing educational challenges.

Global perspectives underscore the importance of inclusivity and international cooperation in addressing disparities across regions. Ethical considerations, challenges related to data privacy, digital literacy, and the need for comprehensive frameworks are recognized. Evaluation mechanisms and continuous improvement strategies are advocated to ensure the efficacy and inclusivity of implemented initiatives. Ultimately, the literature paints a comprehensive picture emphasizing collaboration, ethical integration, and continuous evaluation as pivotal elements in effective transformative strategies for societal development.

Ojo (2011) conducted a study to analyze the influence of e-governance on the advancement of online education in Africa, specifically in relation to promoting social equality. The

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study also considered the impact of socio-political and economic factors on the accessibility, availability, and effectiveness of new technology in achieving social equality on the continent.

Chaffin et, al. (2016) introduced transformative governance as a method of environmental governance that may effectively address, control, and initiate significant changes in linked social-ecological systems (SESs) at various levels.

Chataway et al. (2017) explored a comprehensive explanation of the rationale behind transformational innovation policy and introduces the transformational Innovation Policy Consortium (TIPC), which aims to promote novel approaches to science and innovation policy.It is evident that the journey of TIPC has only just commenced.

Loorbach et al. (2017) provided a description of the area of sustainability transitions research. This discipline has developed over the last twenty years, driven by increasing scientific and public attention towards achieving large-scale social transformation for sustainability. Knowledge advancement alone will not transform society. Boström et al. (2018) proposed moving beyond win-win learning for sustainable development. For lasting social change, we need a more complete understanding of learning that includes institutional, social, and conflictual aspects. The method advocates holistic, transformative learning founded in the natural and social sciences that recognizes how power shapes sustainability in globalized communities.

Fukuda (2020) examined three countries' STI (science, technology, and innovation) issues and assessed ecosystem-related future topics and fundamentals. He believes the public and private sectors must collaborate on labor market frameworks, entrepreneurship, competition, talent and skills development, and data exchange safety and regulation to foster growth. These approaches could boost data-driven innovation's productivity and growth in Society 5.0.

Kraus et al. (2021) conducted a qualitative classification of the literature on digital business transformation, categorizing it into three distinct groups according to its technological, business, and societal effects. The systematic literature review presents the primary study directions of digital transformation, which prioritize technology as the principal catalyst for these transformations. A conceptual framework for transformational governance was suggested in the paper by Konnola et al. (2021). Through the coordination of socio-technical transition, this framework seeks to improve the ecosystem's adaptability and resilience. It does this by making sure

there's a good mix of directionality, redundancy, diversity, connectedness, and polycentricism.

Akour and Alenezi (2022) examined the different forms of digital disparities that have arisen and been strengthened, as well as the stated obstacles that may impede progress. This paper proposes that research on information management should prioritize students, who are increasingly immersed in digitalized daily routines, as well as basic education.

Borras and Edler (2020) examined the state's embedded position in four socio-technical system governance types. The article analyzes cryptocurrency, smart cities, automated vehicles, and nuclear power using a three-pillar approach. They listed 13 state roles which further helped them to appreciate that the state's transformational agency is leveraged by governance modes and executed through specific role combinations.

The literature's different opinions show the complexity of transformational social development tactics. These sources emphasize AI, individualized learning platforms, and collaborative technologies as key drivers of improved learning results and equal access. Governance talks emphasize the need for inclusive policies to overcome digital barriers and promote stakeholder participation, supporting global inclusivity and ethical frameworks. The discourse goes beyond technological advances to advocate for holistic learning that includes social, institutional, and conflictual elements, highlighting power dynamics' significance in sustainability. Labor frameworks, talent development, and data regulation are important, thus public-private collaboration is encouraged to boost growth and innovation. These studies show the complexity of societal transition and the need for collaboration, ethical integration, and holistic evaluation to achieve sustainable success.

1.3   Discussion and Findings

The discussion and findings based on the above can be summarized as follows:

1. Technological Integration in Education: AI, tailored online platforms, and immersive simulations may transform education, according to research. These tools enhance digital skills and critical thinking through targeted, accessible, and continual learning.

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2. Role of Governance in Enabling Equitable Access: Effective governance is key to using education and technology to advance society. Inclusion is essential to closing the digital gap and providing equal access to education and technology.

3. Collaborative Holistic Development Models: Public-private collaboration strategies boost innovation, resource mobilization, and information exchange. Partnerships foster overall societal development by providing new solutions and equitable resource distribution.

4. Challenges and Ethics: Data privacy, digital literacy, and technological integration ethics are major issues. Addressing these issues responsibly requires comprehensive frameworks and ethical principles.

5. Inclusivity, global perspectives: Global perspectives on education and technology emphasize inclusion and addressing inequities among varied populations. Sustainable development and global socioeconomic equality require international cooperation and knowledge exchange.

6. Evaluation and Continuous Improvement Importance: The findings emphasize the need for robust assessment tools to measure strategy efficacy, inclusivity, and sustainability. Transformational methods must change to suit society's changing requirements through continuous improvement and adaptation.

These findings imply that education, technology, and governance may revolutionize society. These techniques can make the world more egalitarian, resilient, and prosperous by using technology, inclusive governance, and cooperation, responsible problem-solving, and global inclusion.

1.4   Suggestion

To foster societal development through transformative strategies, it's imperative to advocate for inclusive policies ensuring equitable access to education and technology while addressing concerns about data privacy, digital literacy, and ethical considerations within these policies.

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Additionally, increasing investment in technological infrastructure across educational institutions and providing educators with training for effective integration of technology in teaching methodologies is crucial.

Collaboration among government entities, private sectors, and NGOs should be fostered to drive innovation, share resources, and establish public-private partnerships aimed at developing tech-driven solutions for education. Emphasizing global cooperation, knowledge sharing, and resource distribution will be pivotal in bridging digital disparities across regions, ensuring universal access to education and technology. Furthermore, instituting robust evaluation mechanisms for educational initiatives and promoting adaptation based on evolving needs are essential for continuous improvement. Lastly, integrating ethical considerations into the use of technology within educational frameworks and adhering to ethical guidelines will ensure responsible and equitable deployment of technology for learning purposes. These concerted efforts can pave the way for a more inclusive, ethical, and prosperous society.

1.5   Conclusion

In conclusion, the convergence of education, technology, and governance presents an unprecedented opportunity for transformative change and societal advancement. The findings underscore the potential of integrating advanced technologies like AI, personalized learning platforms, and immersive simulations to revolutionize education, offering tailored and accessible learning experiences.
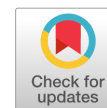
Effective governance is pivotal in shaping inclusive policies, bridging digital divides, and fostering collaborative models that drive innovation and resource sharing. The suggestions emphasize the need for equitable access to technology, global cooperation, continuous evaluation, and ethical integration to ensure responsible and inclusive implementation of transformative strategies. By prioritizing these aspects, societies can aspire to create more equitable, resilient, and prosperous environments, empowering individuals worldwide and laying the groundwork for sustainable and inclusive societal development in the digital age.

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Chapter 2

Incidence of Out-of-pocket Health Expenditure led Impoverishment among Rural Households: An Empirical Study in Himachal Pradesh

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Abstract: The healthcare system in India is characterised by high out-of-pocket (OOP) expenditure, which varies across states and different population groups. This study aims to examine the levels of impoverishment caused by OOP health payments and their determinants among rural households in Himachal Pradesh, India. The study uses cross-sectional data from a survey of 300 rural households from two districts of Himachal Pradesh. We study the level of catastrophic health expenditure (CHE) at two different thresholds i.e., 10 percent and 25 percent of households consumption expenditure. Using the state poverty line for rural areas, the study also estimates the levels of impoverishment due to high OOP payments. The study employs multiple logistic regression models to identify the factors associated with the incidence of impoverishment. The incidence of CHE due to OOP health payments at 10 per cent and 25 per cent level of total consumption expenditure is 69.33 per cent and 38.67 per cent, respectively, in Sirmaur district; and 70 per cent and 34.67 per cent, respectively, for Solan district. Similarly, the level of impoverishment is 25.33 per cent and 16 per cent in Sirmaur and Solan, respectively. Factors such as seeking outpatient care, presence of chronic disease patients and travelling for healthcare are main covariates of impoverishment. The study concludes that OOP healthcare

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payments pose a significant financial risk in Himachal Pradesh. This risk can be minimized by covering the outpatients and needs of chronic disease patients under social health insurance. In addition, the travelling-related financial risks for patients can be mitigated by increasing the participation of private healthcare providers in social health insurance schemes and government investment in strengthening the access to healthcare facilities.

Keywords: Health, expenditure, rural, households

2.1 Introduction

Keeping up with the United Nations Sustainable Development Goals (SDGs), the government of India aims to attain Universal Health Coverage. However, high out-of-pocket (OOP) expenditure poses a challenge to financial risk protection. OOP expenditure in India accounts for 48.8 per cent of total health expenditure (MOHFW, 2021). High OOP spending places a heavy financial strain on households and prevents them from having enough money for necessities like food, clothing, and education (Van Minh et al, 2013). This OOP expenditure becomes catastrophic above a certain threshold and can even impoverish a household. A household is said to be impoverished when the healthcare expenditure causes it to drop below the poverty line (Wagstaff & Doorslaer, 2003).

Health is a state subject in the Indian federal structure, where the state government plays a more significant role. Healthcare services in India are provided by public, private, for-profit, and not-for-profit providers. Most private providers are generally located in urban areas catering to secondary and tertiary needs. In comparison, the public healthcare infrastructure follows a three-tier structure based on population norms (Chokshi et al.,2016). Apart from that, tertiary care is being provided by medical colleges and super-speciality hospitals (Selvaraj et al., 2018).

Himachal Pradesh, a north-western Himalayan state of India, is a unique case with a population of 6.86 million, of which 89.97 per cent living in rural areas. At 10.2 per cent, the state has higher levels of elderly population compared to the national average (UNFPA, 2014). Despite being a Himalayan state and facing complex geographic challenges, it has improved its rural infrastructure and human development outcomes (Das et al., 2015). In terms of per-capita

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government expenditure on health, the state ranks first among Indian states. Amongst all states, the utilisation of public facilities for inpatient care is highest in the state(NSS, 2015).

Conversely, the overall expenses for inpatient and outpatient care in rural areas of the state are higher than their urban counterparts (MOSPI, 2019). A 2018 study has shown the CHE level to be 21.2 per cent for the state, calculated at 10 per cent (Pandey et al., 2018). Another 2018 study has shown that the rate of increase in poverty due to OOP spending is one of the highest for the state (Sangar et al., 2019). For Himachal Pradesh, we observe that most of the available estimates of levels of OOP health expenditure and related disparities in CHE and impoverishment are based on national-level secondary data analysis. However, these mean-centric measures can offer misleading pictures in the face of various inequalities.

In recent years, various initiatives have been taken by the state and the central government to protect households against high OOP expenditures. Some important initiatives include social health insurance schemes such as Pradhan Mantri Jan Arogya Yojana (PMJAY) by the central government and the Mukhya-Mantri Himachal Healthcare Scheme (HIMCARE) by the state government. However, since the launch of such schemes there has been very little or no evidence on the levels of CHE, impoverishment and protection against such payments among rural households.

The present primary study aims to examine the disparities in the prevalence of OOP health expenditure generated CHE and impoverishment among the households in rural areas of Himachal Pradesh. The study provides micro level evidence of health expenditures and the level of protection against such expenditures. The study further provides, contextual determinants at the micro level. These evidence, are important for policy makers to offer improved protection against healthcare expenses. The study also adds to the existing literature of protective and risk factors against high OOP expenditure.

2.2   Literature Review

Several studies on OOP payments and their effects have recently been published in India (Nanda & Sharma, 2023); (Sangar et al., 2019). A recent study in India has shown an increase in CHE

by 2.4 times from 1995 to 2014 (Pandey et al., 2018). Another 2019 study has shown that as
high as 8 per cent of India's population face impoverishment due to high OOP health payments
(Sangar et al., 2019a). In addition, studies have shown households from certain vulnerable
sections of society to be at greater risk of impoverishment than others (Berman et al., 2010;
Sangar et al., 2019a). Also, the levels of CHE and impoverishment have shown a considerable
differential among different states (Ghosh,2011; Pandey et al., 2018). Further, studies show the
inequality in healthcare access and its cost being highest at the regional, district and village lev-
els (Mohanty et al., 2018). Many studies find households in rural areas being more vulnerable to
catastrophe and impoverishment than their urban counterparts (Berman et al., 2010; Ladusingh
& Pandey, 2013).

In addition, some studies have further studied the determinants of catastrophic and impov-
erishing health expenditure. The studies show that the impoverishment is higher in homes with
older members, patients with chronic conditions, and members of lower socioeconomic groups
(Ahmed et al., 2022). Studies have also revealed a strong link between the traits of the head
of the household and impoverishment (Van Minh et al., 2013). Studies showed that households
with less educated and female heads had a higher risk of impoverishment (Choi et al., 2016).
Regarding the household's residence, studies have shown that rural homes are more susceptible
to developing CHE (Van Minh et al., 2013). While some studies have demonstrated a consider-
able impact of health insurance on CHE (Buigut et al., 2015), some studies in India have shown
contradictory results (Prinja et al., 2017).

2.3   Data & Methodology

2.3.1   Data

The current study relies on primary data collected from rural areas of a Himalayan state in In-
dia. The study uses data from 300 households selected from two districts of Himachal Pradesh.
The two districts are chosen based on their ranking in the healthcare infrastructure index. The
healthcare infrastructure index is computed using the availability of doctors, nurses, other med-

ical staff, beds, and medical institutions per thousand population. However, the districts of Kinnaur, Lahaul and Spiti are excluded due to their complex geographic features. Among the remaining districts, Solan, ranking first, and Sirmaur, ranking last, are selected. Further, different blocks in these two districts are also ranked based on the availability of health infrastructural facilities. Finally, the first ranking block from the Solan and the block ranking last from Sirmaur are selected for the survey.

A total of 150 households have been surveyed from each block. The following criterion has been used for locating and identifying the sample households. The households are selected based on their self-reported use of outpatient care during the last month and inpatient care in the previous year. The households are identified through visits to different panchayat headquarters and interaction with different panchayat officials, village-level health workers and other key informants. Starting from the largest panchayat in the block, we kept searching until the required number of 150 households are interviewed. The households with maternity-related expenses are not considered for the study. The data on socioeconomic and demographic characteristics, consumption expenditure; insurance coverage; health and healthcare-related expenditures are collected from the households using a pretested questionnaire. The study uses consumption expenditure as a proxy for income; the recall period is 30 days for the same.

2.3.2 Method

Catastrophic health expenditure

The study uses the methodology suggested by Wagstaff & Doorslaer,2003). Any OOP expenditure turns catastrophic when it exceeds a certain threshold (Z) of total consumption expenditure (TCE). Although there are no universally accepted thresholds, we study the financial burden of OOP payments at two popular thresholds, i.e., 10 per cent and 25 per cent of TCE. The catastrophic payment headcount (HC) measures the percentage of sample households incurring catastrophic health expenditure (CHE).

The headcount index (HC) is defined as:

$$HC = \frac{1}{N} \sum_{i=1}^{N} K$$

where K represents an indicator function, defined as:

$$K = \begin{cases} 1 & \text{if } \frac{T_i}{X_i} > Z \\ 0 & \text{otherwise} \end{cases}$$

Here, N is the sample size, X_i represents the consumption expenditure of person i, T_i is the out-of-pocket (OOP) expenditure of person i, and Z is the threshold.

Poverty Line and Impoverishment

The impoverishment effect due to OOP health expenditure is calculated in terms of poverty headcount as the difference between pre-payment and post-payment impoverishment. The poverty headcount (PHC) measures the proportion of the population falling below the poverty line.

$$PHC = HC_{\text{Post}} - HC_{\text{Pre}}$$

where PHC is the poverty headcount, HC_{Post} is the post-poverty headcount, and HC_{Pre} is the pre-poverty headcount.

Let Z_{Pre} be the pre-payment poverty line. Then,

$$HC_{\text{Pre}} = \frac{1}{N} \sum_{i=1}^{N} P_{\text{Pre}}, \quad \text{where } P_{\text{Pre}} = 1, \text{ if } x_i < Z_{\text{Pre}}$$

where x_i is the individual i's pre-payment income, and P_{Pre} is the pre-payment poverty headcount. Similarly,

$$HC_{\text{Post}} = \frac{1}{N} \sum_{i=1}^{N} P_{\text{Pre}}, \quad \text{where } P_{\text{Pre}} = 1, \text{ if } (x_i - \text{OOP}) < Z_{\text{Pre}}$$

For the measurement of poverty, the study uses the state poverty line (SPL) as per Tendulkar committee estimates. The poverty line is established in terms of per capita consumption or spending on a basket of essential items during a certain period. The methodology gives different poverty level estimates for the rural and urban populations. Here, the study uses the rural poverty line of Indian national rupees (INR) 913 (RBI, 2020). The impoverishment effect of OOP healthcare payments is measured as the change in poverty headcount calculated using household's total consumption expenditure with and without OOP payments (O'Donnell et al., 2007). Therefore, a household that is not already poor becomes one if OOP health expenses cause it to fall below the poverty threshold.

Logistic regression analysis

The study uses multiple logistic regression models to study the effect of factors associated with impoverishment. Based on the literature and our own experiences, we first identified various covariates of catastrophic health expenditure. The covariates we used are socioeconomic characteristics of the head (gender, age, education, earning); characteristics of the household (family size, elders, minors, social and economic category); characteristics of the patient (gender, type, insurance, disease); location and type of the facility etc. The model is specified as follows:

$$\text{logit}(Y_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \varepsilon_i$$

where $i = 1, 2, 3, \ldots, n$,

- Y_i represents the dependent variable with values of either 0 (household not facing impoverishment) or 1 (household facing impoverishment), - β_0 is a constant, - $X_{1i}, X_{2i}, \ldots$ denote the predictor variables, - $\beta_1, \beta_2, \ldots$ represent the coefficients of respective independent variables, and - ε_i represents the error term.

Odds ratios are calculated to study the relationship between dependent and independent variables. The following steps have been followed to choose the most significantly associated explanatory variables. First, we summarise the characteristics of all households and their district-wise distribution. We identify 15 potential covariates based on the available literature

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and our own understanding. Secondly, we have checked for association between each identified covariate and the outcome variable and advanced those variables that are statistically significant for p<0.10 To determine the statistical significance a chi-square test, and t-test are used. Thirdly, we have tested for collinearity among variables and variables correlated with r>0.6 are identified, and the collinear covariates are removed. Among them, only ones more strongly associated with the outcome variable are retained. Finally, logistic regression is applied to study the determinants of impoverishment.

2.4 Data analysis and Interpretation

2.4.1 Characteristics of households

Table 2.1 gives information about selected household characteristics from both districts of the state. For Sirmaur, in terms of characteristics of the head, it is observed that a male member heads most households (80.67 per cent). The head of a household is mostly (78 per cent) an earning member and is rarely elderly (32 per cent). On average, the head of a household has 6.36 years of formal education. The family characteristics of households show that only 36.67 per cent of families have one or more elderly members and only 22.67 per cent of families have members below five years of age. While only 12 per cent of families live below the poverty line, the distribution of consumption expenditure looks skewed as 71.33 per cent of households belong to the bottom half of consumption quartiles. The table shows 36 per cent of families belonging to either one or the other reserve categories. Interestingly, 56 per cent of sample households have some form of health insurance. The average family size in Sirmaur looks on the larger side, as 47.79 per cent families have over six members. The table further show that 63.33 per cent households in Sirmaur district received outpatient treatment and 35.33 per cent are suffering from chronic diseases. While 75.33 per cent of households use public healthcare facilities, 33.67 per cent of patients visited other districts to seek treatment.

In comparison, slightly lesser, that is 75.33 per cent households are headed by a male member in Solan. In 44.67 per cent of sample households, the head of the household is an elderly

person and 80.67 per cent of heads are earning members in Solan. The household heads have a mean of 7.67 years formal education. In terms of the family characteristics of the households, it is observed that 50.67 per cent of households in Solan have at least one elderly member, and only 16 % of families have at least one member below five years of age. The consumption expenditure in Solan looks on the higher side, as 70.1 per cent of families lie on the upper half of consumption expenditure quartiles and 20 per cent families reported living below poverty line.

The table 2.1 shows 24.67 per cent families belong to some reserved category. In Solan, 59.33 per cent families report being insured under some type of health insurance. Family sizes seems smaller as 50 per cent families have up to 4 members only. Opposite to Sirmaur, in Solan 72 per cent families report using inpatient care and 42.67 per cent families have at least one member suffering from chronic disease. While 65.33 per cent families use public healthcare services, 41.33 per cent families report visiting other states for treatment.

Table 2.1: Overall and district wise breakdown of selected characteristics of sample households (in percentage)

Characteristics Solan (%)	Variable	Definition	Category	Total (%)	Sirmaur(%)
Head	Head is elderly	Yes	38.33	32	44.67
	Head is earning	Yes	79.33	78	80.67
	Gender of Head	Male	79	80.67	77.33
	Head's education years	Years	7.01	6.36	7.67
Family	Family members above 58	Yes	43.67	36.67	50.67
	Family members below 5	Yes	19.33	22.67	16
	Economic category	BPL	16	12	20
	Consumption expenditure quartiles	Poor	26	31.33	20.67
		Not-so-poor	24.67	40	9.33
		Not-so-rich	24.33	18	30.67
		Rich	25	10.67	39.33
	Insurance	Yes	57.67	56	59.33
	Family size	Upto 4	35.81	21.24	50
		5 to 6	32.75	30.97	34.48
		Above 6	31.44	47.79	15.52
	Social category	Unreserved	69.67	64	75.33
Patient	Patient Type	Outpatient	45.67	63.33	28
	Chronic ailment	Yes	39	35.33	42.67
	Healthcare facility	Public	70.33	75.33	65.33
	Location	Same district	48.33	52	44.67
		Other district	39	36.67	41.33
		Other state	12.67	11.33	14

2.4.2   Catastrophic Health Expenditure and Impoverishment Effects

Table 2.2 presents the presence CHE and level of impoverishment in both districts, and its distribution among households in different consumption quartiles. In Sirmaur, the households in the rich consumption quartile face the least percentage of CHE. In contrast, in Solan, the households from the not-so-poor consumption quartile constitute the least percentage of households with CHE.

The table 2.2 also shows the overall level of impoverishment among households in the two districts. In Sirmaur district, 25.33 per cent of sample households experience due to OOP health expenditures. Among those facing impoverishment, around 79 per cent belong to the poor and not-so-poor consumption quartiles. No households from rich consumption quartile face impoverishment in Sirmaur. In Solan district, 16 per cent of the sample population experience impoverishment. Among households impoverished by OOP expenditure, 50 per cent are from the poor consumption quartile, while others are almost equally distributed.

Table 2.2 Consumption quartile-wise distribution of households facing catastrophic health expenditure (CHE) and impoverishment across the two districts.

Table 2.2: Catastrophic Health Expenditure and Impoverishment by Quantile

	Catastrophic at 10%			Catastrophic at 25%			Impoverishment		
	Sirmaur	Solan	Total	Sirmaur	Solan	Total	Sirmaur	Solan	Total
Overall	70	69.33	69.67	38.67	34.67	36.67	25.33	16	20.67
Poorest	30.48	25	27.75	25.86	26.92	26.36	34.21	50	40.32
Second	40	7.69	23.92	39.66	7.69	24.55	44.74	16.67	33.87
Third	19.05	30.77	24.88	25.86	26.92	26.36	21.05	12.5	17.74
Richest	10.48	36.54	23.44	8.62	38.46	22.73	0	20.83	8.06

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2.4.3 Identification of determinants of impoverishment using bivariate and correlation analysis

To identify the determinants of impoverishment, a bivariate analysis was undertaken. From the bivariate analysis in, we identify various variables significantly associated with the outcome variable. The characteristics significantly associated in either one or both the districts are: Head being elderly; head is earning; gender of the head; education years of the head; family members above 58; the consumption expenditure quartile; level of health insurance; family size; patient type; members suffering from chronic disease; type of healthcare facility; location of facility. The characteristics like social category, economic category and having members below five years of age were not significantly associated at the chosen p-value.

Following the bivariate analysis, the identified variables are then tested for collinearity in each model, using Pearson's R test, at r>0.6. From the collinearity matrix, the variables highly correlated with each other were identified and one of them, usually the least associated one, is dropped. Two significant variables (members above 58, gender of head) are then dropped from the list of covariates. This procedure gives us the list of potential non-collinear variables for multivariate analysis.

2.4.4 Determinants of impoverishment

Table 2.3 shows the determinants of impoverishment using the state poverty line for rural areas. For households in Sirmaur district, the results of the model show that if the head of the household had more than four years of education, it is less likely to face impoverishment (OR=0.85). In households with one or more members below five years of age were more likely (OR=3.20) to face impoverishment than those with no members below five years.

Further, households with members seeking outpatient care are more likely (OR=13.20) to face impoverishment. Similarly, households with at least one member suffering from a chronic disease are more likely (OR=4.57) to face impoverishment. Also, for households, with at least one member travelling to other districts (OR=5.73) and other states (OR=21.57) for treatment were more likely to impoverish, compared to those seeking treatment in their home district.

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For sample households in Solan district, the results of the model showed that, for house-holds having at least one member below five years of age are more likely (OR=4.48) to face impoverishment. Further, households in the not-so-rich and rich consumption quartiles face (OR=0.07 and 0.12 respectively) were less likely to impoverish when compared to those from the poor consumption quartile. Also, households with at least one member receiving outpatient care were more likely (OR=5.77) to impoverish than those seeking inpatient care. Similarly, for households with at least one member treated at a public facility were more likely (OR=4.56) to impoverish than those treated at a private facility.

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Table 2.3: Characteristics associated with impoverishment related to OOP spending

Characteristics	Sirmaur			Solan		
	Coeff	OR	CI	Coeff	OR	CI
Head is elderly = Yes	0.43	1.53	0.28 - 8.32	0.45	1.57	0.37 - 6.64
Head is earning money = Yes	0.67	1.95	0.54 - 7.05	0.51	1.67	0.53 - 5.23
Education years of the head	-0.16**	0.85**	0.73 - 0.99	-0.02	0.98	0.86 - 1.12
Member below 5 = Yes	1.16*	3.20*	0.88 - 11.62	1.50**	4.48**	1.10 - 18.33
Consumption exp. = Not-so-poor	-0.32	0.73	0.23 - 2.28	-0.34	0.71	0.12 - 4.16
Consumption exp. = Not-so-rich	-1.17	0.31	0.05 - 1.80	-2.72***	0.07***	0.01 - 0.34
Consumption exp. = Rich				-2.16***	0.12***	0.03 - 0.45
health insurance = Yes	0.56	1.75	0.58 - 5.29	0.34	1.4	0.45 - 4.35
Patient type = Outpatient	2.58***	13.20***	3.48 - 50.01	1.75***	5.77***	1.74 - 19.13
Chronic disease = Yes	1.52***	4.57***	1.64 - 12.77	0.46	1.59	0.55 - 4.61
Healthcare facility = Public	0.27	1.31	0.42 - 4.09	1.52*	4.56*	0.93 - 22.27
Hospital = Other district	1.75***	5.73***	1.56 - 20.96	0.12	1.12	0.34 - 3.65
Hospital = Other state	3.07***	21.57***	3.35 - 138.98	0.37	1.45	0.21 - 9.80
Constant	-4.68***	0.01***	0.00 - 0.16	-3.42***	0.03***	0.00 - 0.44
Observations	134			150		

Note: Data from field survey conducted by author. *** p<0.01, ** p<0.05, * p<0.1

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2.5   Discussion and Suggestions

The present study provides evidence on the magnitude of the OOP payments; their catastrophic and impoverishing effect on; and their determinants in rural households of Himachal Pradesh, India. The study also yields insight into the level of financial protection the healthcare system offers and its barriers.

Using the state poverty line for rural areas for the state, we measure the OOP-related impoverishment risk in Himachal Pradesh, India. We find 25 per cent of the sample households in Sirmaur district (lowest available public infrastructure) and 16 per cent sample in Solan district (highest available public infrastructure) face impoverishment risk due to OOP health expenditure. Different studies have also measured poverty using international poverty lines (Sharma et al., 2017). We find households with members using outpatient care, and those having larger family sizes face higher risk of impoverishment in both study areas. A similar finding is also reported by (Kumar e al., 2015). Whereas for households in rich consumption quartile the risk of impoverishment is lower. This finding is similar to (Li et al., 2012).

Those households in Sirmaur who travel to other districts and states for treatment and suffer from chronic diseases, face higher risk of impoverishment, whereas households with heads having at least four years of formal education face lesser risk of impoverishment. These results are also corroborated by other studies like (Kumar et al. 2015). Similarly for households in Solan district, who seek care in a public hospital and has family size more than five, face higher risk of impoverishment.

The present study has certain data-related limitations. The study uses cross-sectional data and can only give a point estimate of CHE and impoverishment; and cannot estimate what percentage of households face persistent impoverishment. We also observe exaggeration of healthcare expenditure by the respondents. Also, the timing of the study, which takes place soon after the covid-19 disruptions can affect the results of the study.

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2.6 Conclusion

The present study examines the levels of impoverishment from out-of-pocket health payments and their determinants in Himachal Pradesh. The study draws attention towards addressing some significant healthcare-related covariates for improving financial protection. The study finds households with patients seeking outpatient care at greater risk of experiencing OOP related impoverishment. In addition, the households with patients undergoing treatment for chronic disease are also at higher risk. Travelling to a health facility is an important covariate of the impoverishment risk (especially in a low infrastructure location). The needs of outpatients and chronic disease patients must be addressed either via social health insurance or other systemic means. While taking policy decisions the government should pay more attention to addressing healthcare needs at local levels. This requires a multifaceted approach, which involves the rationalisation and expansion of public healthcare infrastructure. The increasing role of social health insurance and the participation of private players are steps in the right direction. The involvement of private players can fill the gaps and protect households from long and expensive travel for treatment.

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Chapter 3
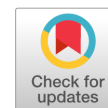
Evaluating the Guidance Needs of Secondary School Students: An Empirical Investigation in Shimla City of Himachal Pradesh, India

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Abstract: The contemporary world is undergoing rapid transformations, leading to intricate challenges such as conflicts, frustration, and unhealthy competition. These complexities contribute to a value crisis within the social system, affecting personal values, family dynamics, and fostering maladjustment among adolescents. Against this backdrop, the present research delves into the guidance needs of secondary school students in Shimla city. The study uses a descriptive research design, employing the Guidance Need Inventory (GNI) for data collection. The study encompasses the entire student population of arts and science streams of Government Senior Secondary Schools operating in Shimla city, with a sample size of 240 students selected through a simple random sampling technique. Descriptive statistics reveal uniformly high levels of guidance needs across all areas for all students.

Intriguingly, the results indicate that guidance needs do not significantly differ based on gender and academic stream, except for the sociological part in relation to their stream. The findings underscore the pressing need for guidance programs within schools, emphasizing the importance of employing trained professionals to address the diverse and high-level guidance needs of students. In light of the ever-evolving challenges in today's society, the study con-

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tributes valuable insights into crafting targeted interventions that can positively impact the physical, social, psychological, educational, and vocational development of students, fostering their overall efficiency and well-being.

Keywords: Guidance Need, Secondary School, Student, Shimla, Himachal Pradesh

3.1   Introduction

In the dynamic landscape of contemporary education, the holistic development of students stands as a paramount concern, requiring a nuanced understanding of their guidance needs. The intricacies of the modern world, marked by rapid societal changes, technological advancements, and evolving career landscapes, have given rise to multifaceted challenges affecting the academic, social, psychological, and vocational dimensions of students' lives. Recognizing the imperative role of guidance in navigating these complexities, this research delves into the comprehensive exploration of the guidance needs of school students.

The term 'guidance needs' encapsulates a spectrum of requirements extending beyond traditional academic support. It encompasses the students' quest for direction in educational pursuits, assistance in navigating intricate career pathways, and support in managing the multifarious challenges associated with personal development and social interactions. As students grapple with an ever-expanding array of choices, societal expectations, and personal aspirations, the role of guidance becomes pivotal in fostering their resilience, adaptability, and overall well-being.

This research is not merely an exploration of theoretical constructs; rather, it aspires to unravel the practical dimensions of guidance needs through empirical investigation. By focusing on school students, the study homes in on a critical phase of development where individuals shape their identities, formulate academic goals, and begin to discern the contours of their future careers. Understanding the intricacies of guidance needs during this pivotal period holds profound implications for the efficacy of educational systems, the well-being of students, and the broader societal fabric.

To navigate the complexities of this inquiry, the research employs a descriptive research

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design, aiming to provide a comprehensive and detailed account of the guidance needs prevalent among school students. Through systematic data collection and analysis, the study aspires to contribute nuanced insights that transcend conventional paradigms, fostering a deeper understanding of the multifaceted dimensions of students' guidance needs. As the educational landscape continually evolves, the findings of this research aspire to inform the development of tailored guidance programs that resonate with the evolving needs of school students, thus helping with their holistic development and ensuring their readiness for the challenges of the future.

3.2   Literature Review

In the evolving landscape of education, understanding the nuanced needs of students has become imperative for crafting effective guidance and counselling programs. This literature review delves into various studies conducted globally, shedding light on the diverse challenges faced by students at different educational levels. A chronological synthesis of these studies reveals overarching trends and specific nuances in different settings.

Bishop et al. (1998) analysed survey data from 803 college students in the United States. The study revealed that over half of students sought help with time management and career uncertainty. Thirty-five to fifty percent needed help with study skills, test anxiety, fear of failure, depression, and anxiety. Gender differences were noted, with females expressing more concern about career choices, life partners, and fear of failure than males. The research highlighted common challenges faced by college students and emphasized gender-based variations.

Güneri et al.(2003) conducted a two-part study of 599 Turkish university students, revealing differing needs based on Grade Point Average (GPA), gender, and age. The research incorporated surveys and interviews with campus counselling staff, highlighting strengths and weaknesses in the existing counselling model. Recommendations included revising the counselling model to enhance coordination and organizational structure.

Watts & Sultana (2004) synthesized three coordinated reviews of national career guidance policies conducted by the Organisation for Economic Cooperation and Development (OECD),

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the European Commission, and the World Bank. The article highlighted differences between high-income and middle-income countries, emphasizing the need for stronger mechanisms within countries to develop a vision and strategy for delivering accessible career guidance throughout individuals' lives. The research underscored career guidance as a public good aligned with policy goals related to learning, the labour market, and social equity.

Kesici, (2007) explored the guidance and counselling needs of middle school students in grades 6-8 using qualitative research methods. Semi-structured interviews with 90 students identified needs related to study skills, exam anxiety, career exploration, and interpersonal issues. Differences emerged by grade, emphasizing the importance of implementing guidance programs tailored to developmental stages.

Kesici (2008) investigated the guidance and counselling needs of 6th, 7th, and 8th grade students in Turkey through interviews with 37 parents. The study identified diverse needs, including effective study methods, motivation, career awareness, social skills, and addressing general adolescent issues. Recommendations focused on starting school counselling programs targeting learning skills, motivation, and career awareness.

Dogar et al. (2011) surveyed 60 secondary school girls in Pakistan to assess their needs across educational, vocational, social, emotional, and behavioural domains. The study identified the highest needs in career choice (45 per cent) and emotional guidance (40 per cent), highlighting the necessity for tailored vocational and emotional counselling programs for this population.

Sculli (2011) discussed the role of needs assessments in comprehensive school counselling programs (CSCPs) and the ASCA National Model in assessing the counselling needs of high school students. The article emphasized the importance of needs assessments in understanding and meeting the counselling needs of high school students.

Ghamari (2013) surveyed 512 secondary school students in Iran, revealing top needs across occupational, educational, physical, psychological, and social domains. The study indicated consistent needs across different academic tracks but identified higher psychological needs among urban students compared to their rural counterparts. The findings suggested the importance of tailoring guidance programs based on subgroup differences.

Parhar et al. (2013) studied the guidance needs of rural and urban secondary school students in Jalandhar district of Punjab state in India. Using the Guidance Needs Inventory (GNI), the research found that rural students exhibited higher mean scores of guidance needs compared to urban students across various areas. The study provided insights into the specific needs of secondary school students in different settings.

Chircu (2014) compared career counselling needs among 962 technical college students in Romania across three academic years. First-year students were primarily interested in further education options, second-year students focused on salaries and work conditions, while third-year students were concerned with finding a job after graduation. The study demonstrated that counselling needs varied based on the students' academic progression.

Valentina & Singh (2014) examined the guidance needs of secondary school adolescents in Imphal district of Manipur state in India, with a focus on gender differences. The research revealed variations in guidance needs between boys and girls, emphasizing the importance of targeted guidance programs to support the overall development of adolescents.

Seeja & Antony (2015) provided a comprehensive overview of research conducted on the identification of guidance needs among higher secondary school students in Kerala. The study used a normative survey method and highlighted significant guidance needs among students, particularly in educational, personal, and vocational domains.

Sharma (2015) investigated the educational guidance needs of 140 elementary school students with learning disabilities in Himachal Pradesh. The study revealed an average level of educational guidance needs among all students, with no significant differences seen between rural and urban students. The findings emphasized the need for comprehensive guidance programs in elementary schools.

Özmen et al. (2016)investigated students' perceptions of counselling services in primary schools, involving 512 fifth-grade students in North Cyprus. The study used a School Guidance Services Scale (SGSS) and highlighted students' perception of insufficient counselling services, emphasizing the need for improvements in primary school counselling.

Valentina & Singh (2016) presented findings from an analytical study conducted in Imphal district of Manipur state in India, analysing the guidance needs of adolescents across differ-

ent education streams. The study involved 600 participants from diverse socio-demographic backgrounds and highlighted a consistent need for guidance in physical, social, psychological, educational, and vocational domains among adolescents.

Negi (2017)investigated the educational and psychological guidance needs of 120 college students in Himachal Pradesh, India. While the study found no significant differences based on gender or area alone, it identified interaction effects between gender and area on both educational and psychological guidance needs. The study emphasized the potential benefits of tailored guidance programs considering gender and background intersections.

Rao (2017)explored the guidance needs of high school students in India, emphasizing the significance of professional guidance in informed decision-making. The study investigated problems faced by students and examined potential influences of familial variables. The research underscored the crucial role of guidance services in mitigating academic difficulties and enhancing overall student well-being.

Balci (2018) conducted a quantitative survey to explore the career guidance needs of 241 middle school students in Turkey. The study identified that over half of students expressed a need for assistance in managing time, dealing with career uncertainty, improving study habits, and handling test anxiety. Additionally, over 35 percent reported requirements for support in addressing fear of failure, depression, anxiety, assertiveness, and other related issues. The findings provided valuable insights into the specific guidance needs of middle school students in Turkey.

Keshf et al. (2012) explored the career guidance and counselling needs of 18 Pakistani undergraduates through in-depth qualitative interviews. Thematic analysis identified seven key needs, including self-awareness, information/guidance, direction, practical exposure, informed decision-making, emotional management, and meeting academic needs. The study emphasized the importance of proactive guidance-seeking behaviour among students and suggested tailored institutional offerings to address identified needs.

Ramli et al. (2021) examined the need for a website-based reality counselling self-help model to alleviate academic stress among high school students in Malang Raya. The study surveyed high school counsellors and identified key characteristics, content, materials, and ob-

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jectives for the proposed model. The findings suggested the necessity of such a model to address academic stress and improve the mental health of high school students.

This chronological review of these studies underscores the complexity of students' guidance needs, the necessity for tailored interventions, and the importance of considering cultural, geographical, and developmental variations in designing effective counselling programs. The collective findings contribute to a nuanced understanding of the challenges faced by students at different educational levels and in diverse geographical contexts, providing a foundation for the development of targeted and comprehensive guidance services.

3.3 Research Methodology

3.3.1 Research Gap

The existing literature reviews primarily focus on higher education institutions and secondary schools in diverse international settings, providing a comprehensive understanding of guidance needs. However, there is a noticeable research gap concerning the specific guidance needs of government secondary school students in Shimla city of Himachal Pradesh in India. The current studies largely omit the unique socio-cultural context, academic environment, and challenges faced by students in this region. A new study in Shimla city could bridge this gap by examining the distinctive needs of government secondary school students, offering targeted insights to enhance guidance programs tailored to their local context, thus contributing to the existing body of knowledge.

3.3.2 Research Objectives

Based on the provided hypotheses, the research objectives of the study are:

1. To investigate and identify the levels of guidance needs among government secondary school students.

2. To assess and compare the guidance needs of government secondary school students in various area of guidance based on their academic streams and gender.

3. To synthesize the findings and offer practical recommendations for the development and implementation of tailored guidance programs in government schools, considering academic streams and gender differences.

These research objectives aim to systematically investigate and analyse the hypotheses, providing a comprehensive understanding of the guidance needs among government school students and informing the development of targeted support initiatives.

3.3.3 Sample Design

The study followed a quantitative approach to research. The targeted population for this study comprised of all students of arts and science streams of Government Senior Secondary Schools in Shimla city. Simple random sampling technique was used to select the sample of 240 students 120 male (60 arts & 60 science) and 120 females (60 arts & 60 science) studying in 12th class from six Government Senior Secondary School of Shimla city of Himachal Pradesh. Table 3.1 describes the sample distribution in the study area.

Table 3.1: School-Stream-Sex wise Distribution of the Sample

Sr. No.	School Name	Arts		Science		Total
		Male	**Female**	**Male**	**Female**	
1	Kasumpati	3	10	4	22	39
2	Sanjauli	7	9	11	11	38
3	Summer Hill	9	12	4	6	31
4	Totu	13	19	11	11	54
5	Phagli	9	10	10	10	39
6	Lal Pani	19	-	20	-	39
	Total	60	60	60	60	240

Source: Field Survey.

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3.3.4 Data Collection and Analytical Tools

Data was collected via interview method in September 2023. For the collection of data Guidance Needs Inventory (GNI) developed by Grewal (1982) was used to identify the strength of guidance needs of individual in five areas, namely physical, sociological, psychological, educational and vocational. For data entry and analysis, Microsoft Excel and IBM SPSS Statistics have been used respectively. Descriptive as well as inferential statistics has been used to analyse the processed data. Analysed data has been presented in the cross-tabular form.

3.4 Results and Discussion

3.4.1 Identifications of Level of Guidance Needs among Students regarding their Stream and Sex

Table 3.2 reveals significant variations in guidance needs among students of arts and science streams across various areas. In the arts stream, most students require guidance in educational (57.5%) and vocational (57.5%) areas, followed by sociological (50%) and psychological (50%) areas. Physical guidance needs are relatively lower (44.2%). In comparison, science students exhibit a higher need for guidance in sociological (37.5%) and psychological (37.5%) aspects. Educational (58.3%) and vocational (54.2%) guidance needs are also substantial. However, physical guidance requirements are significantly lower (6.7%). Interestingly, both streams show a minimal need for very low-level guidance across all areas.

Overall, the findings suggest a crucial role for guidance services in catering to diverse needs of students from different streams. While arts students require more support in educational and vocational areas, science students seek assistance with sociological and psychological aspects. Tailored interventions and resources should be developed to address these specific needs and enhance student well-being and academic success.

Table 3.3 indicates that, for both sexes, most students exhibited low to high guidance needs in all evaluated domains. Around thirty-two to forty-seven percent of males and nearly twenty-

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eight to thirty-eight percent of females showed low level of guidance needs required, while about 42 to 60 percent of males and nearly 45 to 63 percent of females showed the requirement for high level of guidance needs. This suggests that the majority of students, regardless of sex, have modest to substantial advising needs across the board.

However, some variations between sexes emerge within the very low and very high categories. Slightly more females (11.7%) than males (10%) reported very high educational guidance needs. Additionally, nearly twice as many males (18.3%) as females (10.4%) signified very high vocational support required. Yet when viewed comprehensively, both sexes showed largely comparable distributions of predominantly low to high advising necessities in most areas evaluated. Only minor differences were evidenced in the outlier groups, implying that overall guidance needs are relatively similar between male and female students.

Table 3.2: Level of Guidance Needs among Students regarding their Stream

Areas	Stream	Very Low	Low	High	Very High	Total
Physical	Arts	5 (4.2%)	40 (33.3%)	53 (44.2%)	22 (18.3%)	120 (100%)
	Science	8 (6.7%)	42 (35%)	62 (51.7%)	8 (6.7%)	120 (100%)
Sociological	Arts	6 (5%)	45 (37.5%)	60 (50%)	9 (7.5%)	120 (100%)
	Science	18 (15%)	46 (38.3%)	45 (37.5%)	11 (9.2%)	120 (100%)
Psychological	Arts	8 (6.7%)	48 (40%)	60 (50%)	4 (3.3%)	120 (100%)
	Science	11 (9.2%)	54 (45%)	45 (37.5%)	10 (8.3%)	120 (100%)
Educational	Arts	1 (0.8%)	38 (31.7%)	69 (57.5%)	12 (10%)	120 (100%)
	Science	2 (1.7%)	34 (28.3%)	70 (58.3%)	14 (11.7%)	120 (100%)
Vocational	Arts	3 (2.5%)	29 (24.2%)	69 (57.5%)	19 (15.8%)	120 (100%)
	Science	8 (6.7%)	31 (25.8%)	65 (54.2%)	16 (13.3%)	120 (100%)
Overall	Arts	1 (0.8%)	35 (29.2%)	74 (61.7%)	10 (8.3%)	120 (100%)
	Science	2 (1.7%)	43 (35.8%)	71 (59.2%)	4 (3.3%)	120 (100%)

Source: Authors' own calculations. Note: Percentages are given in parentheses.

While some small variances exist between sexes in the very low and very high categories for certain domains, the majority of both male and female students signify remarkably analogous

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guidance support levels across physical, sociological, psychological, educational, vocational, and overall needs. The bulk of both sexes demonstrate low to high level of guidance needs required, with only subtle differences in the extremes.

Table 3.3: Level of Guidance Needs among Students regarding their Stream

Areas	Stream	Very Low	Low	High	Very High	Total
Physical	Arts	5 (4.2%)	40 (33.3%)	53 (44.2%)	22 (18.3%)	120 (100%)
	Science	8 (6.7%)	42 (35%)	62 (51.7%)	8 (6.7%)	120 (100%)
Sociological	Arts	6 (5%)	45 (37.5%)	60 (50%)	9 (7.5%)	120 (100%)
	Science	18 (15%)	46 (38.3%)	45 (37.5%)	11 (9.2%)	120 (100%)
Psychological	Arts	8 (6.7%)	48 (40%)	60 (50%)	4 (3.3%)	120 (100%)
	Science	11 (9.2%)	54 (45%)	45 (37.5%)	10 (8.3%)	120 (100%)
Educational	Arts	1 (0.8%)	38 (31.7%)	69 (57.5%)	12 (10%)	120 (100%)
	Science	2 (1.7%)	34 (28.3%)	70 (58.3%)	14 (11.7%)	120 (100%)
Vocational	Arts	3 (2.5%)	29 (24.2%)	69 (57.5%)	19 (15.8%)	120 (100%)
	Science	8 (6.7%)	31 (25.8%)	65 (54.2%)	16 (13.3%)	120 (100%)
Overall	Arts	1 (0.8%)	35 (29.2%)	74 (61.7%)	10 (8.3%)	120 (100%)
	Science	2 (1.7%)	43 (35.8%)	71 (59.2%)	4 (3.3%)	120 (100%)

Source: Authors' own calculations. Note: Percentages are given in parentheses.

3.4.2   Comparison of Guidance Needs of Students regarding their Stream and Sex

Table 3.4 reveals a nuanced picture of student guidance needs based on their chosen academic stream. Significant differences emerged in the areas of sociological and educational guidance. Arts students reported significantly higher perceived need for sociological guidance (M = 32.21) compared to science students (M = 29.28), t(238) = 2.19, p < 0.05. In contrast, science students expressed slightly higher needs for educational guidance (M = 43.93) compared to arts students (M = 43.19), though this difference was not statistically significant. No significant differences

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were observed in the remaining areas of physical, psychological, and vocational guidance needs between the two groups.

Table 3.4: Comparison of Guidance Needs of Students regarding their Stream

Areas	Stream	N	M	SD	SEM	t-value
Physical	Arts	120	23.17	6.98	0.64	1.80
	Science	120	21.59	6.58	0.60	
Sociological	Arts	120	32.21	9.04	0.83	2.19**
	Science	120	29.28	11.50	1.05	
Psychological	Arts	120	27.04	8.02	0.73	1.14
	Science	120	25.79	9.01	0.82	
Educational	Arts	120	43.19	11.25	1.03	-0.50
	Science	120	43.93	11.52	1.05	
Vocational	Arts	120	18.98	4.95	0.45	0.19
	Science	120	18.85	5.80	0.53	
Overall	Arts	120	144.59	33.92	3.10	1.13
	Science	120	139.44	36.67	3.35	

Significant at ***1%, **5%, and *10%. $\alpha = 0.05$ and d.f. = 238. N = Number of Observations, M = Mean, SD = Standard Deviation, and SEM = Standard Error of Mean. Source: Authors' own calculations.

Overall, the data suggests that while both arts and science students require guidance across various domains, their specific needs may differ depending on their chosen stream. Further investigation is needed to understand the factors underlying these differences and tailor guidance programs. Table 3.5 compares the guidance needs of students regarding their sex. No significant differences were found between males and females in all five areas of guidance needs. The t-values ranged from -0.38 to 1.29, which are all well below the critical value of 1.97 at $\alpha = 0.05$ with 238 degrees of freedom. This suggests that the observed differences between males and females are likely due to chance and not indicative of any true gender-related differences in guidance needs.

Students from arts and science streams exhibit distinct guidance needs. Arts students re-

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quire more support in educational and vocational areas, but science students seek help with sociological and psychological aspects. Overall, the majority of both arts and science students have low to high guidance needs across various domains.

Gender also plays a role in shaping guidance needs, although the differences are more subtle. While males show slightly higher needs for vocational guidance and females for educational support, these discrepancies are minor and not statistically significant. Both male and female students show comparable distributions of guidance needs, with most requiring low to high levels of support across all assessed areas.

These findings highlight the importance of tailoring guidance services to cater to the diverse needs of students from different academic streams and sexes. Further research is necessary to understand the underlying factors influencing these variations and develop more effective and personalized interventions.

Table 3.5: Comparison of Guidance Needs of Students regarding their Sex

Areas of Guidance Needs	Sex	N	M	SD	SEM	t-value
Physical	Male	120	22.93	6.40	0.58	1.24
	Female	120	21.83	7.18	0.66	
Sociological	Male	120	31.21	10.10	0.92	0.69
	Female	120	30.28	10.77	0.98	
Psychological	Male	120	26.21	8.21	0.75	-0.38
	Female	120	26.63	8.87	0.81	
Educational	Male	120	44.50	11.49	1.05	1.29
	Female	120	42.62	11.22	1.02	
Vocational	Male	120	19.06	5.74	0.52	0.41
	Female	120	18.78	5.02	0.46	
Overall	Male	120	143.90	34.45	3.15	0.83
	Female	120	140.13	36.26	3.31	

Significant at ***1%, **5%, and *10%. $\alpha = 0.05$ and d.f. = 238.Source: Authors' own calculations.Note: N = Number of Observations, M = Mean, SD = Standard Deviation, and SEM = Standard Error of Mean.

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3.5   Conclusion

The findings of the study shed light on the significant and uniform high-level guidance needs among secondary school students in Shimla city. Notably, both male and female students in government schools exhibit similar levels of guidance needs across various domains, highlighting a shared need for comprehensive guidance despite gender. The guidance needs are consistently similar across academic streams, except in the sociological area, suggesting a nuanced aspect of divergence based on the chosen stream.

Based on the insights derived from this research, several recommendations can be proposed to enhance the guidance and counselling landscape in schools. Foremost, school organizations should actively advocate for and recommend suitable programs to policy planners. These programs should ensure the longevity and effectiveness of guidance initiatives within educational institutions. To achieve this, the employment of trained professionals is crucial. These professionals should not only possess the qualifications but should also be provided with the requisite facilities and structural support to effectively manage and deliver guidance services in schools.

Recognizing the importance of informed decision-making in academic and vocational pursuits, students should be equipped with exhaustive and up-to-date information about new courses and their future prospects. Dissemination of this information can be achieved through collaboration with state governments and leveraging mass media channels such as radio, television, and bulletins. Additionally, organizing seminars, discussions, and orientation programs for students focused on educational and vocational interests can prove instrumental. These initiatives have the potential to enhance students' self-concept, stimulate their interests, and ultimately contribute to their overall personal and academic development.

In essence, implementing these suggestions can pave the way for a more robust and effective guidance framework in schools, addressing the diverse needs of students and preparing them for a successful and fulfilling future.

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Chapter 4

Delving into the Cinematic Representation of the Nexus between Gender Dynamics, Social Entrepreneurship and Sustainability in India

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Abstract: This study aims to present a comprehensive examination of the cinematic representation of the nexus between gender dynamics, social entrepreneurship, and sustainability in India. Previous researchers have widely documented that cinema across the globe has been a powerful medium that both reflects and influences societal norms, perceptions, beliefs, and values. Over the years, Indian cinema has also witnessed a significant transformation in the portrayal of gender dynamics. From traditional gender roles and stereotypes, there has been a shift towards more inclusive and progressive narratives that challenge the status quo. The changing gender dynamics in Indian cinema are a testament to the evolving role of women in society. From traditional, submissive roles, Indian films have moved towards portraying women as strong, independent, self-reliant, and multifaceted individuals. While challenges remain, the impact of these portrayals on society is undeniable, and Indian cinema continues to play a pivotal role in advocating for gender equality, entrepreneurship, and sustainability in the country. This study explores the cinematic depiction of changing gender dynamics, social entrepreneurship, and sustainability in Indian cinema by focusing on the evolution of women's roles and the representation of gender diversity and empowerment. **Keywords**: Gender, sustainability,

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entrepreneurship, India

4.1   Introduction

The relationship between gender dynamics, social entrepreneurship, and sustainability is complex and multifaceted (Majeed, 2016; Bhatia, 2021; Arumugam et al., 2022). Each of these elements influences and is influenced by the others, creating a dynamic interplay that can have significant implications for societal development, women empowerment, and familial well-being (Ratten, 2020). Past researchers have defined gender as a social construct which involve the roles, behaviors, and expectations society attributes to individuals based on their perceived gender (Majeed, 2016; Lister, 2023). These dynamics can influence how people engage with and impact the environment, hence, gender dynamics also play a crucial and decisive role in shaping the landscape of social entrepreneurship (Ratten, 2020; Thangaraja et al., 2022). Ensuring gender diversity in the entrepreneurial ecosystem is not only a matter of social justice but also has practical implications (Bhatia, 2021). Diverse teams bring a variety of perspectives and ideas, which can enhance the effectiveness and creativity of social enterprises. Further, the social entrepreneurs often identify and address some gender-specific societal challenges such as gender-based violence, lack of access to education for girls, and unequal economic opportunities, are common focus areas for many social enterprises (Majeed,2016; Bhatia, 2021). By addressing these issues, social entrepreneurs generously contribute to gender equality and empowerment. Similarly, recognizing the role of women in sustainability is crucial. Women often bear the brunt of environmental degradation and are simultaneously powerful agents of change.

Cinema serves as a mirror to society, reflecting its joys, struggles, and complexities. Through films, the audience witness stories that resonate with their own experiences thereby making them feel connected and understood. It portrays diverse cultures, lifestyles, and issues, promoting audience empathy and understanding. Many movies promote awareness, cultural exchange, and inspire change by depicting historical injustices by addressing political and social issues, shedding light on topics like reality checks of the country, poverty, discrimination, and inequality. Cinema also has the power to influence culture by shaping our beliefs and values, often

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blurring the line between fiction and reality. Keeping this discussion in context, present study is undertaken to comprehend the cinematic representation of the nexus between movies, gender dynamics, social entrepreneurship, and sustainability through a Bollywood movie "Sui Dhaaga: Made in India". The understanding and addressing these connections will guide the concerned agencies to foster holistic approaches to societal challenges that promote equality, environmental stewardship, and sustainable development.

4.2 Literature Review: Cinematic narratives as catalysts for change

The advancements in technology have revolutionized the film industry, making it easier for diverse voices and stories to be heard (Majeed, 2016; Bhatia, 2021; Arumugam et al., 2022). Streaming platforms like Netflix and Amazon Prime have democratized access to filmmaking and widened the reach of impactful narratives (Ratten, 2020; Bhatia, 2021). Cinema, as both a reflection and influencer of society, continues to inspire change and shape culture with its unique ability to ignite conversations, challenge perceptions, and evoke emotions that lead to real-world actions (Arumugam et al.,2022). The impact of cinema on society will undoubtedly remain a dynamic force, inspiring generations to come. By embracing the power of storytelling, filmmakers have the potential to drive positive change and contribute to a more empathetic, inclusive, and culturally rich society. Movies often depict social issues and injustices, inspiring social entrepreneurs to address these problems creatively. Movies play a crucial role in shaping perceptions of gender roles and identities. The portrayal of men and women in cinema can either reinforce traditional stereotypes or challenge and redefine them. Analyzing gender representation in films helps understand societal attitudes and expectations. Cinematic narratives can serve as a catalyst for individuals to embark on ventures aimed at positive social impact. Several filmmakers and actors use their platforms to raise awareness about social and environmental issues, supporting social entrepreneurship initiatives (Thangaraja et al., 2022). This can contribute to building a culture of social responsibility and conscious consumerism. Similarly, some films directly address environmental challenges, promoting sustainability and ecological

consciousness. These narratives can influence viewers to adopt more sustainable lifestyles and
support eco-friendly initiatives (Mittal, 2020). Further, movies have the power to contribute
to cultural shifts and attitudes towards sustainability. By depicting sustainable practices or the
consequences of unsustainable actions, films can influence societal values and encourage responsible behavior.

Movies have the power to contribute to cultural shifts and attitudes towards sustainability. By depicting sustainable practices or the consequences of unsustainable actions, films can influence societal values and encourage responsible behavior. Films celebrate diverse perspectives by showcasing the intersectionality of gender, social entrepreneurship, and sustainability (Thangaraja et al., 2022). This inclusivity in storytelling helps break down barriers and fosters a more comprehensive understanding of these issues (Arumugam, et al., 2022; Jora et al., 2023). In conclusion, understanding the cinematic take on gender dynamics, social entrepreneurship, and sustainability in Indian context is a rich terrain for exploration. By critically analyzing cinematic narratives and their impact on societal values and behaviors, researchers and advocates can gain valuable insights into fostering positive change in these interconnected realms.

4.3   Research Methodology: Selection of the Movie

Keeping the aim of the present study, i.e., to present a comprehensive examination of the cinematic representation of the nexus between gender dynamics, social entrepreneurship, and sustainability in India, several Bollywood movies were analyzed resulting in the final selection of the film "Sui Dhaaga: Made in India".

"Sui Dhaaga: Made in India" is a Bollywood film released in 2018 that beautifully weaves the tale of entrepreneurship, self-reliance, and the indomitable spirit of the Indian people. Directed by Sharat Katariya and produced by Maneesh Sharma, the film stars Varun Dhawan as Mauji and Anushka Sharma as Mamta, portraying a heartwarming story of a couple who embark on an entrepreneurial journey to break free from the constraints of their mundane lives. The narrative not only entertains but also serves as a source of inspiration for budding entrepreneurs, highlighting the challenges, triumphs, and the essence of 'Made in India' entrepreneurship.

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This movie provides an interesting perspective on the study objectives through its narrative of entrepreneurship, self-reliance, and economic empowerment. For example: (i) the central theme of this movie revolves around Mauji and Mamta's journey to create their own small-scale tailoring business. In doing so, they not only achieve economic independence but also generate employment opportunities for themselves and others in their community; (ii) the film illustrates how entrepreneurship can be a catalyst for economic growth, particularly at the grass-roots level. Mauji and Mamta's venture starts small but eventually grows, contributing to the economic development of their community; (iii) Mauji and Mamta's journey involves acquiring and honing their tailoring skills. The film underscores the importance of skill development and capacity building; (iv) the film depicts how entrepreneurship can be a tool for poverty allevia-tion. Mauji and Mamta's decision to start their own business is motivated by a desire to escape poverty and achieve a better standard of living; (v) this movie challenges traditional gender roles, especially in the context of economic activities. Mamta's active involvement in the tailor-ing business breaks stereotypes and contributes to a more inclusive understanding of economic empowerment; and (vi) while the film primarily focuses on economic sustainability, it indirectly addresses social sustainability by highlighting the positive impact of the tailoring business on the community. Economic growth, when coupled with social considerations, contributes to a more sustainable and inclusive development process.

4.4   Plot Description and Analysis

The movie "Sui Dhaaga - Made in India" is a heart-warming story of pride and self-reliance, which finds its roots in the heart of India and reflects the passion that runs through the veins of every single Indian. Taking the message of "Made in India" forward, the film modestly tries to bring back our traditional art forms and handicrafts in focus. Through Mauji (Varun Dhawan) and his wife Mamta (Anushka Sharma), the film talks about the need of social entrepreneurship as a tool for social and economic development of our artisans, living their life in the margins due to the changing times. Set in a small town in India, the film encapsulates the journey of an honest man from a humble background, who pursues his passion, overcoming all odds and

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soon finds himself on the cover of an international magazine with the world taking note and appreciating his talent. A clean family entertainer, the film emphasizes virtues like honesty, self-respect and community living.

Gender Dynamics and Entrepreneurship - The film portrays traditional gender roles, with Mauji representing the male breadwinner and Mamta as the supportive wife. However, as the narrative progresses, Mamta's role expands beyond the conventional domestic sphere. She becomes an active participant in the entrepreneurial venture, challenging traditional gender norms. This shift reflects the evolving dynamics in which women are increasingly contributing to economic activities and entrepreneurship. The film also underlines the importance of identifying opportunities in adversity. Mauji faces exploitation at his workplace, working tirelessly for meager wages. However, the turning point comes when he decides to take control of his destiny. Recognizing the demand for handcrafted, 'Made in India' products, Mauji and Mamta seize the opportunity to start their own tailoring business. This reflects a crucial entrepreneurial lesson – the ability to identify gaps in the market and transform challenges into opportunities.

Social Entrepreneurship - Mauji and Mamta's journey epitomizes social entrepreneurship at a grassroots level. They start their own tailoring business to become self-reliant, emphasizing community and social impact. The venture not only transforms their lives but also has a positive ripple effect on the people around them. This reflects the core principles of social entrepreneurship, which aims to address societal challenges through innovative and sustainable business models. As Mauji and Mamta embark on their entrepreneurial journey, they encounter numerous challenges that test their resilience. From financial constraints to societal skepticism, the couple navigates the entrepreneurial landscape with determination and innovation. The film emphasizes the power of creativity in overcoming obstacles. Mamta's unique embroidery skills and Mauji's dedication to quality craftsmanship showcase the transformative impact of innovation in business, reinforcing the idea that creativity is a potent tool in entrepreneurial success.

Sustainability in Craftsmanship - While the film doesn't explicitly focus on environmental sustainability, it does highlight the value of traditional craftsmanship. The characters revive the art of handloom and tailoring, emphasizing the importance of preserving and promoting traditional skills. This aspect aligns with a sustainability perspective that values cultural heritage

and sustainable practices, even though the film's primary focus is on economic sustainability. At its core, "Sui Dhaaga" advocates for self-reliance. The protagonists break free from the constraints of their employment and, instead of relying on others, decide to create their own destiny. This message aligns with the broader narrative of promoting entrepreneurship as a means of fostering self-reliance, a concept integral to economic development.

Empowerment and Sustainable Development - The entrepreneurial journey of Mauji and Mamta leads to empowerment on multiple levels. It challenges gender norms, empowers individuals economically, and contributes to the overall development of the community. Empowerment, in this context, is a key component of sustainable development as it seeks to create lasting positive change that benefits individuals and society in the long term. The movie captures the essence of the entrepreneurial spirit that is deeply ingrained in the cultural fabric of India. Mauji, a skilled craftsman working in a nondescript shop, and Mamta, a homemaker with untapped creative potential, symbolize the countless individuals across the country with hidden talents waiting to be unleashed. The film brilliantly showcases how the entrepreneurial flame can be kindled from the most unexpected places, urging individuals to recognize their potential and pursue their dreams.

Community and Social Impact - The success of Mauji and Mamta's venture is not measured solely in financial terms but also in the positive impact on the community. Social entrepreneurship, as depicted in the film, emphasizes the well-being of the community and the creation of social value. This aligns with the broader goals of sustainability, which include social and community development alongside economic and environmental considerations. "Sui Dhaaga" also underscores the significance of community support and collaboration in entrepreneurship. The couple's journey is not a solo endeavor; it is a collective effort that involves the support of family, friends, and the community at large. The film portrays how collaborative efforts and a sense of community can contribute to the success of a business. This aspect resonates with the real-world scenario where thriving entrepreneurial ecosystems are built on a foundation of mutual support and collaboration.

Cultural Context and 'Made in India' theme - The film celebrates the 'Made in India' theme, promoting indigenous craftsmanship and production. This aligns with the global trend

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of consumers preferring locally made and culturally rich products. Mauji and Mamta's venture becomes a symbol of promoting and preserving traditional craftsmanship in the face of globalization.

In summary, "Sui Dhaaga: Made in India" provides a narrative that can be analyzed through the lenses of gender dynamics, social entrepreneurship, and aspects of sustainability. The film portrays a journey of empowerment, challenging traditional gender roles, and fostering economic self-sufficiency at a grassroots level. While the film primarily focuses on economic sustainability, it indirectly touches on the broader themes of social and cultural sustainability through the revival of traditional craftsmanship and community impact. This movie by portraying the transformative power of entrepreneurship in fostering economic independence, generating employment, and contributing to sustainable economic development at the grassroots level, also provides a narrative that aligns with the Goal 8 of the United Nations Sustainable Development Goals (SDGs) which is "Decent Work and Economic Growth."

4.5   Conclusion

The movie Sui Dhaaga: Made in India" not only tells a compelling story of entrepreneurship but also subtly delves into the realm of changing gender dynamics, social entrepreneurship, and sustainability in Indian context. This movie portrays gender equality by challenging traditional gender roles, depicting collaborative entrepreneurship, showcasing shared responsibilities, and illustrating the empowerment of women in both personal and professional spheres. The film contributes to the ongoing discourse on gender equality and serves as a positive representation of how partnerships built on mutual respect and shared aspirations can break down societal stereotypes. The main characters of the movie, Mamta and Mauji embark on their entrepreneurial journey together, breaking away from the conventional gender roles often assigned in Indian society. Mamta's contribution is not limited to the domestic sphere, she actively participates in the tailoring business. The film highlights that entrepreneurship is not exclusive to any gender and success is achievable through collaborative efforts. The film realistically depicts the struggles faced by Mamta and Mauji, portraying challenges that are not gender-specific.

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This approach avoids reinforcing stereotypes and emphasizes that entrepreneurial challenges are universal, irrespective of gender.

The movie sheds light on the traditional craftsmanship of local artisans. Mauji and Mamta's decision to start a tailoring business is not just a personal endeavor but also a means of empowering local artisans who possess valuable skills. By choosing handmade products over mass-produced ones, the protagonists contribute to the preservation of local art and crafts, showcasing the social impact of their entrepreneurial venture. As Mauji and Mamta's business expands, they hire local individuals from their community, contributing to job creation. This aspect aligns with the social entrepreneurship model, which often emphasizes creating opportunities for marginalized or underprivileged communities. The couple's enterprise becomes a source of livelihood for others in their locality, fostering economic growth at the grassroots level. The emphasis on handmade, locally produced goods in the film aligns with sustainable and ethical business practices. Social entrepreneurship often involves a commitment to environmental and social sustainability. Mauji and Mamta's focus on traditional, eco-friendly craftsmanship contributes to sustainable consumption and production patterns.

The movie portrays a sense of community support and upliftment. Mauji and Mamta's success is not isolated; it positively impacts the community around them. This resonates with the social entrepreneurship principle of creating positive change in communities by addressing social issues and improving quality of life. Mauji's decision to break free from exploitative labor practices at his previous workplace aligns with the social entrepreneurship narrative. By establishing their own business, the protagonists take a stand against unfair treatment, contributing to a more just and equitable working environment.

"Sui Dhaaga: Made in India" intertwines the narrative of entrepreneurship with elements of social impact. The film illustrates how a small business, driven by passion and dedication, can contribute to the betterment of society by empowering local artisans, creating employment opportunities, promoting sustainability, and fostering community upliftment. The story of Mauji and Mamta serves as a cinematic example of how entrepreneurship can be a powerful force for positive social change. The film emphasizes the importance of craftsmanship and the pursuit of excellence. Mauji and Mamta prioritize the quality of their products over mass production. This

commitment to quality aligns with sustainability principles, encouraging consumers to value products with longer lifespans and lower environmental impact. Mauji and Mamta source their materials locally, contributing to a reduction in transportation-related carbon emissions. The emphasis on local sourcing aligns with sustainability goals by supporting regional economies and reducing the environmental impact associated with the transportation of materials over long distances.

Social entrepreneurs are often at the forefront of developing innovative solutions to environmental and social challenges. This includes sustainable business models, eco-friendly technologies, and community-driven initiatives that promote both social and environmental well-being. Social entrepreneurship often adopts a "triple bottom line" approach, emphasizing social, environmental, and economic impact. This aligns with the principles of sustainability, seeking to balance the needs of people, the planet, and profit. The movie "Sui Dhaaga: Made in India" transcends the boundaries of entertainment to become a cinematic ode to entrepreneurship. Through Mauji and Mamta's journey, the film imparts valuable lessons about identifying opportunities, embracing creativity, building community support, and ultimately achieving self-reliance. As the characters stitch their dreams into reality, the movie stitches together a narrative that resonates with aspiring entrepreneurs, reminding them that with determination, innovation, and community support, they too can embark on a journey towards success and self-reliance.

The relationship between the concepts examined in this study, i.e., gender dynamics, social entrepreneurship, and sustainability underscores the importance of supportive policies. Governments and organizations that promote gender equality, social entrepreneurship, and sustainable practices create an environment conducive to positive change. In conclusion, the relationship between gender dynamics, social entrepreneurship, and sustainability is intricate and interdependent. By understanding and addressing these connections, we can foster holistic approaches to societal challenges that promote equality, environmental stewardship, and sustainable development.

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Chapter 5

Traditional Social Knowledge: Issues and Challenges in Patenting

Charu Lata Singh [*] iD

Abstract: The traditional social knowledge is the basis of any society. It is the part of the wealth and heritage of any nation. Traditional knowledge is passed on from one generation to the other. And going through the generations, it gets challenged, experimented, adopted, applied and absorbed to become a social knowledge. It gets patronised many a times by the indigenous societies to take the shape of traditions through the prevailing regimes. Many a times such practices over the period of time may get termed as primitive against the experimented scientific and technological advancements; and the rich knowledge embedded in traditions and cultures may get totally denounced or ignored or may get encroached upon. The threat of encroachment is reflected in misuse of it through obtaining patents presenting the old knowledge in new garbs. It is important that such references of 'Indigenous Scientific Tempers' and 'Social Knowledge' are ?Protected and Preserved? against the 'Patenting Regimes'. Many a times the developing countries remain at the receiving end due to lack of technology and fight for patents. Various applications are either cancelled of withdrawn or the claims are amended by the international patent offices. As for example in case of turmeric, which without doubt is indigenous social knowledge and therapeutic usage of Turmeric for its healing and antiseptic properties is age old in Indian culture, but had to be experimentally proved to be considered as our traditional knowledge by US patent offices. To publish and document the social knowledge is a

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challenging task. The present study puts light on various such aspects of traditional knowledge and scientific temper by taking case studies from India thereby discussing the patent issues to draw the inferences from the study for further applicability.

Keywords: Traditional knowledge, Social knowledge, Scientific temper, Patents, Issues

5.1   Introduction

'Traditional Knowledge, whether written or oral, need to be treated as prior art in determining patentability'.

The indigenous, traditional and social knowledge are part of the wealth and heritage for any nation. Such living body of knowledge is passed through generations to new generations. Over the period of time, much of such knowledge may become social knowledge. More often, the developments in terms of scientific inventions by the indigenous societies, is termed primitive. Such rich knowledge of existing scientific facts and inventions imbedded in the cultures and traditions of these societies and nations is many a times ignored. It is important to understand the scientific temper, social knowledge in Indian contexts.

Scientific temper calls for a rational behavior. As a concept 'scientific temper' is related to an individual?s way of thinking. It calls for rationality, reason and lack of belief in dogmas and superstitions. It involves logical thinking process based on scientific attitudes which involves: questioning, observing, testing, analysis and reacting to certain conclusions. Scientific temper encompasses application of logic, discussion, argument and analysis in all its fairness. It helps in understanding the phenomena, issues, occurrences etc. in a very objective manner to invigorates rational mind to reach to the truth and present it the way it is. Social practices based in Scientific temper is what is sustained for long periods of time to become social knowledge. Social knowledge is thus a living body. ?India possesses a rich traditional and social knowledge which is generally being passed down by word of mouth from one generation to another? (Source: Singh, Charu Lata, 2020).

As per Indian Constitution, to develop scientific temper was made one of the fundamental duties of Indian citizens. It was incorporated in Constitution of India, Article 51A through the

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42nd Amendment of the Constitution in 1976. It read, it shall be the duty of every citizen of India, ?to develop the scientific temper, humanism and the spirit of enquiry and reform.?

Indian Constitution and governments strive to protect and develop scientific temper and preserve the rich social knowledge of the country. It is very important that 'Indigenous practices build on Scientific Tempers' called 'Social Knowledge' are 'Protected and Preserved' against 'Patenting Regimes'. Indian Government has led to many patent applications concerning India's traditional knowledge, but they have either been cancelled or withdrawn or claims have been amended in several international patent offices.

5.2 Objectives

1. To study the cases related to traditional knowledge.

2. To look into the various aspects of Patent & Issues which are important to discuss.

3. To seek and study the inherent implications.

5.3 Existing Social Knowledge: Indigenous Scientific Temper in Indian Context

Indian culture and civilization are a living and evolving one. It is important to understand that we connect scientific temper to what brings creativity and innovation, which in turn leads to evolution and progress. In that context, it is impossible that our such a rich cultural heritage could have remained devoid of the scientific temper. It is this reason that it is still growing and shall continue for ages. In other words, the Indian civilization is scientific in nature. The application of scientific temper in Indian historical Context is imminent.

In Indian culture, tradition and values based on questioning and observing have been the fundamental element ever since we refer to the Gurukul teachings and systems. Most of this traditional and social knowledge is having roots in ancient cultures has been informal and oral. Hence, is not protected by conventional intellectual property protection systems.

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India has a civilization which is traced back to over a period of about 5,000 years. It has a wealth of traditional knowledge in ancient scriptures which consist of ;

- Vedas

- Upanishads,

- Epics,

- Bhagavad-Gita,

- Brahma sutras,

- Puranas,

- Manusmriti,

- Shastras and Smritis.

- Arthshastra,

(Source: National Biodiversity Authority 2014).

This scenario has promoted many developing countries to develop their own specific and special systems for protecting traditional and social knowledge against the poaching developed, technologically and scientifically advanced societies and countries. Measures Taken by Government to Protect Ancient and Traditional Knowledge of Indigenous Medicinal Systems

Traditional Knowledge Digital Library (TKDL) set up in 2001, as a collaboration between the Council of Scientific and Industrial Research (CSIR) and the Ministry of Ayush is a pioneering Indian initiative to prevent exploitation and to protect Indian traditional knowledge from wrongful patents mainly at International Patent Offices. India?s rich and time-tested traditional medicinal knowledge which exists in languages such as Sanskrit, Hindi, Arabic, Persian, Urdu, Tamil etc. is neither accessible nor comprehensible for patent examiners at the international patent offices.

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"The TKDL contains documentation of publicly available traditional knowledge (TK) that: relates to Ayurveda, Unani, Siddha and Yoga is in digitized format is available in five languages: English, German, French, Japanese and Spanish" (Source: WIPO, 2020).

The TKDL seeks to prevent the granting of patents for products developed utilizing TK where there has been little, if any, inventive step intends to act as a bridge between information recorded in ancient Sanskrit and patent examiners (with its database containing information in a language and format understandable to patent examiners) facilitates access to information not easily available to patent examiners, thereby minimizing the possibility that patents could be granted for 'inventions' involving only minor or insignificant modifications.

Till date 3,35,260 formulations have been transcribed, 220 wrongful patent filings have been prevented and 12 patent offices have been provided access to TKDL database namely European Patent Office, US Patent Office, Japanese Patent Office, German Patent Office, Canadian Patent Office, Chile Patent Office, Australian Patent Office, CGPDTM (India), UK Patent Office, and Malaysian Patent Office, Rospatent (Russia)and Peru Patent Office?(Business Standard, December 5, 2015).

Besides setting up of TKDL, Yoga has since been inscribed in UNESCOs representative list of Intangible Cultural Heritage of Humanity. Indian Patent Office has also brought out Guidelines for processing Patent Applications relating to Traditional Knowledge and Biological Material to help Patent examiner to analyze what constitutes novelty and inventive step in Traditional Knowledge (TK) related invention (AYUSH, 2020).

India was the first to raise the fundamental issue at the World Intellectual Property Rights Organisation (WIPO) as to why the traditional knowledge-based system should not be treated at par with the industry-based system(Trivedi, Hetvi, 2020).

India has pioneered in the protection of its traditional knowledge. It is the only country in the world to have setup the Traditional Knowledge Library(TKDL). TDKL helps in filing and keeping record of patent applications with regards to traditional knowledge. It has helped in getting patents for a number of medicinal plants and is working to secure the intellectual property rights with have been ours for ages.

The Intellectual Property in relation to traditional knowledge is being protected in two types

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of cases:

- Defensive protection which aims to stop people outside the community from acquiring intellectual property rights over traditional knowledge.

- Positive protection under which there is granting of rights that empower communities to promote their traditional knowledge, control its uses and benefit from its commercial exploitation.

5.4   Methodology

The study is exploratory and descriptive in nature and describes various Case studies from India.

- Defensive protection cases; which aims to stop people outside the community from acquiring intellectual property rights over traditional knowledge.

- Positive protection Cases: under which there is granting of rights that empower communities to promote their traditional knowledge, control its uses and benefit from its commercial exploitation.

5.4.1   Defensive Protection Cases

5.4.2   The Neem Case

A controversy that can be tagged the ?first? for India, and which rose doubts about a supposedly ?strict? patent system, was the granting of patent to a company W.R. Grace. The company was granted a patent in the United States and the European Union, for a formulation that held in the stable storage of azadirachtin, the active ingredient in the neem plant; it planned to use azadirachtin for its pesticidal properties. Traditional systems of medicine like Ayurveda and Unani, identify antiviral and antibacterial properties of the neem , also known as the ?curer of all ailments? in Sanskrit, and prescribe the same for treating skin diseases and as a natural pesticide. The applicant admitted in the patent application of how the pesticidal uses of neem

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were known and pointed out to the fact that storing azadirachtin for a longer duration is difficult. The US patent granted, covered a limited invention whereby the applicant was only given the exclusive right to use azadirachtin in the particular storage solution described in the patent. The grant of the patent was followed by an uproar and it was challenged through re-examination and post-grant opposition proceedings before the United States Patent and Trade Mark Office (USPTO) and the European Patent Office (EPO), respectively. Though there was no success at the Uspto, the European Patent Office ruled stating the patent granted, lacked in novelty and inventive step.

5.4.3   The Turmeric Case

In case of turmeric, the Indian Council for Scientific and Industrial Research (CSIR), had objected to the patent granted and provided documented evidences of the prior art to US Patent Offices. Though it was a well-known fact that the use of turmeric was known in every household since ages in India, it was a herculean task to find published information on the use of turmeric powder through oral as well as topical route for wound healing. After extensive researches, various references were found in different languages namely Sanskrit, Urdu and Hindi.

A re-examination application was filed against the granted patent, along with nearly two dozen references, which resulted into early success. The inventors? defence was proven weak in front of the modern commentaries on classic ayurvedic texts, extracts from Compendium of Indian Medicinal Plants and nineteenth century historical texts from the library of Hamdard University. Resultantly, USPTO, revoked the patent agreeing that the use of turmeric was an old art of healing wounds in India

5.4.4   The Basmati Case

Another case that created much havoc was a patent granted by the USPTO to an American company called RiceTec for ?Basmati rice lines and grains?. Basmati rice is a traditionally grown aromatic variety of rice, in India and Pakistan.

The grant of this patent created multitude IP issues besides that under the patent law i.e.

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under trademarks and geographical indications. RiceTec had been granted patent for the invention of hybrid rice lines that combined desirable grain traits of Basmati rice with desirable plant traits; this was due to the inferior quality of Basmati rice that grew in US in comparison to the good quality Basmati rice being cultivated in northern India and Pakistan and would help in growing a better crop of Basmati rice in the western hemisphere, especially US.

A re-examination request was filed, with declarations from two scientists, along with several publications on Basmati rice and the research conducted on the rice in India?one of which made the USPTO realise that core claims of RiceTec were non-obvious. .

5.4.5   JEEVANI AND KANI Tribes Case

New experiments are beginning to emerge on benefit-sharing models for indigenous innovation. An example of India is worth sharing. It relates to a medicine which is developed from and based on active ingredients in a plant, Trichopus zeylanicus (Arogyapaacha), found in South-Western part of India. Scientists at the Tropical Botanic Garden and Research Institute (TBGRI) in Kerala learnt of the plant, which is claimed to bolster the immune system and provide the additional energy. The medicine is traditional knowledge used by ?Kani? Tribe. These scientists isolated and tested the ingredient and incorporated it into a compound, which they christened ?JEEVANI?, the giver of life. The tonic is being manufactured by a major Ayurvedic drug company in Kerala.

5.4.6   Yoga Patent

A US-based NRI, Bikram Choudhary's applied to get copyright for his method of teaching yoga; He applied for the patent of yoga; Yoga enthusiasts and gurus sais move is unjustified as yoga belongs to the entire human race. USPTO has reportedly issued 150 yoga-related copyrights, 134 trademarks on yoga accessories and 2,315 yoga trademarks. India has taken a strong view against the granting of copyrights and patents to Yoga postures by the USPTO and is preparing to oppose patents.

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5.4.7 Patenting for the Indian variety of wheat Nap Hal

MONSANTO, was assigned a patent (EP 0445929 B1) on the Indian variety of wheat Nap Hal under the simple title ?plants?. On January 27th 2004 Research Foundation for Science Technology and Ecology (RFSTE) along with Greenpeace and Bharat Krishak Samaj filed a petition challenging the patent rights. The patent was resultantly revoked in October 2004.
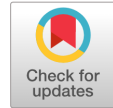
5.4.8 Positive Protection Cases

- Safeguarding the rights for eatables: For Tirupati Laddu, Goa Feni, Darjeeling Tea

- Safeguarding the rights for cloth: Banarsi Saree,

- Madhubani Paintings

These and many products have been given GI (Geographical indication) rights. Protection of rights is directly related to economic empowerment of the producer community. The measures to safeguard the social / traditional knowledge, which involving various aspects of Patent & Issues are difficult to resolve but should not be stopped.

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WIPO, Traditional Knowledge and Intellectual Property

Chapter 6

Navigating the Digital Divide: The Dual Impact of Technology on Business Management and Financial Outcomes

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Abstract: As technology advances all throughout time, it plays an important role in corporate development, having a big impact on managerial strategies and financial outcomes. However, there is a tendency for technology to have both positive and negative effects. In this paper, it has been analysed that how technology affects financial outcomes and management, substantiated evidences with data from different organizations and businesses. It is worth mentioning that giving a glance at its disadvantages one cannot rule out its use and in addition observing the advantages one cannot completely rely on it either thus it is important to discuss both aspects in depth.

Keywords:Technology, Management, digital, divide

6.1 Introduction

Undoubtedly, as organizations rely increasingly on technology to manage their businesses, it's essential to comprehend both its advantages and the corresponding difficulties. The rapid and

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effective production of papers like sales reports and annual reports has cut down on administrative work, helping firms to run more efficiently, but the digital revolution has also given rise to a new set of socioeconomic worries. The errors of handwritten work have been avoided (Gupta et al., 2022; Mittal, 2020). The integration of technology into businesses has revolutionized operations by automating repetitive tasks, allowing teams to focus on developing innovative plans and strategies instead of monotonous tasks. This optimization includes correlations and math related to the calculation of taxes such as Goods and Services Tax (GST), resulting in more accurate financial reports and potentially higher profits. In addition, technology facilitates global expansion by facilitating connections with businesses across national borders, opening up lucrative opportunities that can generate significant profits, even millions (Mittal et al., 2021; Yadav et al., 2021). Additionally, by using technology to build strong consumer trust, companies can build long-term relationships with their customer base, resulting in better customer retention and improved profitability.

As companies incorporate more and more technology into their operations, the financial implications of technology integration can present significant challenges, especially for small businesses and startups (Mehta et al., 2022). While technology has the potential to level the playing field and enable businesses to compete globally, the reality is that not all businesses have equal access to the resources needed to exploit the full potential of technological advances (Mehta et al., 2022).

For small businesses in particular, the pressure to invest in high technology to stay competitive can be daunting. The financial burden of acquiring and maintaining technology-based systems, including hardware, software and infrastructure, can strain limited budgets, leading to reduced profitability or even financial loss. In addition, rapid technological development can make certain investments obsolete in a short period of time, requiring constant renewal and improvement, which in turn further strains financial resources. In addition, the success of a new business largely depends on the appeal of its products or services to the public. Despite significant technological investments, if a company's offering does not resonate with its target audience, it may experience financial setbacks and difficulty recouping the initial investment. That's why it's important for companies, especially startups, to carefully balance technology in-

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vestments with thorough market research and strategic planning to ensure their offerings align
with customer needs and preferences.

6.2   Literature Review

Information Technology (IT) is one of the key factors that help a company to penetrate new innovative markets and create new products and services that drive business and company growth. Communication is the most talked about department, which is easily accessible thanks to the expansion of the Internet, made possible by the availability of such tools as fax, telegram or mail. Simple, affordable and fun, email services with many exciting features have now become the most popular choice. The Internet is also a powerful weapon in marketing, given the increasing public consumption of the Internet. Networks also facilitate communication between employees and the board. Informal relationships are now more necessary because they are likely to have a significant impact in strengthening relationships. (Mgunda, 2019), the country advanced the position more scientific and technological innovations and its strong support for technology innovation is reflected in various innovation policies in recent years in various regions and companies. Everything excellent results in scientific and technological innovation for various companies is a contribution R&D expenses and staff. In general, corporate R&D investments can to contribute positively to the results of companies. But only R&D investment is measured as a variable, which lacks proportionality.(Li Shasha, 2021).

After the pandemic, new legislation and technological revolution has caused successful development of new innovations. Further, it has improved product quality, capacity and processes. Innovative technologies has improved business analysis and forecasting processes leading to new product development, order processing, logistics, production automation, quality control and marketing. Modern technology is gradually replacing ergonomically demanding and dangerous profession by reducing the use of hazardous equipment. These innovations are playing a vital role in the transformation of troubled companies and regions, as they often have a significant impact on economic development.(Jemala, 2021) Machines have been replacing human labour for centuries. Weavers were replaced by weavers. Elevators were replaced by buttons.

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Travel agencies were driven out of business by the Internet. A study found that between 1990 and 2007, roughly 400,000 manufacturing jobs were lost in the United States to automation.

Today, however, the trend toward replacing human labour with machines accelerates as companies try to prevent workplace infections from spreading and keep operating costs down. The United States lost about 40 million jobs during the pandemic. While some jobs have returned, some are gone forever. A group of economists estimate that 42 percent of jobs lost during the pandemic were permanent.(Semuels, 2020) The effect of technology use varies from country to country and to lump all countries into one group to get one result may lead to ill-advised policies. In the case of low income countries, increasing the number of Internet users will help in reducing poverty levels, while broadband Internet access will have a positive impact on income inequality. Thus, low income countries are more likely to reap the benefits of policies that encourage the masses to access Internet services. The impact of improving mobile access and Internet facilities is not just about easy communication but also about telehealth services and online education, as well as remote jobs. One of the factors that can strengthen these initiatives is the growing popularity of smartphones over traditional mobile phones even in low income countries. Providing Internet services will empower the common man to generate income online.(Afzal et al., 2022) Information and communication have always opened up opportunities for the poor to generate income, reduce isolation and flexibly respond to emergencies. As the use of mobile phones explodes in developing countries, even marginalized communities are now benefiting from modern means of communication.(Laurent Elder & Alison Gillwald, 2014)

6.3   Main Content

One of the leading names in the pizza industry, Dominos has been making waves with an efficient and technology-driven approach. Despite a relatively limited number of locations, the company has successfully scaled its operations to handle an impressive number of orders each day, ensuring fast delivery in as little as 30 minutes. Crucial to its success is the careful maintenance of an advanced database structure made possible by the integration of state-of-the-art software technology. Notably, Domino's has strategically expanded its customer base by lever-

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aging popular platforms such as Zomato and Swiggy and actively engaging its audience on social media platforms such as Facebook and Twitter. Domino's anywhere, an innovative chat platform, has revolutionized the way one interact with customers, enabling seamless interactions that cover everything from billing and ordering to delivery and feedback. The innovative side cleaning of the car, especially useful during the challenges of the pandemic, underlines Domino's commitment to ensure a smooth and customer-centric experience even in the face of adversity. The company's impressive stock price, currently at approximately \$396.96, is a testament to the profound impact of technology integration on the company's continued success and profitability. Another big progress can be observed in the education sector "Unacademy" as one of the largest learning platforms that has earned higher profits it has done association with various other coaching institutes and teachers earning huge profits as well as providing quality services to the users. Additionally delhi university has done admission through the CSAS portals where in such algorithms have been used providing an easy acess for the students in checking seat allocations, pay fees and other details . The credit for this undoubtedly shall goo to technology. The shopping stores such as myntra , ajio and lifestyle provide schemes on various payment modes such as credit card and HDFC thus attracting users and increasing their sales. On the other hand, Apple, known for its highly sought-after iPhones, has established itself as a global technology leader with \$247.7 billion in revenue. Behind the success of the brand lies the strategic use of artificial intelligence (AI) and various coding languages such as jQuery, CSS, lodash and Google Analytics, which enables the development of complex and user-friendly electronic products. However, recent consumer reports have highlighted concerns about overheating and slower performance in certain models due to significant technological advances in recent versions. Despite its continued success, Apple's challenge is to balance consumer needs for innovation with the practicalities of implementing new technologies smoothly and efficiently.

Renowned tire manufacturer Michelin has consistently distinguished itself from the industry through its commitment to technical development and customer engagement. As the second largest tire manufacturer in the world, Michelin has actively adopted business-to-business (B2B) communication strategies, fostered strong ties with its customer base and continuously invested

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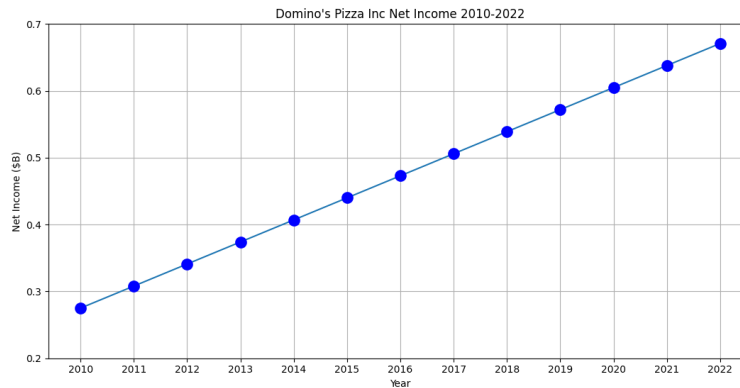
Figure 6.1: Dominos Pizza Net Income 2010-2022

in an active research and development department dedicated to technological innovation and improvement. By leveraging AI-based information across sectors and harnessing the power of business intelligence, Michelin has successfully improved its operational efficiency and overall profitability, and strengthened its position as a key player in the competitive global tire market. Walmart, the retail giant known for its commitment to customer satisfaction and operational excellence, has undergone a major digital transformation to improve its customer service and simplify administrative procedures. By significantly reducing wait times and streamlining its administrative processes, Walmart has reinforced its commitment to providing an unparalleled shopping experience. Leveraging strategic partnerships with technology leaders such as Microsoft and Google, Walmart has deployed advanced artificial intelligence tools to manage and analyse critical data, resulting in a state-of-the-art "data cafe" that strengthens its supply chains and improves profitability. . This strategic use of technology has placed Walmart at the forefront of retail innovation and set the benchmark for others in the industry.

TSMC (Taiwan Semiconductor Manufacturing Co. Ltd.), a pivotal player in the semiconductor industry, has earned significant acclaim for its cutting-edge technology solutions and commitment to delivering high-quality products. With an impressive revenue of $ 71.66 billion, TSMC specializes in the production of semiconductors for electronic devices, showcasing its expertise in a wide range of technologies such as CMOS sensors, MS/RF, e-Flash, mems

technology, and BCDs. By consistently embracing innovation and leveraging its technological prowess, TSMC has solidified its reputation as a reliable and pioneering provider of semiconductor solutions, catering to a diverse clientele and contributing significantly to the everevolving landscape of the global electronics industry.

Nike, a world pioneer in sports apparel and sports accessories, has made significant strides in its business strategy by leveraging cutting-edge technology and innovative customer engagements. By introducing popular programs such as "Nike Run Club" and "Nike Training Club", the company effectively bridged the gap between its brand and its global customer base, promoting a more personalized and engaging brand. In particular, the strategic decision to stop wholesale sales in 2018 allowed Nike to foster more direct and meaningful relationships with its customers, resulting in a significant 50 percent increase in financial gains. With a strong emphasis on direct customer interaction and engagement, Nike has successfully positioned itself as a leading brand in the sports industry, responding to the changing needs and demands of a diverse and global customer base. Additionally, the unfortunate events surrounding Code Spaces and Med Star Health are stark reminders of the vulnerability of today's digital landscape. A major code hosting service, Code Spaces, fell victim to a devastating Distributed Denial of Service (DDoS) attack, resulting in the irreversible destruction of critical data, backup resources and machine configurations. The incident caused the sudden termination of the service, affecting not only code farms but also many companies dependent on its infrastructure, including Telefonica. Similarly, Med Star Health, a large hospital chain with operations in Baltimore, Maryland and Washington, D.C., experienced a severe network outage caused by an unidentified virus that completely shut down the company's patient database and email system. This unprecedented cyberattack underscored the critical importance of strong cyber security measures in the healthcare industry. It emphasized the need for comprehensive and proactive data security protocols to protect sensitive patient data and ensure the smooth delivery of critical healthcare services. Recently, Aadhar card of 815 million citizens have been breached through technology advancements. The poverty in itself is becoming a major cause of concern as the less educated and unskilled workers are not getting employment opportunities the job opportunities indeed have been minimised for them.

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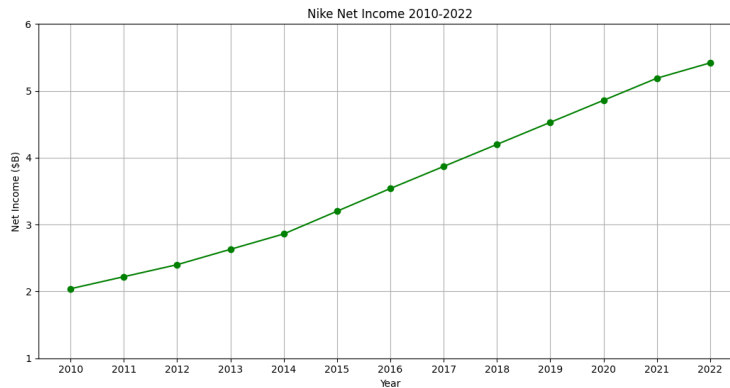
Figure 6.2: Nike Net Income 2010-2022

6.4 Discussions and Conclusions

To conclude in today's fast-paced and dynamic business environment, technology integration has become a cornerstone for achieving and maintaining competitiveness. Companies in various industries rely more and more on technological development to make operations more efficient, increase productivity and promote innovation. The use of technology gives companies the opportunity to automate processes, improve efficiency and deliver products and services more quickly and accurately. However, to achieve these benefits, it is important for companies to be aware of the potential pitfalls associated with too much technology.

Maintaining a balance between technology integration and people-centric strategies requires aligning technology investments with core business values and goals. By emphasizing the human touch in customer service, promoting employee engagement and fostering a culture of innovation, companies can effectively navigate the complex environment of the modern business environment and harness the full potential of technology for sustainable growth and long-term success.

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Chapter 7
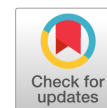
Navigation of Climate Change Framework: Analysis of Synergy Between SDGs and UNFCCC

Kalyani Acharya [1] iD

Abstract The year 2015 is potentially historic, marked by the alignment of Sustainable Development Goals (SDGs) and a novel international climate action treaty. This synergy signifies a pivotal moment for steering human development toward sustainability. The documents underline the inherent connection between climate and development, recognizing that addressing the climate challenge significantly impacts the achievement of various SDGs, and vice versa. The research paper synthesizes the relationship between Sustainable Development Goal 13 and the global climate action policy within the Climate Change framework. Additionally, it offers insights into the strategies employed to meet the ambitious temperature targets of the Paris Agreement, aiming for a rise of less than 2°C above preindustrial levels and even more stringent efforts to limit the increase to 1.5°C. The study also underscores a notable gap in implementing climate action to combat climate change.

Keywords: Climate Change, Synergy, SDGs, UNFCCC, Sustainable Development

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7.1 Introduction

It is hoped that 2015 will go down in history as the year that put human growth on a more sustainable course. Planetary Social Contract of Historic Proportions achieved two significant benchmarks. A new development agenda with the goal of eliminating poverty and promoting inclusive development within ever-tinier global borders was adopted in New York on September 25. A set of agreed-upon sustainable development goals (SDGs) will be used to monitor advancements in the economic, social, and environmental spheres. According to Griffin et al. (2022), the purpose of the SDG framework is to optimize synergies and manage trade-offs among the 169 targets that are connected with the 17 distinct goals. Among these, Goal 13 establishes the duty to take measures to mitigate the climate change effects. Additionally, on December 12, nations decided on a new global climate. These two instruments established a synthesis of Collective Global Action towards climate change. In this article author establishes the policy synergy given in these two instruments and action initiated to combat climate change and implementation of targets set by these instruments. This article outlines both these international framework to address the climate change and the efficacy of these regimes according to synthesis report of published in March 2023. The article further mentions the implementation gap in the measures to be adopted according to the current framework of Paris Agreement to address the climate change. In the end suggestions has been given to reduce the gap and strengthen the mechanism.

7.2 Objectives of the Study

1. To analyze the effectiveness of international commitments, specifically focusing on the Sustainable Development Goals (SDGs) and the Paris Agreement, in addressing climate change.

2. To assess the implementation gaps and barriers hindering the achievement of climate-related targets.

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7.3   Research Methodology

The research methodology adopted for this paper has been qualitative in nature. The most distinguished form of research. References have been taken from non-numerical resources and concepts, opinions and deliberations on the topic surrounding the focal point of this paper. Available International documents have been taken into consideration and link has been established between Sustainable Development Goals and UNFCCC for addressing the climate change.

7.4   Sustainable development goals

Sustainable Development Goals 2030 Agenda was launched in September 2015 as a successor to Millennium Development Goals after years of toil of negotiations. Though a sequel to Millennium Development Goals it shows a clear departure from previous agenda. The previous agenda was majorly criticized for the narrow approach which was mainly focused on North-South relations, poverty reduction and for technocratic approach. But SDGs on the other hand represents a holistic and wide agenda for global sustainable development. The expansive scope of SDGs also presents different challenges which are arising from different goals and targets. The interwoven goals of environmental, social, and economic preservation are accompanied by conflicting agendas, interests, and priorities. According to some study, most countries' SDGs have more trade-offs than synergies, but SDG 13's significant climate action implies a profound socio-technological revolution that poses a special challenge for development. Goal 13 calls for the urgent action to address climate change and also specifies the targets that how the menace of climate changes can be addressed.

GOAL 13: Urgent action to address climate change and to mitigate its impacts

The adoption of the Sustainable Development Goals (SDGs) represents a shift towards a more comprehensive global sustainable development agenda. However, this broadened scope introduces challenges due to the intricate interactions among various targets and goals. The inter-

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connected objectives spanning environmental, social, and economic preservation often come with conflicting agendas, interests, and priorities. Research indicates that the majority of countries' SDGs involve more trade-offs than synergies (Pradhan et al., 2017). Notably, SDG 13, emphasizing significant climate action, presents a unique challenge, necessitating a profound socio-technological revolution for development. Policies focused on climate change mitigation have the potential to impede economic growth, alter industrialization negatively, exacerbate poverty and inequality, and influence socio-economic factors contributing to conflict in certain nations (Fuso, 2018). Anthropogenic activities are exacerbating extreme weather conditions, posing risks to food security, energy availability, and other critical issues. Urgent steps are imperative to address climate change and its far-reaching impacts.

Targets linked to the environment:

1. Target 13.1: Strengthen adaptive capacity and resilience to combat climate-related disasters.

2. Target 13.2: Integrated measures by policy making and planning for climate change.

3. Target 13.3: Knowledge and capacity building to address climate change challenges.

4. Target 13.4: Commitment of United Nations Framework Convention on Climate Change to be implemented to mobilize $100 billion annually by 2020 for developing countries, focusing on meaningful mitigation actions and transparency in implementation. Operationalize the Green Climate Fund promptly.

5. Target 13.5: Promotion of mechanisms to strengthen capacity for efficacious climate change-related planning and management in least developed countries and small island developing States, with a focus on women, youth, and local marginalized communities.

7.5   United Nation Framework Convention on Climate Change (UNFCCC)

The contemporary biome is confronted with perpetual threat, rendering the necessity of a systematic and harmonious approach (Gunderson et al., 2005)is pertinent in relation to globalized ecosystem. (Tan et al., 2020) The inception of the United Nation Framework Convention on Climate Change (UNFCCC) is worldwide nation's first significant attempt to address the predicament of global warming. Apart from SDGs major regulatory framework to deal with Climate Change is UNFCCC. Prior to the adoption of Convention existing international instruments did not effectively address the greenhouse threat. (Palmer, 1992)The genesis of Climate Change Framework was started with Kyoto Protocol in COP-11 (COP 11 Highlights | UNFCCC, 2005) which further paved a way for international climate negotiations.

   The UN Framework Convention on Climate Change is the international community's first genuine attempt to address the issue of global warming. Before the Convention was adopted in 1992 existing international instruments did not really address the greenhouse threat. The Kyoto Protocol at COP-11 marked the beginning of climate change diplomacy which was followed by the Paris Agreement. Parties to the UNFCCC finally achieved a historic deal to address climate change at COP-21, which was held in Paris. This agreement was negotiated and approved by consensus of representatives from 196 nations. For the first time, it united all nations behind the goal of launching audacious campaigns to counteract and adapt to its impacts, with increased support to help developing nations do this.

7.5.1   Old Regime of UNFCCC to address climate change : Kyoto Protocol

The Kyoto Protocol is an agreement based on highly centralized mechanism distinguished by its inflexible approach to greenhouse gas (GHG) emissions reduction (Raymond, 2011). Embedded in a traditional "top-down" framework, the Protocol mandates legally binding commitments for emission reductions was came into force in 2005. The guiding requisites for climate policy implementation for the Protocol, such as the idea of legally binding mitigation commitments,

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(Bodansky & Rajamani, 2018) common but differentiated mitigation responsibilities between developed and developing countries (Gupta, 2010) equity and benefits of present and future generations, (Jaswal et. al., 2023) were established by Article 3 of UNFCCC. Kyoto Protocol was negotiated in order to place binding obligations on developed country parties to reduce GHG emissions. (Kyoto Potocol-UNFCCC, 1998) The Protocol also features one of the more effective mechanisms for compliance among multilateral environmental agreements ("MEAs"). Comprising both a facilitative branch and an enforcement branch, the latter possesses the authority to compel non-compliant parties into action. These peculiar features, characterized by legally binding obligations and their enforcement, derived from the authority vested in international consensus. Notably, the Protocol exclusively binds developed-country Parties, obliging them to reduce emissions by an average of 5.2% below 1990 levels by 2012. (UNFCCC, Press Relaese,1997) To ensure compliance by developed nations, the Protocol introduced reporting and verification procedures.

Shortcomings and Failure of Kyoto Protocol

The earlier approach of climate change regime failed as many developed countries either not ratified or did not abide to the ratified emission reduction targets. Having set legally binding emissions reduction commitments for developed countries only, the Protocol lost both the participation of the United States, whose government grew reticent about international environmental cooperation in the absence of China's involvement (Borger, 2001). Resultantly, parties to the Protocol perceived the treaty as lopsided and ineffective (Bodansky, 2016). From the very inception, the Kyoto Protocol faced dissent of United States, who was then largest emitter of world, to ratify the agreement due in part to its exclusion of limits on rapidly growing economies like China. China further surpassed the United States as the largest emitter of world in 2006. Around 1992, developed countries were primary emitters but total GHG emissions from the developing world surpassed those of the industrialized nations by 1994. (Friedrich &Damassa, 2014) Consequently above 50% of new international emitters were outside the purview climate regime. The limitations of the Kyoto Protocol became blatantly evident when its successor treaty was being negotiated.

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7.5.2 A Shift Towards Novel Approach to Address Climate Change: Paris Agreement

After the Copenhagen COP 15 failed to produce a more comprehensive agreement to replace the Kyoto Protocol, it became clear that a new approach was needed in international climate policy. (Victor, 2011) This diplomatic failure was caused by a multitude of causes, such as divergent views on the roles of affluent and developing countries, the sheer volume of parties involved in the negotiations, and the difficulty of determining the global concentration of greenhouse gases needed to prevent "dangerous" climate change (Stewart et al., 2013). The discussions only managed to rescue the Copenhagen COP by agreeing on a limited set of initiatives, and the worldwide accord that was hoped for was not reached. (COP 15, UNFCCC, 2015)

While Kyoto Protocol applied a extensive differentiated approach to combat climate change, Copenhagen Accord and Cancun Agreement tried to punt into place a "bottom up" mechanism. Though architectures offered some benefits, but in their disadvantages outweighed the benefits, resulting in the failure of both climate regimes. Nevertheless, these precursor regimes played a pivotal role in paving the way for a new climate regime—the Paris Agreement. The Paris Agreement embodies a paradigm shift that emphasizes consensus and efficacy. The primary objective of the Paris Agreement is to provide flexibility that fosters broad agreement and extensive participation, all while preserving the pursuit of viable and effective mitigation and adaptation goals, (Dimitrov, 2016) addressing the matters of global distributive justice (Moellendorf, 2012). The 2011 COP 17 Durban Platform for Enhanced Action is where the accord had its start. A crucial "bottom-up" component of the evolving agreement was then established when COP-19 in Warsaw called on parties to submit "Intended Nationally Determined Contributions" (INDCs) well in advance of the Paris Conference. Finally, at COP-21 in Paris, representatives of 196 countries reached a landmark agreement to combat climate change. This agreement marked the first instance in which all nations rallied behind a common cause to undertake ambitious efforts to combat and adapt to climate change while ensuring enhanced support for developing nations in their endeavors.

Distinctive Features of Paris Agreement

1. Long Term Goals

   The Long Term Goals characterized by the Paris Agreement envisions an endeavor of nationally defined programs presented by countries on a voluntary basis. These programs designed to achieve mitigation targets to limit temperature rise to below 2°C, with aspirations to restrict it to 1.5°C. (Paris Agreement-Article 2, 2015) Further this approach advocates for an economic transition toward a low-carbon future by promoting energy efficiency and fostering technological breakthroughs across various economic sectors.

2. Nationally Determined Contributions (NDCs)

   The pivotal element in the Paris agreement is the concept of Nationally Determined Contributions (NDCs), an unconventional climate agreement aimed at addressing global climate change challenges. It was a departure from earlier climate agreements by combining a two-pronged approach, integrating both bottom-up and top-down mechanisms, with an emphasis on the former(Rajamani, 2016). In essence, the Paris Agreement establishes a legally binding framework that obliges nations to set forth their own specific goals for mitigating and adapting to climate change, which are tailored to their unique circumstances and capabilities. This marks a significant shift from earlier agreements that imposed top-down emissions reduction targets on countries. According to Article 4 of the agreement, nations are required to "pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions," and "each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve" (Keohane & Victor, 2011). Additionally, the Paris Agreement promotes the efficacy dimension by encouraging countries to set more ambitious mitigation targets compared to previous climate treaties. Although the primary objective remains limiting global temperature rise to below 2°C, the agreement also strives to push for efforts to limit the increase to just 1.5°C. These mechanisms combine to create a climate regime that blends consensus-based decision-making with the promotion of effective goals for reducing greenhouse gas emissions, addressing the shortcomings of earlier agreements such as the Kyoto Protocol

and the Copenhagen Accord (Held & Roger, 2018). While countries retain the autonomy
to set their own mitigation and adaptation objectives, the Paris Agreement constructs a
robust legal framework, encompassing essential procedural obligations. These include
the periodic assessment of each country's progress in implementing domestic policies to
attain their stated targets. Moreover, the Paris Agreement fosters a culture of ambition
by encouraging nations to set more ambitious mitigation targets compared to previous
climate treaties (Spash, 2016).

3. Hybrid multilateralism

Hybrid multilateralism, as exemplified by the Paris Agreement, represents a nuanced
approach that combines elements from different international climate agreements. It har-
monizes the adaptable, nation-specific approach found in the Copenhagen Accord with
the structured, top-down regulations akin to those in the Kyoto Protocol. This shift in
approach marks a departure from traditional binary models that tied a nation's climate
commitments to its level of development. Instead, the Paris Agreement embraces a more
inclusive strategy. Rather than imposing predetermined emissions targets through ne-
gotiation, each participating country is empowered to set its own targets based on its
unique circumstances. The aim is to encourage broad engagement, particularly from ma-
jor greenhouse gas emitters. Surprisingly, by eliminating the threat of punishment for
noncompliance, this strategy aims to promote greater ambition (Leal-Arcas, 2013). In
addition to its decentralized approach to emissions targets, the Paris Agreement provides
non-state actors with platforms and opportunity to engage in various processes and com-
mit to reducing emissions. This strategy seeks to strengthen and supplement national
governments' climate pledges and goals (Fitzgerald, 2020).

Some academics refer to this strategy as "hybrid multilateralism" since it involves a com-
plicated interplay between public and private authority. It involves giving non-state enti-
ties a more integrated role in multilateral processes, including keeping an eye on national
policies and testing out adaptation and mitigation techniques at the local, regional, and
international levels (Bäckstrand et al., 2017).

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7.6   Navigation: Implementation gaps and barriers

Policy Implementation Gap

Every new climate policy that is adopted is likely to lower the intensity of national emissions (Eskander & Fankhauser, 2020). Nevertheless, the mere act of incorporating policies does not guarantee their combined efficacy. (Dubash, 2021). Policies can fall short of what nations' own NDCs call for (Kuromochi et al., 2021). Policies are still lacking in significant mitigation regions (Nascimento et al., 2021) and there is a discrepancy between the adoption and application of policies in major emitters. Non-policy factors influence emissions as well. The global COVID-19 pandemic, for example, resulted in short-term emission decrease and a global economic downturn (Le Quéré et al., 2020). Emissions are also influenced by non-policy causes. For instance, the global COVID-19 pandemic caused a brief drop in emissions as well as a global economic depression (Hans et al., 2022). However, current recovery spending is still insufficient to put countries on a low-carbon trajectory, despite repeated demands to take advantage of this opportunity to enhance low-carbon investments. Recent policy-based emission forecasts are still insufficient to fulfill global temperature goals, according to a variety of integrated assessment models (Sognnaes et al., 2021). According to research using different quantification approaches, the median of emissions shows that, under accepted policies, global emissions have not yet peaked and are not predicted to do so before 2030.

There are no sources in the current document. It is possible to evaluate the additional emission reductions required to meet the NDCs' reduction targets by comparing them with the country's present mitigation strategies. To attain the unconditional NDCs by 2030 and the conditional NDCs by 2021, countries will probably need to enact more or stricter policies aimed at reducing global GHG emissions by an additional 4.5 GtCO2eq and 6.1 GtCO2eq, respectively. Just six economies bear the lion's share of the burden (about 75% for the unconditional NDCs and aroundof the required reductions, namely the USA, China, Canada, EU-27, Japan and Brazil. The USA, China, Canada, EU-27, Japan, Brazil, and the other six economies bear the lion's share of the burden—about 75% for the unconditional NDCs and roughly of the necessary reductions. For a number of nations, including Saudi Arabia, Turkey, India, the Russian

Federation, and several non-G20 members, including Iran, the emission goal levels under the NDC scenario are anticipated to be higher than the expected levels under the current policies. With their present strategies, these nations should surpass their NDC targets. For the unconditional and conditional NDC scenarios, we estimated that these nations will overachieve their NDCs and maintain their current policy-driven emission trajectory, resulting in additional net reductions at the global level of 4.1 and 2.5 GtCO2eq, respectively. With no realistic path to 1.5 C, climate action policy is still falling short of the Paris Climate Goal. The only thing that can save the human species from an impending climatic catastrophe is a drastic change. There is only a 66% possibility, based on current NDC development, of limiting global warming to 2.6 °C by the end of the century. Furthermore, there is a serious risk of a rise of up to 2.8 C under the existing policy framework.

Mitigation Gaps and Barriers

The execution of all mitigation techniques is fraught with issues related to costs, scale, and technical concerns. In order to allow for the widespread use of mitigation strategies, almost all of them must also overcome institutional obstacles. There is a strong degree of confidence that the current growth paths will result in behavioral, geographical, economic, and social impediments to faster mitigation at all scales. The decisions made by stakeholders, including the private sector, citizens, and legislators, affect how societies grow. The breadth and complexity of climate governance are influenced by structural aspects of country conditions and capabilities (e.g., political systems, economic and natural assets, cultural influences, gender considerations). Political support for mitigating climate change and final policy outcomes are influenced by the degree to which businesses, youth, labor, media, Indigenous Peoples, and local communities are involved, as well as by civil society players.

Adaptation Gaps and Barriers

1. Despite advancements, disparities in adaptation persist, with a distinction between existing adaptation levels and the necessary levels to address impacts and minimize climate risks.

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2. Certain sectors and regions have already encountered both soft and hard limits to adaptation, although adaptation efforts have provided some relief against climate impacts.

3. Growing evidence indicates instances of maladaptation in different sectors and regions.

4. The implementation of adaptation measures in vulnerable sectors, regions, and social groups faces limitations due to systemic barriers.

7.7 Conclusion and suggestion

The international efforts to address climate change, as encapsulated in the Sustainable Development Goals (SDGs) and the Paris Agreement, mark significant milestones in the pursuit of a sustainable and resilient future. The adoption of the SDGs in 2015 signaled a departure from the narrow focus of previous development agendas, emphasizing a holistic approach to global sustainable development. Goal 13, in particular, highlights the urgency of taking decisive actions to mitigate the impacts of climate change. The Paris Agreement, emerging from the shortcomings of previous frameworks like the Kyoto Protocol, introduced a novel approach by blending both bottom-up and top-down mechanisms. The Nationally Determined Contributions (NDCs) and the long-term goals set by countries provide a flexible framework that accommodates diverse circumstances while collectively aiming to limit global temperature rise. This hybrid multilateralism seeks to foster broad engagement and encourage non-state actors to contribute to climate action. However, despite these commendable international commitments, the implementation of climate policies faces notable gaps and barriers. The policy implementation gap is evident in the discrepancy between adopted policies and their effective application, particularly in major emitting countries. The COVID-19 pandemic, while temporarily reducing emissions, has not translated into sustained low-carbon trajectories in global recovery spending.Mitigation gaps and barriers persist, with challenges related to costs, scale, and technical aspects hindering the widespread adoption of mitigation strategies. The current growth paths pose obstacles at various levels, influenced by political, economic, and social factors. Additionally, the current trajectory falls short of achieving the Paris Climate Goal, emphasizing the need for drastic

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changes. Adaptation efforts also face challenges, with existing gaps between current adaptation levels and those needed to address climate impacts. Some sectors and regions have reached soft and hard adaptation limits, and instances of maladaptation are emerging. Systemic barriers constrain adaptation options in vulnerable sectors, regions, and social groups.

Suggestions

1. Enhanced Implementation and Monitoring: Strengthening the implementation of climate policies and enhancing monitoring mechanisms are crucial. Countries need to bridge the gap between policy adoption and effective implementation, with a focus on transparency and accountability.

2. Increased Ambition: Nations should reassess and increase the ambition of their NDCs to align with the Paris Climate Goal. This includes setting more stringent mitigation targets and promoting sustainable practices across various sectors.

3. Global Cooperation: Climate change is a global challenge that requires collective action. Enhanced collaboration among nations, businesses, and civil society is essential to address mitigation and adaptation challenges comprehensively.

4. Inclusive Decision-Making: Inclusion of diverse stakeholders, including non-state actors, local communities, and marginalized groups, is crucial for effective climate governance. Their involvement can contribute to more robust and equitable climate policies.

5. Research and Innovation: Continued investment in research and innovation is vital for developing and implementing new technologies and strategies to address climate change. This includes efforts to overcome barriers related to costs and technical feasibility.

6. Adaptive Management: Recognizing the dynamic nature of climate change, adaptive management strategies should be employed. Regular reassessment of policies and adaptation measures will help address evolving challenges and uncertainties.

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7. Capacity Building: Building the capacity of vulnerable sectors, regions, and social groups is essential for effective adaptation. This includes addressing systemic barriers and providing support for the implementation of adaptation options.

8. Public Awareness and Education: Raising public awareness and education on climate change is critical. Informed and engaged citizens can contribute to the demand for ambitious climate policies and sustainable practices.

In conclusion, addressing climate change requires a concerted and sustained effort from the international community. While significant strides have been made, there is a pressing need to overcome implementation gaps, enhance ambition, and foster global cooperation to achieve the goals set out in the SDGs and the Paris Agreement.

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Chapter 8

A Tripple Bottom Line Assessment of Solid Waste Mangaement System: An Application of AHP

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Abstract: Effective solid waste management is essential for sustainable development, addressing environmental concerns, and achieving socio-economic well-being. This study presents a comprehensive analysis of the solid waste management system using the Triple Bottom Line (TBL) framework and employs the Analytic Hierarchy Process (AHP) as a decision-making tool. The research aims to evaluate the environmental, social, and economic dimensions of the waste management system, considering various criteria and sub-criteria.

The environmental dimension assesses the impact of waste management practices on ecosystems, natural resources, and climate change. Factors such as waste reduction, recycling, composting, and energy recovery are evaluated to determine their environmental effectiveness. The social dimension focuses on the implications of waste management on human health, community well-being, and equity. Parameters like public participation, awareness programs, employment generation, and social justice are considered. The economic dimension investigates the financial viability and cost-effectiveness of waste management strategies. Criteria such as cost of collection, treatment, disposal, revenue generation, and economic benefits are examined.

The Analytic Hierarchy Process (AHP) is applied to analyse the relative importance of criteria and sub-criteria in the TBL assessment. AHP allows decision-makers to structure the decision problem, prioritize criteria, and derive weights based on pairwise comparisons. Expert

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opinions, stakeholder inputs, and available data are utilized to establish the decision hierarchy and pairwise comparisons. The AHP process facilitates a systematic evaluation, enabling decision-makers to identify the most suitable waste management strategies based on TBL principles.

The findings of this study provide valuable insights into the performance of the solid waste management system from a TBL perspective. By considering the environmental, social, and economic dimensions simultaneously, decision-makers can identify strategies that achieve optimal outcomes across multiple dimensions. The AHP-based assessment enables a transparent and rational decision-making process, promoting informed choices and resource allocation in waste management. This research contributes to the existing body of knowledge by integrating the TBL framework and AHP methodology for solid waste management assessment. It emphasizes the importance of a holistic approach to waste management that goes beyond traditional cost considerations.

Keywords: Triple Bottom line Assessment, Application of AHP,Solid Waste Management system

8.1   Introduction

The term "solid waste management" describes the systematic and environmentally friendly gathering, moving, handling, and discarding of solid waste. It includes the methods and techniques used to manage different kinds of solid waste, such as hazardous waste, commercial, industrial, and residential waste as well as debris from building and demolition projects (Tiwari S et al., 2022). Solid waste management aims to maximize resource recovery, encourage sustainable practices, and reduce the harmful effects of waste on the environment and public health.

The Triple Bottom Line (TBL) is a sustainability framework that takes into account three interconnected dimensions: environmental, social, and economic. It expands the traditional focus on financial performance to include the broader impacts and outcomes associated with an organization's activities (Fatima S, 2023).

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Strong waste administration is an essential part of ecological manageability and general
wellbeing. It includes the assortment, transportation, removal, and reusing of strong waste
created by human exercises. Strong waste can incorporate different materials, for example,
family squander, modern waste, development and destruction trash, and the sky is the limit
from there. The administration of strong waste is an intricate and diverse test that requires
cautious preparation and execution of compelling methodologies to limit its ecological effect
and advance asset productivity.

All in all, coordinating strong waste administration rehearses into the Triple Main concern
system guarantees a thorough assessment of its effect on friendly, natural, and financial per-
spectives. An all-encompassing way to deal with squander the executives adds to feasible turn
of events, addressing the necessities of the present without compromising the capacity of people
in the future to address their own issues.

8.2   Literature Review

Finding the essential components for solid waste management success is the primary goal of
the literature review in this study. An AHP-based model for the assessment of impact on life
of solid waste has been developed using the results of the literature review and the input of an
expert panel. The MCDM numerical device known as AHP was first introduced by Saaty in
1980. It separates muddled issues into sensible lumps and orchestrates them in a various lev-
elled structure. Not at all like item life cycle evaluation (LCA), squander life cycle evaluation
(LCA) assesses the natural exhibition of a few interrelated squander the board innovations in
light of a specific waste creation from the place of waste age to its definitive removal (Gentil et
al., 2010).The dynamic cycle is made more troublesome when monetary and social elements are
incorporated due to their various units and often clashing objectives. Pointers from these three
aspects have been acclimatized by specialists utilizing multi-standards examination (MCA) ap-
paratuses to dependably create a general inclination positioning framework for the proposed
other options.

As per De Benedetto and Klemeš (2009), cost and speculation information for various MSW

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plan choices should be accumulated simultaneously with a LCA examination to guarantee powerful essential navigation. The financial examination is a troublesome errand due to the wide assortment of treatment plant choices, scale, monetary requirements, and persistently further developing treatment innovation. The intricacy of the LCA monetary plan is acquired by the perplexing and different outflows that should be coordinated with a financial worth. Commonplace financial pointers in the MSW setting incorporate things like the expenses related with building and laying out nonrecurring securing offices, repeating and working expenses, life ranges, innovation, working circumstances, natural effects and discharges, social acknowledgment, usage rates and efficiencies, squander the executives strategies, and so on. The kind of vehicle, the quantity of age hubs, treatment and removal offices, time spans, and distances all influence the expense of transportation. The expenses additionally incorporate energy deals from squander to-energy plants and incomes from recuperated and reused materials. Financial execution pointers incorporate productivity record (PI), inward pace of return (IRR), and old style net present worth (NPV). These are registered utilizing fitting restitution periods, breakeven amounts, deterioration life ranges, and rebate rates.

Applying the cultural BL to the macroeconomic framework, it takes a gander at what a specific civil waste administration system means for individuals living there (Foolmaun and Ramjeeawon, 2012; Reich 2005). To all the more likely comprehend how strategy and strategy producers can be associated with practical improvement that will either work on the social states of partners or at any rate act in a socially capable way, cultural life cycle evaluation plans to recognize tradeoffs (Dreyer et al., 2010; Mittal et al., 2021). There are huge contrasts in the effect of the social aspect on MSW between societies, philosophies, and formative stages. When considered, social pointers can contrast extraordinarily.

More elevated level thoughts of strengthening, association, value, social cohesiveness, institutional turn of events, destitution lightening, and populace security may likewise be incorporated.

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8.3 Research Methodology

This study considers both waste created industrially, such as from stores, offices, and businesses, and waste produced locally, i.e., all solid waste originating from residential properties, including garden waste. The methodology aims to evaluate the expected Municipal Solid Waste (MSW) Sustainability Rankings (SRs) corresponding to the ecological, economic, and social pillars of sustainability. The methodology creates a Composite Sustainability Index (CSI) for each MSW SR after calculating the indicators within each Bottom Line (BL).

The eigenvalues can be computed with the formula:

$$\lambda_{\max} = \sum_{j=1}^{n} \frac{a_{ij} w_j}{w_i}$$

where W is the eigenvector and $\lambda_{\max}$ is the largest eigenvalue of the matrix.

Level of Preference	Explanations
1	Preferred equally
3	Preferred moderately
5	Preferred strongly
7	Preferred very strongly
9	Preferred extremely strongly
{2, 4, 6, 8}	Intermediate values

Table 8.1: Saaty's nine-point scale

AHP Methodology

1. Step 1: Clearly define and state the goals of the difficult and unclear problem.

2. Step 2: A survey method or group decision is used to break down the complex problem into a hierarchical structure. There are various levels within the hierarchical structure. The problem's objective is represented by the top level hierarchy. In the next level, this goal is further broken down into a number of criteria. The criteria are further broken

down into levels of sub-criteria that emphasize the specifics of the criteria. The hierarchy is broken down this way until there is no more room for breaking down the sub-criteria.

3. Step 3: A decision matrix can be used to perform a pairwise comparison in order to highlight the relative importance of each criterion. The decision making matrix is built using experts and decision makers, utilizing Saaty's (1994) nine-point rating system, which is displayed in Table III. The components that support a common node in the hierarchical structure are compared to the other components of that node. If a node has "n" elements, for instance, then n (n - 1)/2 comparisons occur under that node.

Environmental Fruitful reusing relies upon the nature of the reused materials and the amount they look like virgin material (Shonfield 2008). To prepare it for the reusing businesses, the MRF gets the 32% of the waste that is recyclable. Paper and cardboard make up 10.5% of the items, trailed by plastic PET jugs (4.8%), glass (4.3%), and metals (2.8%). The MRF residuals (9.5%) and the leftover waste (68%) will be shipped off an incinerator. The incinerator's extras will be unloaded in a landfill. Like SR5, SR6 (Fig. 3d) reuses metal, glass, plastic PET jugs, paper, and cardboard.34.7% of natural waste, including food and wood squander, is treated by fertilizing the soil rather than consuming. Along with treatment extras from fertilizing the soil and reusing, the excess squanders (18.4%) are scorched. The incinerator's extras will be landfilled.

The second the waste enters a MRF, landfill, or incinerator is remembered for the framework limits. As indicated by Goedkoop et al. (2010), the model considers a second-request framework limit, which incorporates all life cycle processes except for discarding capital products and foundation property. Since the transportation costs are no different for each SR, they are excluded. The methodology involves treating the soil or MRF to expect source division for the SRs. The sweltering climate and these boundaries make outflows decline or spread to the dirt. As indicated by the CML 2001 (Leiden 2001), the effect appraisal stage LCIA relegates the subsequent emanations to the fitting natural effect classes.

Table 8.2: Decision Matrix for Environmental Criteria

	PC	GS	RC	CE
PC	1	4	3	0.5
GS	0.25	1	3	0.25
RC	0.33	0.33	1	0.20
CE	2	4	5	1

Economical Civil strong waste technique estimating is an intelligent interaction. This is a result of the significant time-frame skylines of the elaborate expectations, which are connected to the country's coordinated long haul vision for MSW the executives notwithstanding the various variables that impact the amount of waste produced. Among them are the developing populace, moving socioeconomics, and various different things referenced in ECC (2014). Because of this, common next period time series forecasting techniques like seasonal forecasting, moving average, and exponential smoothing produce unreliable results (Armstrong 1985). Since linear regression yielded the most accurate estimates, we used it to extrapolate the MSW generation tonnage for this study. The pairwise comparison between the criteria is as follows:

Table 8.3: Criteria Impacts, Ranks, and Eigenvalues

Cat	Impacts	Rank	(+)	(-)	Eigenvalue
Cost Effectiveness	25.1%	3	5.4%	5.4%	0.25076
Job Creation	29.5%	2	4.3%	4.3%	0.294631
Resource Recovery	35.6%	1	9.6%	9.6%	0.35639
Economic Impact on Local Business	9.8%	4	9.8%	9.8%	0.98213

The equivalent yearly income throughout the span of the venture, addressed by the underlying expense and the possible rescue esteem, is the capital recuperation for some random speculation. Here, P, F, and n represent the office's originally cost, assessed rescue esteem, and assessed administration life, separately. The undertaking's rescue esteem following 50 years is assessed to be 10% in light of the fact that the underlying expense (an administration project)

did exclude land costs. Considering this, the expense per ton for each not entirely settled. The
decision matrix comparing the criteria against each other is presented below:

Table 8.4: Decision Matrix

	CE	JC	RR	EIB
CE	1	1	0.5	3
JC	1	1	1	3
RR	2	1	1	3
EIB	0.33	0.33	0.33	1

Social Employment The quantity of workers and the quality of the working environment
are the two factors that determine employment. The quantity of employment opportunities that
the MSW SR will take advantage of defines the first parameter. The term "working conditions"
refers to a range of factors that affect an employee's or individual's working environment, such
as amenities, physical surroundings, degree of safety or danger, stress and noise levels, and
labor rights (OHS 2015). standard of living The indicators of noise, odor, traffic, and living
conditions are used to measure this. It is determined by the quantity of complaints that citizens
of the nation or region have filed. The infrastructure pertaining to housing serves as a barometer
for living conditions .The main markers of a good living environment are better water quality,
availability of hygienic facilities, adequate size, and sturdy structural integrity.

The comparison between the criteria based on their impacts, ranks, and Eigenvalues is pre-
sented in the table below:

Table 8.5: Comparison of Criteria Impacts and Eigenvalues

Cat	Impacts	Rank	(+)	(-)	Eigenvalue
1. Public Health Impact	39.3%	1	9.4%	9.4%	0.392895
2. Community Acceptance	8.0%	4	1.6%	1.6%	0.079956
3. Environmental Justice	34.9%	2	3.0%	3.0%	0.349052
4. Quality of Life	17.8%	3	4.4%	4.4%	0.178097

Table 8.5 shows the detailed comparison among Public Health Impact (PH), Community Ac-

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ceptance (CC), Environmental Justice (EJ), and Quality of Life (QOL) based on their impacts, ranks, and both positive (+) and negative (-) contributions, alongside their Eigenvalues.

The decision matrix comparing the criteria against each other is presented below:

Table 8.6: Decision Matrix

	PH	CC	EJ	QOL
PH	1	4	1	3
CC	0.25	1	0.25	0.33
EJ	1	4	1	2
QOL	0.33	3	0.5	1

The decision matrix provides a comparative analysis among the four criteria, indicating how each criterion compares against the others in terms of their relative importance.

8.4   Results and Discussions

To gauge the potential ecological expenses associated with MSW SRs, LCA was completed. Key components of energy, neighbourhood surface geography of land arrangements, and meteorological circumstances were remembered for our review's LCI frontal area and foundation. We found that discharges from the groundwater sub-classification and a piece of the sea sub-class are redirected into the dirt by the country's very dry environment, which has low precipitation and a high pace of vanishing, as well as the close by topographical developments of the springs. The investigation uncovered that the genuine effect of abiotic asset consumption could be undervalued by almost 25 per cent while photochemical oxidation and human poisonousness could be undervalued by almost 9 per cent on the off chance that geographical and meteorological variables were not considered. Fertilizing the soil, reusing, and burning are all important for this SR. While considering the neighbourhood topographical arrangement of the surface geology and meteorological states of the country, the examination likewise shows that abiotic exhaustion was most impacted, trailed by photochemical oxidation and afterward human harmfulness.

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Scores for the Economical We project the generation of MSW waste for over 30 years into the future, with a focus on the year 2050. For our long-term forecast, linear regressions were the most reliable approach because they generated the least amount of error. The first nonrecurring costs were determined empirically using data from AECOM (2012) and Tsilemou and Panagiotakopoulos (2006). Recurring operational costs comprise energy, laboratory, and raw material expenses,wastewater disposal, labour, supervision, facility maintenance,Insurance, overhead, and training programs (Mittal P et al., 2023).

Scores for the social Section 4 delves into the definition and assessment of social indicators and their sub-themes, drawing on Delhi's (2008) AHP method. Information from focus group discussions was combined with expert opinion and judgment to create the data for the social assessment of the suggested MSW SRs. Researchers, private companies involved in MSW collection and treatment, and executives and experts from Kuwait Municipality Department of Environment comprised the focus groups. The focus group talked about the administrative, social, legal, technical, economic, and physical aspects of various MSW alternatives in relation to the environmental aspects of local businesses. Additionally, previously gathered information from a survey of more than 800 homeowners was provided to the experts. This survey was designed to determine the social and demographic makeup of the waste-generating communities as well as their opinions of the advantages and disadvantages of the current waste management system.

TBL evaluation The computation and standardization of CSI values that were obtained by cross-augmentation are the means by which the TBL assessment is communicated. In this manner, the discoveries exhibit that the territory of Uttar Pradesh is currently ready to recommend an ISWM framework because of the extension of LCA to incorporate both the financial and social perspectives. Nonetheless, on the grounds that the strategy is delicate to squander organization, allocated needs to each BL, the feasibility of natural waste for fertilizing the soil, proficiency of arranging at the source and MRF productivity, nearby circumstances, and waste creation, these outcomes probably won't be ideal for different nations with various financial setting and needs.

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Criteria	Eigenvalues
Environmental	4.206
Social	4.062
Economic	4.061

Table 8.7: Eigenvalues of Criteria

8.5 Conclusion

The solutions must be economically and socially acceptable, as well as environmentally viable, in order to develop an integrated and sustainable MSW system. The TBL framework was utilized in this research to facilitate the integrated MSW solutions' sustainability objectives. LCA was done inside the ecological BL as per the ISO 14044 norm to evaluate the conceivable natural weights associated with different MSW the board SRs. The accompanying classifications of natural effect — abiotic exhaustion, fermentation, eutrophication, an Earth-wide temperature boost, human harmfulness, and photochemical oxidation — had their still up in the air. The standardized qualities showed that landfilling is at present the most oppressive of the MSW the board SRs that were thought about. But the most effective SRs were those that combined composting with any other form of treatment, ideally incineration.

Given its heartiness for the long-range arranging skyline for the year 2050, direct relapse was utilized inside the monetary BL to work out figures for MSW age for a long-range arranging skyline. There was a lack of costing data accessible for the material recuperation offices, reusing incomes, and waste treatment offices, requiring broad information mining in both worldwide government reports and distributed writing. These nonrecurring first costs included site portrayal, natural appraisal, hydrogeological study, and land securing designing plan; development costs included clearing the site, exhuming it, building structures, and giving specialized hardware; furthermore, different expenses were incorporated. The yearly repeating functional expenses were additionally considered. These included expenses for work, natural substances, office upkeep, protection, above, and energy.

The societal BL looks at how the residents are affected by a certain MSW management

strategy. The research demonstrated how the social dimension's impact on MSW differs greatly amongst cultural contexts. The subcategories of waste composition and the most recent treatment technologies within each category will be the focus of future research. Further investigation will also focus on conducting more viability studies on financial incentives for the use of recycled and biodegradable materials in industry. Solid waste management is a critical global issue that requires comprehensive strategies to address its environmental, social, and economic dimensions. The integration of the Triple Bottom Line (TBL) framework, along with the application of Analytic Hierarchy Process (AHP), offers a valuable approach for evaluating and improving waste management systems. This study aimed to conduct a TBL assessment of solid waste management, employing AHP as a decision-making tool.

Table 8.8: Criteria Weights and Sub-Criteria Analysis

Criteria	Sub-Criteria	Local Weight	Global Weight
Social (4.062)	Public health impact	0.392895	1.5959
	Community acceptance	0.079956	0.3248
	Quality of life	0.349052	1.4178
	Environmental justice	0.178097	0.7234
Economic (4.061)	Cost effectiveness	0.25076	1.0181
	Job creation	0.294638	1.1965
	Resource recovery	0.35639	1.4472
	Economic impact on local business	0.098213	0.3988
Environmental (4.206)	Political compliance	0.3118421	1.3116
	Governmental support	0.132909	0.5590
	Regulatory compliance	0.076127	0.3201
	Community engagement	0.479122	2.0151

The findings of this research underscore the importance of considering the environmental, social, and economic dimensions in solid waste management. By incorporating the TBL frame-

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work, decision-makers can assess the impact of waste management practices on ecosystems,
natural resources, human health, and community well-being. The evaluation of environmental
effectiveness enables the identification of strategies that minimize environmental impacts, such
as waste reduction, recycling, and energy recovery.

The social dimension of waste management is crucial for ensuring equitable access to waste
management services and promoting community engagement. Public participation, awareness
programs, and social justice considerations contribute to building sustainable waste manage-
ment systems that address the diverse needs and concerns of communities. By evaluating the
social implications within the TBL framework, decision-makers can foster inclusiveness, social
equity, and empowerment in waste management practices.

The economic dimension plays a vital role in shaping waste management strategies. Cost-
effectiveness, revenue generation, and economic benefits are important considerations in evalu-
ating waste management options. By assessing the economic viability of different strategies
within the TBL framework, decision-makers can identify approaches that achieve financial
sustainability while also considering environmental and social outcomes. This promotes the
adoption of waste management practices that optimize resource recovery, generate employment
opportunities, and contribute to overall economic well-being.
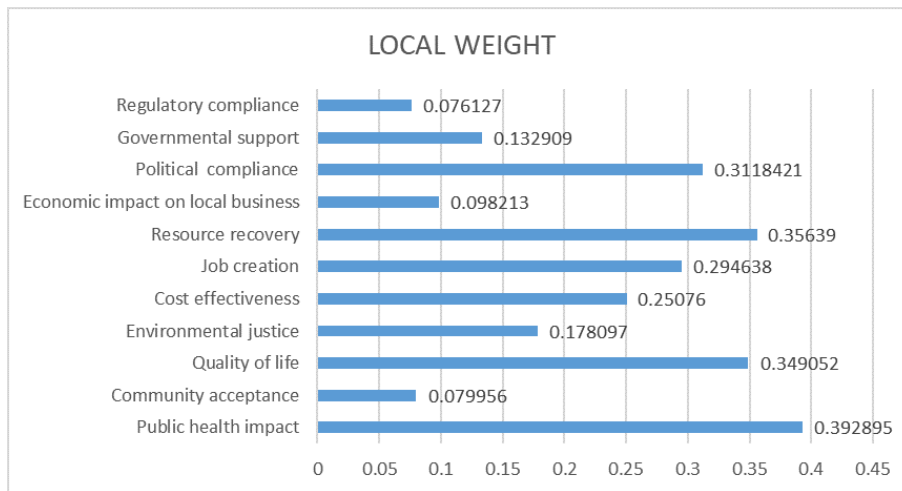
Figure 8.1: Local Weight

The application of Analytic Hierarchy Process (AHP) in the TBL assessment of waste management systems enhances decision-making processes. AHP provides a systematic and transparent methodology for structuring complex problems, prioritizing criteria, and deriving weights based on pairwise comparisons. By incorporating expert opinions, stakeholder inputs, and available data, AHP enables decision-makers to make informed choices and allocate resources effectively. This facilitates a comprehensive evaluation of waste management strategies, leading to more sustainable and balanced decisions.

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Chapter 9

The Impact of Artificial Intelligence on Customer Relationship Management in the Indian Banking Industry

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Abstract The banking sector in India is a crucible of technological evolution, and AI-driven CRM is at the forefront of this transformative journey. AI's revolutionary impact on CRM is undeniable, offering highly personalized and efficient services. It streamlines customer interactions, automates routine tasks, enhances predictive analytics, and fortifies security and fraud detection. Chatbots are becoming pivotal in the real-time assistance of customers, significantly improving response times and reducing customer service costs. Predictive analytics enables banks to anticipate customer needs and recommend tailored financial products, driving customer retention rates and business growth.

The study reveals that AI technologies are playing a transformative role in reshaping the landscape of customer relationship management in the Indian banking industry. With the continuous evolution of AI technologies, Indian banks are well-positioned to navigate the changing banking landscape and deliver innovative services while upholding the highest standards of security, data privacy, and regulatory compliance.

Keywords: Artificial Intelligence, Customer Relationship Management, Banking Industry, India

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9.1   Introduction

Artificial Intelligence (AI) stands as a beacon of technological innovation, illuminating the path toward an entirely new landscape in Customer Relationship Management (CRM) within the Indian banking sector. This transformative journey spans the past, present, and a promising future, offering a compelling narrative of evolution and adaptation.

9.1.1   The Past: CRM in Indian Banking

To understand the significance of AI in CRM today, we must first journey into the past. The historical framework of CRM within Indian banks paints a picture of a sector that operated on the bedrock of manual processes. In this era, customer interactions were predominantly in-person or over the telephone, yielding reactive responses to customer needs and relatively impersonal exchanges (Laudon, & Laudon, 2019). One of the most striking characteristics of this bygone era was the limited capacity to leverage data for strategic purposes. Customer data resided in siloed databases, with little opportunity for meaningful analysis (Creswell & Creswell 2017). CRM practices were burdened by inefficiencies, lacking the ability to anticipate and respond to customer requirements or market dynamics proactively (Asif et al., 2023).

9.1.2   The Present: AI Revolutionizing CRM

Fast-forward to the present, and the transformation is astounding. AI has disrupted and revolutionized CRM in Indian banking. It has bestowed upon the sector the power of real-time data analysis and advanced predictive analytics, enabling banks to provide highly personalized and proactive services. AI-driven chatbots, virtual assistants, and sentiment analysis technologies have elevated customer interactions to a level of sophistication unimaginable in the past (Laudon, & Laudon, 2019). These automated tools offer 24/7 support, efficiently handling customer inquiries and addressing concerns with speed and precision (Tiwari, et al., 2021).

Predictive analytics have become a cornerstone of CRM, allowing banks to anticipate customer needs and offer tailored solutions, thereby fostering a deeper level of engagement and

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satisfaction. AI's role in the present extends beyond enhanced customer interaction. It also plays a pivotal role in the realm of security and fraud prevention. With the banking sector under constant siege from sophisticated cyber threats and fraud attempts, AI has emerged as a stalwart guardian. It is capable of identifying and responding to potential breaches with remarkable speed and accuracy, thereby reinforcing customer trust and safeguarding sensitive financial information (Creswell & Creswell 2017).

One of the most profound developments of the present era is the integration of Natural Language Processing (NLP) and sentiment analysis into customer interactions (Czaja & Blair, 2018). This innovation enables banks to not only understand customer feedback but also adapt their strategies and services in response to customer concerns and expectations. Sentiment analysis provides insights into the emotional tenor of customer interactions, offering valuable data that banks can use to fine-tune their services and better meet customer expectations (Gupta and Tiwari, 2023).

9.1.3   The Future: AI's Promise in CRM

Looking forward, the future of AI in CRM holds immense promise. Several trends are poised to reshape the landscape of customer relations within the Indian banking sector.

- Hyper-Personalization: AI will redefine the customer-bank relationship by offering not just personalized but predictive experiences. AI's capacity for data analysis will enable banks to anticipate individual needs and offer tailor-made financial products and services, aligning precisely with each customer's unique circumstances and preferences.

- Automation: The drive toward automation is set to continue. Routine and repetitive tasks, such as data entry and transaction processing, will be further automated, allowing human resources to engage in more creative and value-added activities. This will enhance operational efficiency, contributing to a smoother customer experience (Tiwari et al., 2022).

- Enhanced Customer Insights: AI will unlock deeper insights into customer behaviors and preferences. These insights will become invaluable for crafting more effective marketing

strategies and customer retention initiatives. By understanding the motivations and desires of customers on a profound level, banks can deliver solutions that better meet their evolving expectations.

- Risk Management: Risk management, particularly concerning loan approvals and investment decisions, is poised for a revolution. AI's advanced analytical capabilities will play a pivotal role in risk assessment and mitigation, ensuring that the risk-return balance remains optimal.

- Regulatory Compliance: As regulatory requirements evolve, AI will ensure that banks remain adaptable and compliant. AI-driven systems will monitor and update processes in real time, ensuring ongoing compliance with evolving regulations. This will be crucial in an environment where regulatory changes are a constant and sometimes unpredictable challenge.

- Data Security: The security of customer data and the prevention of fraud will remain central concerns. AI will continue to evolve in its role as a vigilant guardian, identifying and preventing fraud, safeguarding customer data, and ensuring that the integrity and privacy of financial information are maintained.

This research-based learning project seeks to delve deeply into these historical, present, and future dimensions of AI's impact on CRM within the Indian banking sector. It aims to offer an in-depth exploration of how these transformations are shaping the industry, influencing the quality of customer experiences, and contributing to India's position in the global financial landscape.

The study recognizes the pivotal role that AI plays in not only improving operational efficiency but also in shaping the future of customer relations, offering insights into the evolving banking landscape. In an era where technology is rapidly changing the dynamics of the banking sector, this research project provides a valuable opportunity to analyze the profound implications of AI in the ever-evolving context of Indian banking.

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9.2   Literature Review

The banking sector in India is at the forefront of a transformative journey driven by the infusion of Artificial Intelligence (AI) into Customer Relationship Management (CRM). AI technologies are redefining how banks in India engage with customers, optimize their services, and adapt to the dynamics of the digital age (Czaja & Blair, 2018).

Jora et al. (2022) point out that the pandemic has reshaped consumer priorities, necessitating AI-driven solutions for ensuring health and safety in retail. AI-driven technologies have become instrumental in creating seamless digital and Omni channel experiences, as observed by Johnson (2021). Mittal (2020) highlights significant investments in AI by the retail sector, with leaders like Company XYZ revolutionizing CRM through personalized recommendations and efficient customer engagement.

Mittal et al. (2023) underscores the growing significance of AI in CRM, with a focus on enhancing customer-brand relationships. AI's role in gathering and analyzing customer feedback, as mentioned by Peffers et al. (2007), is crucial in improving customer experiences. Bharadwaj (2000) discuss the theoretical and practical implications of AI in CRM, with companies like Company XYZ serving as models for effective AI integration.

Bryman (2015) stresses the importance of understanding customer perceptions of AI technology. He highlighted the need for AI research to address CRM challenges in a post-pandemic world. The author findings underscores AI's role in analyzing vast data generated during the pandemic, while its impact on the digital customer experience and business strategies.

Devenport et al. (2010) advocate for value creation through Industry 4.0 technologies and the role of AI in CRM. Johnson (2021) highlight the significance of web-based technologies in overcoming COVID-19 challenges, emphasizing the need for businesses to adapt. Moore et al. (2021) explore the role of digital technologies in maintaining customer engagement during crises, underscoring the importance of using data to guide new approaches.

Davis (2016) discuss AI's contribution to predictive analytics in Indian banking. AI algorithms are helping banks anticipate customer needs and recommend customized financial products, leading to improved customer retention rates and business growth. In our exploration

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of the profound impact of Artificial Intelligence (AI) on Customer Relationship Management (CRM) in the Indian banking sector, we embarked on a journey that spanned historical legacies, current innovations, and promising future trends. Let us revisit the foundational insights from our introduction and the extensive discussion, contextualized within the research objectives initially set for this study.

9.3   Discussion and Finding

9.3.1   Historical Context: A Trip Down Memory Lane

Our journey commenced with an excavation of the historical landscape of CRM within Indian banks. It revealed a bygone era characterized by manual processes, restrained data utilization, and predominantly reactive and impersonal customer interactions. Customer data, a dormant treasure trove, resided in fragmented silos, leading to missed opportunities for insightful analysis. This historical backdrop painted a picture of CRM marked by inefficiencies and missed potential.

9.3.2   Contemporary Dynamics: The AI-Powered CRM Era

Transitioning from the past to the present, we unveiled a CRM paradigm thoroughly transformed by the infusion of AI. AI stands as the disruptive catalyst, endowing banks with the prowess to process and analyze colossal repositories of customer data in real-time (Mittal et al., 2023). This transformation has facilitated a transition toward personalized and proactive services. AI-driven innovations such as chatbots, virtual assistants, and sentiment analysis have elevated customer interactions to an unprecedented echelon of sophistication, fostering deeper customer satisfaction and trust. One of the most significant developments in the contemporary Indian banking milieu has been the amalgamation of Natural Language Processing (NLP) and sentiment analysis into customer interactions. These innovations enable banks not only to comprehend customer feedback but also to adapt their strategies and services in real-time, providing dynamic and adaptive responses to customer concerns and expectations.

9.3.3   Future Horizons: Navigating the AI-Enriched CRM Landscape

Peering into the future, our discussion unveiled a panorama of promising trends poised to re-shape CRM practices in the years to come:

- Hyper-Personalization: AI is on the verge of revolutionizing the customer-bank relation-ship by not just personalizing but predicting customer experiences. The capacity for AI to anticipate individual needs is set to usher in custom-tailored financial products and services, finely attuned to the unique circumstances and preferences of each customer.

- Automation: The onward march of automation is set to continue. Routine, repetitive tasks, from data entry to transaction processing, are bound to be further automated, liber-ating human resources to engage in more creative and value-added pursuits. The endgame is operational efficiency, contributing to a seamlessly enriched customer experience.

- Enhanced Customer Insights: AI's profound aptitude for gleaning deeper insights into customer behaviors and preferences will play a pivotal role in sculpting more effective marketing strategies and customer retention initiatives. By plumbing the depths of cus-tomer motivations and desires, banks can render solutions that better align with evolving expectations.

- Risk Management: The paradigm of risk management, especially concerning loan ap-provals and investment decisions, is braced for a seismic shift. AI's analytical prowess is set to be instrumental in both risk assessment and mitigation, ensuring that the delicate balance between risk and return is optimally maintained.

- Regulatory Compliance: As regulatory exigencies continue to evolve, AI will assume the role of the guardian, guaranteeing that banks remain pliable and compliant. AI-powered systems will vigilantly monitor and adapt to the evolving regulatory landscape, addressing one of the most pressing challenges in the sector.

- Data Security: The twin concerns of data security and the deterrence of fraud will remain in the spotlight. AI will continue to evolve in its role as the vigilant guardian, identifying

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and forestalling fraud while safeguarding the integrity and confidentiality of customer data.

9.3.4   Reflecting on Objectives: A Tapestry of Insights

In the context of our research objectives, let us revisit the central findings that have emerged from our deep dive:

Impact on User Participation Index: AI 's seamless integration into CRM has propelled the User Participation Index to unprecedented heights. AI-powered chatbots and virtual assistants, coupled with predictive analytics, have ignited customer engagement. The result is an elevated User Participation Index within the Indian banking sector, as AI enhances user experiences and kindles more profound customer interaction.

Impact on Policy Regulation Barriers: AI's triumphant journey in CRM has posed a stern test to policy regulation barriers. Policymakers find themselves at the crossroads, weighing the scales between innovation and security. While AI enhances efficiency, the spectre of data breaches and privacy infringements lingers. Consequently, policymakers are continually refining policies to accommodate AI, all the while ensuring that customer data and the financial system remain securely guarded. Compliance with evolving regulatory prerequisites is the key to a harmonious integration of AI-driven innovations.

9.4   Conclusion

The ascendancy of AI in CRM has cast a spotlight on concerns regarding privacy violations. The boundless collection and analysis of customer data raise the spectre of data security and privacy. The tightrope that banks now tread involves skillfully balancing the utilization of customer data for service enhancement with the sacrosanct duty of protecting customer privacy. It is a fine equilibrium that necessitates robust data protection mechanisms to preclude encroachments on the privacy violations threshold.

AI's role in sculpting digital safety awareness levels presents a dichotomy. On one hand, it has augmented the consciousness of potential threats and vulnerabilities in the digital realm,

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particularly within the banking sector. The enhanced role of AI in fraud detection and real-time security monitoring has instilled a sense of assurance among customers. Simultaneously, it has catalyzed a greater awareness of the need for digital safety practices. Customers are increasingly prompted to embrace more secure practices for safeguarding their digital assets, aligning with the fortified awareness levels ushered in by AI.

To harness the transformative potential of AI, banks must exemplify adaptability and agility. The alignment of AI-powered innovations with evolving regulatory requirements, while ensuring the harmonious coexistence of these technologies with the sacrosanct principles of data security and customer privacy, is paramount. Customer-centricity remains the lodestar, and the ability to provide personalized, anticipatory experiences will define the winners in the sector.

The banking domain should continue to embrace innovation and push the boundaries of what is achievable with AI. It must be noted that the trajectory of AI in CRM within the Indian banking sector is still unfolding. The onus lies on banks to steer through this ever-evolving landscape skillfully, making the most of AI's potential while adroitly addressing the challenges and responsibilities it brings in its wake. As AI continues to evolve, the financial institutions of India have the opportunity to become leaders on the global stage, pioneers in crafting a CRM framework that is not just efficient and secure but also intensely customer-centric. They have the chance to usher in an era where banking is defined by personalized services, anticipatory offerings, and unwavering dedication to the principles of data security and customer trust.

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Chapter 10
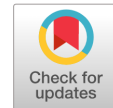
A Conceptual Framework for Digital Platform: A Soft System Methodology Approach

Laxmi Gupta[*] [ID]

Abstract In the dynamic landscape of digital technologies, the need for effective frameworks to guide the development and operation of digital platforms is paramount. The purpose of this study is to provide a holistic and systematic method to address complex, ill-structured problems, making it particularly suitable for the nuanced challenges posed by digital platforms. The Soft System Methodology (SSM) was developed for this study, which deals with the challenges and critical factors for Digital Platforms. The conceptual framework presented in this paper synthesizes key elements from SSM, adapting them to the specific requirements and intricacies of digital platforms. The proposed framework emphasizes the importance of a systems thinking perspective in designing and managing digital platforms, considering both the technical and social dimensions. It provides a structured approach for stakeholders to analyze, model, and optimize digital platform processes, fostering adaptability and sustainability in an ever-evolving technological landscape.

Keywords: Digital platforms, Soft System Methodology, Conceptual framework, Systems thinking, Technology, Systems analysis

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10.1   Introduction

Research on the adoption of digital platform has been conducted in both developed and developing nations worldwide (Chen et al., 2020). The trends of digitalization and shifting of market places online is global, but due to infrastructure and trust deficits in the virtual world, platforms are not yet able to replace the physical market spaces completely (Kenney and Zysman, 2016; Gupta and Tiwari, 2023). Digital platforms systems are designed for convenience and allow users to connect from far away places and get the best of the goods and services remotely with just a click of their devices (Schubler, 2018). Risk issues with internet based platforms are increasing day by day and there are certain gaps which hinder the user to switch to online modes.

Platforms such as malls which link consumers & merchants and newspapers which connect subscribers & advertisers have existed for years. But the latest information technology has remarkably reduced the need to own any physical infrastructure and assets (Dai and Nu, 2020). IT has made building and scaling up platforms very cheap and simple, while allowing for smooth participation that strengthened network effects, and enhanced the ability to capture, analyze, and exchange large amounts of data that increases the platform's value to all the stakeholders (Parker and Alstyne 2016; Parkar et al., 2016). A platform is a business that enables value-creating interactions between external producers and consumers. It provides an open, participative infrastructure for such interactions while setting governance conditions for them. Its purpose is to complete matches among its users to facilitate the exchange of goods, services, or some social currency, thus enabling meaningful value exchanges between all participants (Jora R, 2022). In today's rapidly changing technological landscape, digital platforms emerged as a powerful force in shaping the way people interact, communicate, and conduct business (Berman and Willems 2020; Chen and Dubois 2019). A digital platform is a software-based infrastructure that enables multiple users to interact with each other, usually for a specific purpose or activity. These platforms are designed to facilitate communication, transactions, and collaborations between users, and they have become an essential part of modern life. From social media and e-commerce to on-demand services and cloud computing, digital platforms

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have transformed the way we live, work, and play. They have created new business models and revenue streams, enabled unprecedented access to information, and transformed the way we connect and collaborate with others. As the digital landscape continues to grow, the importance of digital platforms is only expected to grow, as they become more deeply integrated into our daily lives and the global economy.

To sum up we can define Platforms as: "A platform is a business based on enabling value-creating interactions between external producers and consumers. The platform provides an open, participative infrastructure for these interactions and sets governance conditions for them. The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants."

As these platforms continue to evolve, the need for robust frameworks and methodologies becomes crucial to guide their development and ensure their seamless integration into diverse environments. Despite the multiple research on digital platforms, certain gaps persist. These gaps may include the need for a unified conceptual framework that incorporates both technical and social dimensions, and a comprehensive understanding of the systemic interactions within digital ecosystems. Identifying and addressing these gaps is crucial for advancing our understanding and facilitating more effective strategies for digital platform development and management (Mittal et al., 2023). Hence, this study endeavours to address the complexities of digital platforms. The research objective encompass the development of a holistic conceptual framework and the application of Soft System Methodology to enhance our understanding of digital ecosystems. The research objective of this study are as follows:

RO-1: To understand the issues faced by various stakeholders in functioning of digital platforms.

RO-2: To develop a conceptual framework for the management of digital platform issues through the mapping of identified issues with their possible solutions.

These objectives guide the research towards providing actionable insights for stakeholders in the digital platform domain. The contribution of this research lies in its synthesis of Soft System Methodology principles into a conceptual framework tailored for digital platforms. By bridg-

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ing the gap between technology and social dynamics, the study aims to offer a practical guide for stakeholders involved in the design, implementation, and management of digital platforms. (Asif M, et al., 2023; Tiwari, et al., 2021). This contribution aligns with the broader goal of fostering adaptability and sustainability in an ever-evolving technological landscape.

10.2   Literature Review

Since the 1990s, digital-driven technologies have accelerated the evolution of global business organisations, creating a new type of business organisation called the "platform economy." The platform economy model is the most notable economic model of the twenty-first century, may be characterised as a combination of economic and social activities generated by a transaction platform to link suppliers and consumers to enhance sales and profits (Xu and Lee, 2020). The pipeline business model, which was based on the idea of producing and selling more to build value, has been replaced by digital platforms, which are proving to be game changers (Parker et al., 2016). Industry borders and the nature of rivalry are being redrawn by digital platforms. Digital platforms have become a crucial part of modern business models, enabling firms to create new markets, generate revenue streams, and increase their customer base.

In the last ten years, there have been several studies conducted on the platform economy, most of these focused solutions towards implementation. However, the success of digital platforms is dependent on various factors, which are critical to their success. One of the most important is network effects, which refers to the value that a platform creates by connecting users and increasing the number of participants. According to Boudreau and Lakhani (2015), network effects drive user adoption, which can lead to increased value creation for all users. Furthermore, the ability to scale is another critical factor that can impact the success of digital platforms. Scaling involves increasing the platform's user base and capabilities to meet growing demand, while ensuring that quality is maintained (Chen and Dubois, 2019). Providing a seamless user experience is also critical, as it can improve user engagement and retention (Berman and Willems, 2020). Additionally, offering unique value propositions, building trust among users, and having a solid monetization strategy are other essential factors that can impact the

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success of digital platforms. There are relatively fewer research that examine the dyadic interaction when it comes to digital platforms in business-to-business transactions; instead, most studies either concentrate on the client or service provider sides (Jiang et al., 2019).

Many organizations do not know the ideal B2B digital marke2011). Also, future study should examine platform service provider tactics and their effects on stakeholders and their response mechanisms. Consequently, there is a need to study the critical factors that lead to effective adoption of digital platforms (Chong et al., 2016; Johnson, 2013) and the performance of B2B digital platforms, which are prominent in businesses worldwide yet understudied While the literature provides a rich understanding of digital platforms, certain gaps persist. There is a need for research that synthesizes existing knowledge into practical frameworks applicable to diverse contexts. By building upon prior studies, this research aims to contribute fresh perspectives and refine existing theories. Hence, this study include the need for a unified conceptual framework that incorporates both technical and social dimensions, and a comprehensive understanding of the systemic interactions within digital ecosystems. The research involve formulating a comprehensive conceptual framework and employing Soft System Methodology to enrich our comprehension of digital ecosystems.

10.3 Research Methodology

10.3.1 Soft System Methodology

Soft System Methodology (SSM) is a qualitative approach used to tackle complex, ill-structured problems (shown in Figure 1). SSM involves a process of inquiry, which includes identifying the problem, defining relevant system components, and exploring potential solutions (Checkland, 1999; Checkland 2006). SSM is particularly useful in situations where the problem is not well-defined, and there is a need for stakeholder involvement to explore alternative solutions (Hanseth and Lyytinen, 2010). According to Hu and Wilson (2017), SSM can be used to analyse the critical success factors of digital platforms by providing a holistic view of the system and its environment. The basic approach of SSM can be summarized as a seven-step method-

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ology that utilizes the principle of human interaction to illustrate the situation of interaction (Checkland, 1981). Steps of the Soft System Methodology (SSM) are defined in Figure 1 and explains as below:

- Identification of problem situation: The approach to SSM starts from identification of real-world situation where it is difficult for certain stakeholders, now this problem is defined in such an unclear and non - structured condition that results in a symptom map.

- Problem situation expressed: By observing the symptoms map, classify the problem scenario and find the actual underlying issues and the root cause of a problem that leads to a rich picture of the situation.

- Root definitions of relevant purposeful activity system: Firstly, from the rich picture, the problem is described, and then establish a root-definition for process transformation which will address the related issues.

- Development of conceptual models: A theoretical representation is reflected by a conceptual model for the future system. This conceptual model recommends the formation of a particular definition that is referred to as the root definition, and the layout should be targeted to the components of the CATWOE model (Checkland and Scholes, 1999), which are as follows: clients (customers), actors (participants), transformation process, world view, owner, and constraint on the environment.

- Comparison of model and real-world: Here, the conceptual model is compared with the identified problems.

- Identify desired changes and alternative solutions: to achieve solutions, changes are theoretically optimal and culturally viable.

- Approach to solve the situation of the problem: Implementing a final model that can be introduced.

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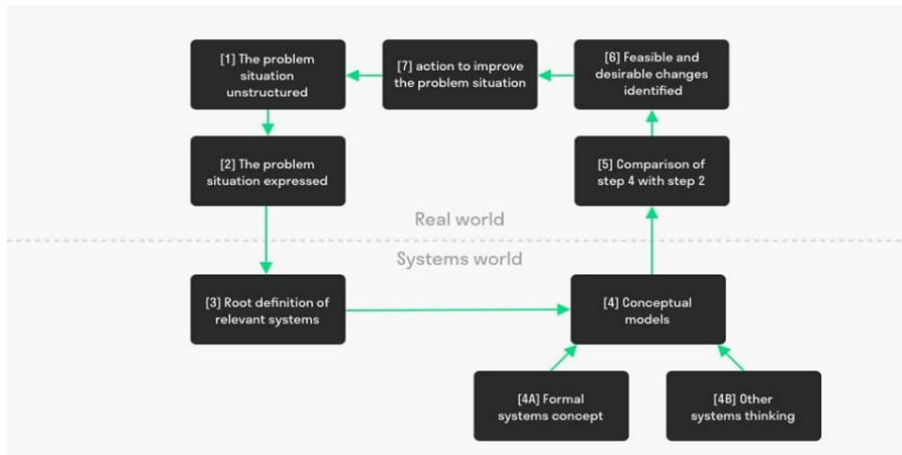
Figure 10.1: Seven Stages of SSM

10.4 Discussion and Analysis

10.4.1 Application of Soft System Methodology

To understand the functioning of Digital Platforms, Soft System Methodology Analysis was done. Various stakeholders were labelled as different Group Levels as follows:

1. Platform Development and Launch: This is the stage where the idea is conceptualized and analysed for market suitability. Here market condition is also important, whether it is a niche market or already matured market. It is important to give right input to the development and launch team, so that the product does not fail during the launch fail. Also, the developing team is also responsible for continuous improvement, so they are one of the major stakeholders.

2. Service Provider Platform User (SPPU): This is a customer for the Platform company but a Service Provider essentially for the customers who visit the platform to buy or access the service. They are usually called "Seller".

3. Platform Service Provider Firm: The main job of these is to provide a Digital market

space with safety checks and payment facilities. It is the platform's role to see that both the "Buyer" and "Seller" parties are satisfied with the service and enough trust is maintained between them.

4. Service User Platform User (SUPU): They access the platform to use the service or buy goods. They are the ultimate key player in determining whether the platform is a success or not. Most of the features.

5. Security/ Quality control: Most of the firms outsource this operation. Some firms have an inhouse team for security and quality control operations. They handle mostly the back-end operations.

6. After sales/ Customer care: These act as a bridge between the customer and the back-end operations team. Any complaint either from SPPU or SUPU are handled by this team. They are essentially on the front-end dealing with both the buyers and the sellers.

7. Regulatory Authority: These are essentially the government agencies looking after the trade practices of the Platforms. For example, Competition Commission of India (CCI) checks that fair trade is being practiced. Together they all work in sync with each other for the smooth functioning of the Digital Platforms and all have their importance and challenges. We will see those challenges in the study and try to find out the root cause behind the problem.

Symptom Map, which is a visual representation of the problem situation and the symptoms associated with it. The Symptom Map helps to identify the underlying causes of the problem and the stakeholders involved in the procurement process. The Symptom map (Figure 10.2) represents all the stakeholders, and the bubbles show the major challenges associated with each stakeholder.

These problems are preliminarily defined here which will be further elaborated in the Rich Picture. Symptom map is a preliminary representation of problems, they are unstructured at this stage, which will be further refined in the rich picture stage.

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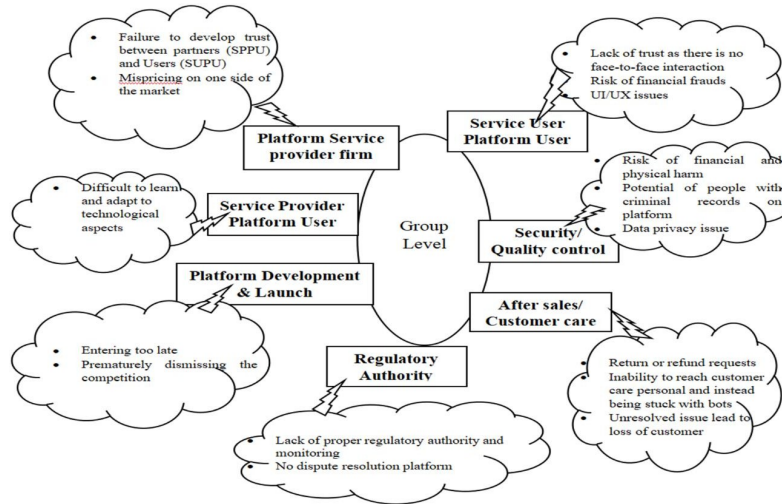
Figure 10.2: Symptom map for Digital Platforms

The Rich picture (Figure 10.3) is a schematic representation of the challenges between the functioning of each stakeholder. As we can see that there is a trust deficit between the SPPU and SUPU and the risk of financial frauds comes between SUPU and security/quality control team.

After defining the challenges for each stakeholder in the Rich picture the root problem is defined, and Alternate Root definition is formulated (as shown in Figure 10.4). The main problem identified is that there is dearth of trust between the partners i.e., the service provider and service user and the platform provider. The alterative to this problem is that is difficult to check fraudulent elements on online digital platforms as there is no face-to-face interaction. Also, another problem is of the fluctuating demand and the lack of flexibility provided to SPPU and SUPU for operations and control. This involves identifying the assumptions, values and beliefs of the stakeholders and considering alternative perspectives on the problem. On the bases of Root problem definition, Conceptual model (Figure 10.5) is defined. It is a hypothesis to recommend boarder solutions to the key problems identified. After conceptualizing the key issues and a broader solution to address thos problems, the Final Implementation Model (Figure 10.6) is made. This represents the final recommendations to improve the gaps in the smooth
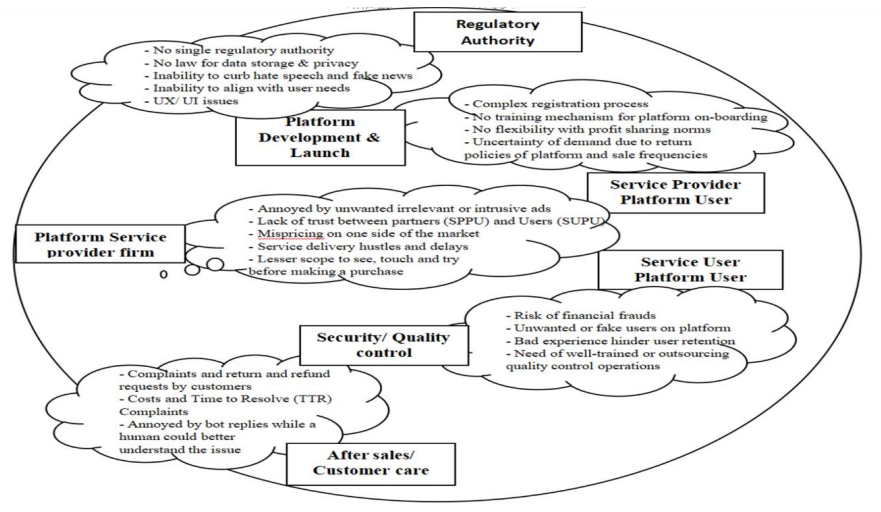
Figure 10.3: Rich Picture

functioning of Digital Platforms.

The recommendations are made on three lines- First is to ensure flexibility in the system b going the user choice and flexibility for profit sharing and other operations and pricing policies. Second is on the lines on improving the control and security of the platform. This is crucial for building trust amongst the partners SPPU and SUPU. Another recommendation is to ensure better communication, transparency, and accountability in the system. This is necessary to ensure accurate prediction of future demand and also there would be no mis- pricing on one side of the market. It will help in providing more positive user experience, increased innovation and greater efficiency.

10.5   Conclusion

In conclusion, this research has presented a conceptual framework for digital platforms, employing the Soft System Methodology (SSM) approach. The evolving nature of digital technologies necessitates adaptable frameworks, and the integration of SSM principles addresses the intricate challenges associated with digital platforms. The proposed conceptual framework

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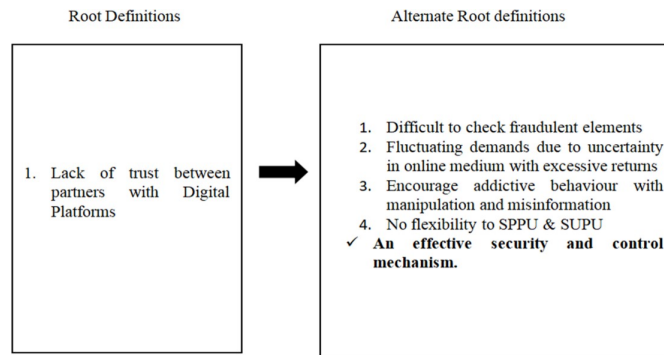
Figure 10.4: Root definitions
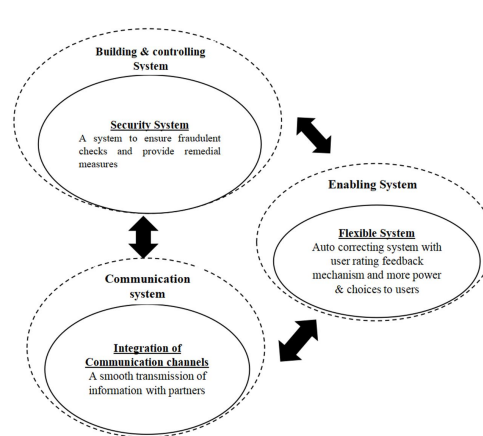
Figure 10.5: Conceptual Model

underscores the significance of a holistic perspective, emphasizing the interconnectedness of technological components, user dynamics, and organizational contexts. By adopting a systems thinking approach, the framework offers a structured methodology for stakeholders to analyze, model, and optimize digital platform processes. Through a thorough review of existing literature and case studies, we have demonstrated the applicability and effectiveness of the proposed framework. The synthesis of SSM principles into the framework not only enhances our understanding of digital ecosystems but also provides a practical guide for stakeholders in the design and management of digital platforms.

As digital landscapes continue to evolve, the presented framework stands as a valuable con-

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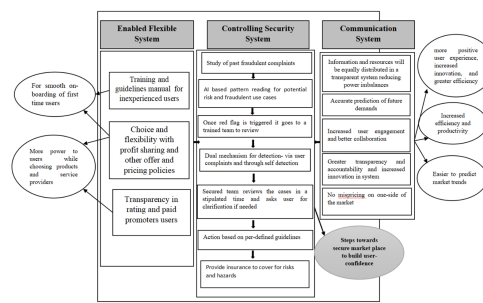
Figure 10.6: Final Implementation Model

tribution to both academic research and industry practice. Its emphasis on adaptability and sustainability ensures its relevance in navigating the complexities of technological advancements. Moving forward, this conceptual framework serves as a foundation for further research and practical applications in the dynamic realm of digital platforms. In essence, the integration of Soft System Methodology into the conceptual framework provides a robust and systematic approach, fostering a deeper understanding of the intricacies involved in the development and operation of digital platforms.

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Chapter 11

Industry 5.0 Contribution to Sustainable Development: A Roadmap for Environmental Sustainability

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Abstract: There is an evaluation of the industry of 5.0 on the sustainability development procedure as much as possible. There is industrial development in evaluating the sustainability procedure. **Material and methods**: Survey analysis is properly determined in the primary qualitative methods with 85 responses. **Significance of the study**: There is an evaluation of some crucial importance of the development of industry 5.0 in the sustainability approach where the crucial development is defined appropriately. **Findings**: The significance of the study on the evolution of the growth of industry 5.0 in the sustainable development in the management working aspects in a proper way. **Conclusion**: There is the development process of sustainability in industry 5.0 is actually organized on the factors which are developed on maintaining a basic implication process.

Keywords: Industry 5.0, Environmental sustainability, Sustainable Development

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11.1 Introduction

Industry 5.0 mainly focuses on the valuation processes that are performed in the industry in order to achieve the success of the business (Mittal P ,2020). Along with this, there are different ways present in industry 5.0 that help to lead industry 5.0 towards sustainable development in the different business organizations (Tiwari et al., 2022). Moreover, in this research project, different research objectives and research questions are developed which also help to achieve the research aim that is developed by the researcher (Tiwari et al., 2021).

11.2 Aim of the Paper

The aim of the research project is to find out the different ways that help to lead industry 5.0 towards sustainable development.

11.3 Objectives

The objectives of the research project are based on the aim of the research project. Therefore the research objectives are as follows:

1. To identify different ways that are present in the development of Industry 5.0

2. To estimate the compatibility between industry 5.0 and the suitable development

3. To find out the effect of industry 5.0 on the sustainable development of the business organization

4. To analyze the energy sectors of industry 5.0 in terms of sustainable development

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11.4   Literature Review

Different ways present in the development of industry 5.0

In terms of developing the approaches that are used in industry 5.0, the organization needs to find out the ways that help to improve industry 5.0. Moreover, these ways also help to improve the technology that is mainly adopted in industry 5.0 (Asif et al., 2023). With the help of this innovative technology, the collaboration process that is performed in industry 5.0 is getting better that the existing one.

Figure 11.1: Different ways present in the development of industry 5.0

Figure 11.1 describes the different ways that are present in industry 5.0. Therefore these ways are human capital and technologies, institutional framework, research, and development theory the economical scale of the industry 5.0, digitalization and implementation of technology, ESG regulation, and sustainable development (Broo et al., 2022; Cillo et al. 2022).

The leading process of industry 5.0 toward the sustainable development

In order to incorporate sustainable development industry 5.0 needs to follow a process. The process is used in order to incorporate sustainable development in the different aspects of industry 5.0.
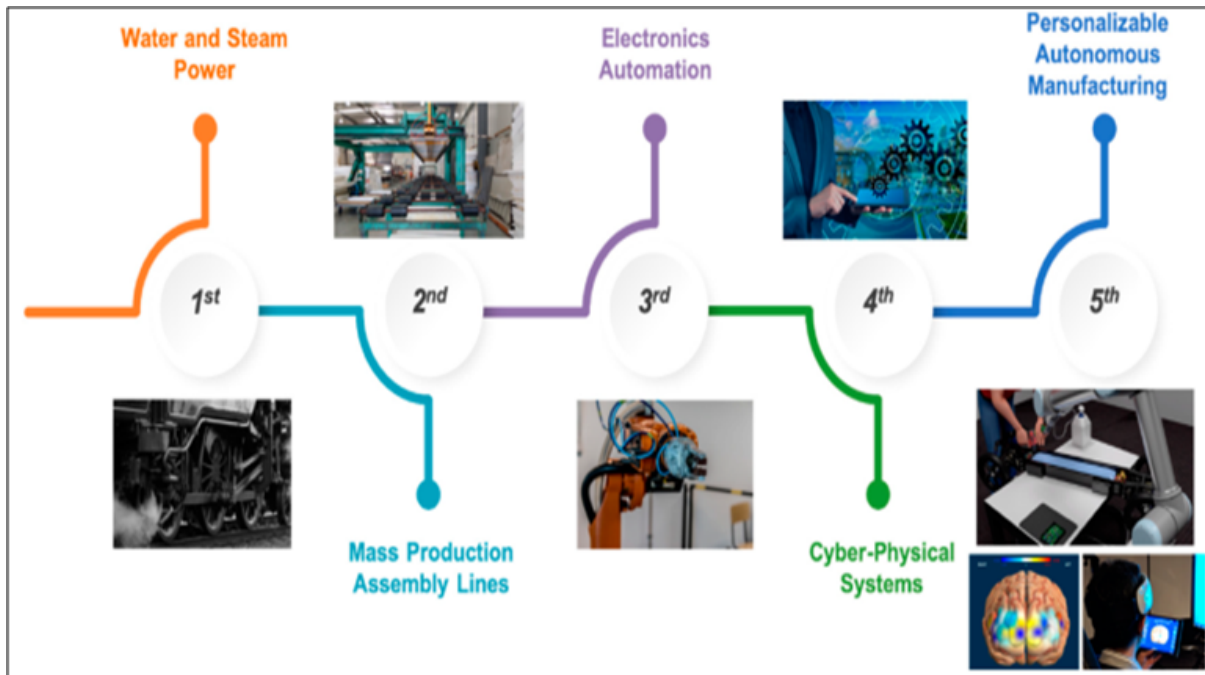
Figure 11.2: The leading process of industry 5.0 toward the sustainable development

Figure 11.2 shows the five different process that is used in industry 5.0 in order to incorporate sustainable development in the internal sector of industry 5.0. Water and steam power need to be maintained in order to promote sustainable development (ElFar et al., 2021). Mass production needs to be monitored in order to assess the sustainable development approach. Moreover, the electric automation process needs to be incorporated in order to produce sustainable development. Cyber-physical system and autonomous manufacturing process needs to be developed in order to incorporate development in industry 5.0 (Madsen et al., 2021; Doyle-Kent et al., 2022).

Key factors of industry 5.0

The key factors of industry 5.0 help to achieve the goal that is developed in industry 5.0. The goals of industry 5.0 are related to the collaboration of technology with human creativity that are observed in the industry as well as in society (Golovianko et al. 2023). Therefore it can be stated that factors of industry 5.0 also promote the approach where the industry can be able to contribute the improvement of society.
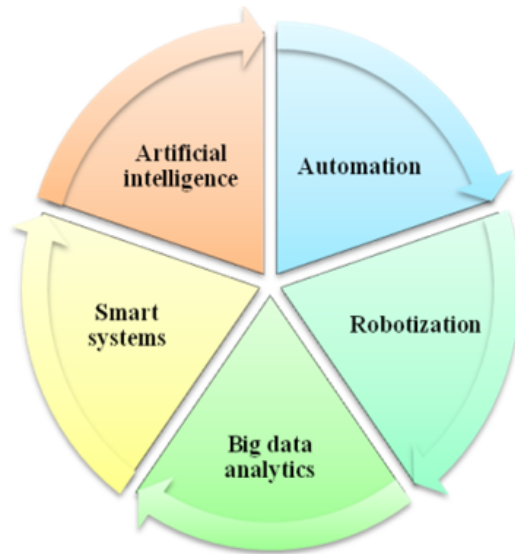
Figure 11.3: Key factors of industry 5.0

Figure 11.3 describes the key factors that are necessary for the promotion of the improvement process of industry 5.0. The key factors are AI, automation, robotization, data analysis, smart system,

11.4.1 Literature gap

The literature gap of this conducted research project is based on the area that is remain uncover by the researcher while collecting different types of relevant information and data. It has been observed that the researcher cannot be able to collect the data on the basis of the advantages of

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incorporating sustainable development in industry 5.0 and along with this the issues faced in
the incorporation process of sustainable development in industry 5.0.

11.5   Theoretical framework

Sustainable development model

The term sustainable development model is developed on the basis of three different types of
pillars. These three pillars are developed on the basis of economic factors, social factors, and
ecological factors. Each of the factors are connected with the others.
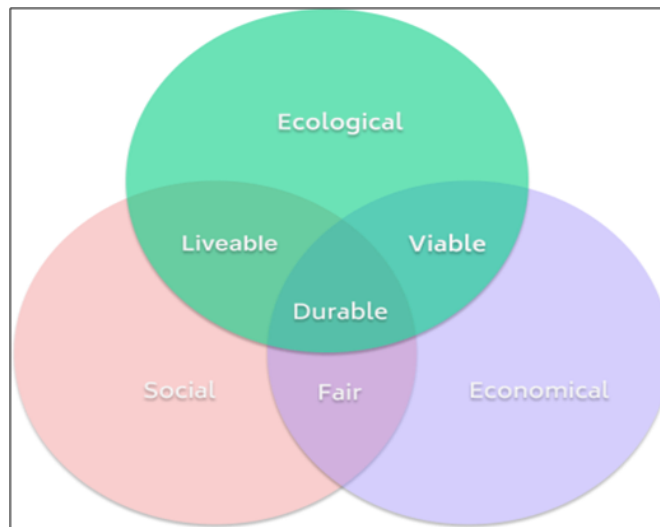
Figure 11.4: Three pillars of sustainable development

Figure 11.4 represents different pillars of sustainable development that are mainly responsi-
ble for achieving all the goals that are required to promote the sustainable development approach
in the internal sector of the organizations of industry 5.0.
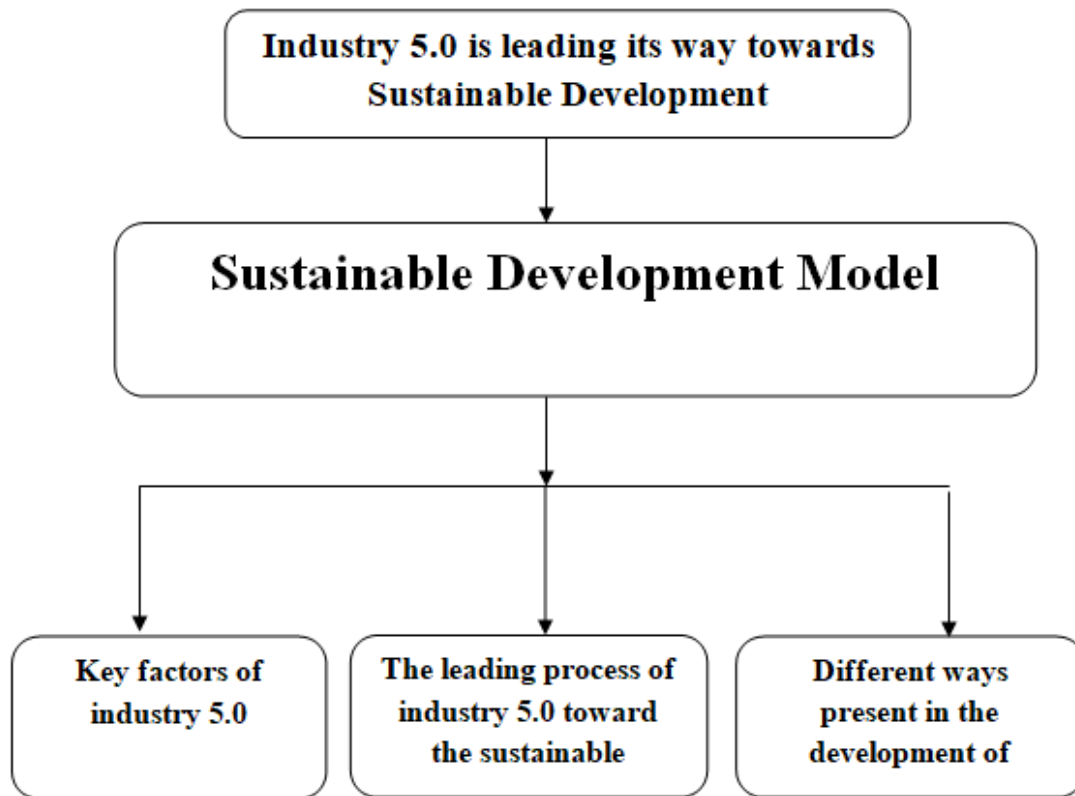
Figure 11.5: Conceptual schema

Conceptual framework

11.6 Hypothesis

- **H1**: There is a link, present between the energy sectors and the key factors of industry 5.0

- **H0**:There is no link is present between the energy sectors and the key factors of the industry 5.0

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- **H2**: There is a strong connection has been observed between industry 5.0 and the sustainable development process

- **H0**: There is no strong connection has been observed between industry 5.0 and the sustainable development process

11.7   Research methodology

Data collection

Data collection is the process that is utilized in the research project in the methodology section in order to improve the quality of the research project. Therefore, it can be stated that with the help of the data collection method, the researcher can be able to collect the data as well as the relevant information from different sources. Hence, it can be clearly noticed that in this research project, the researcher choose the primary quantitative data collection method in order to gather the information from different sources for conducting this research project. Researcher needs to perform the survey analysis process. In order to perform the survey analysis process the researcher selected 85 participants as a sample size for this research project and those 85 participants are going to participate in the survey analysis process. Furthermore, the researcher collects the responses from the participants of the survey analysis process.

Data analysis

The data analysis process is performed by the researcher in order to analyze the are also collected by the researcher in order to conduct this research project. It has been observed that with the help of this data analysis process, the researcher can be able to develop the result and the final findings of the research project. In order to analyze the data the researcher needs to perform the SPSS software where the researcher needs to run different tests such as reliability, validity, and correlation ad so many others. Therefore it can be stated that in this research project, the researcher needs to analyze the statistical data that is collected from the responses of the 85 participants who took part in the survey analysis process.

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	Frequency	Percentage	Valid Percentage	Cumulative Valid Percentage
Female	49	57.6	57.6	57.6
Male	20	23.5	23.5	81.2
Prefer not to say	16	18.8	18.8	100
Total	85	100	100	

Table 11.1: Gender

11.8   Results and Findings

11.8.1   Demographic Data

Table 11.1 shows that the highest number of percentage has been received by the female partic-
ipants and the lowest number of percentage has been received by the participants who are not
interested to provide their information about gender.
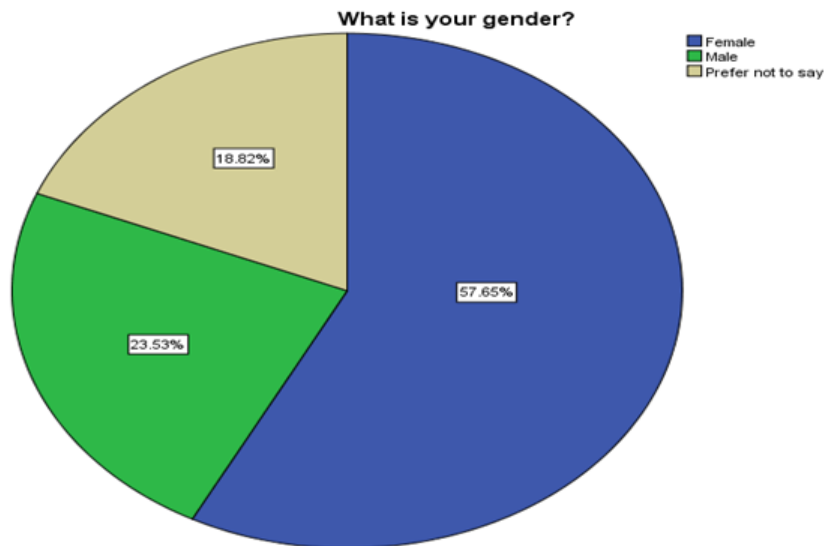
Figure 11.6: Gender

Figure 11.6 observed that female participants are given the most number of responses in
the survey analysis process, and on the hand, it has been noticed that the lowest number of

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	Frequency	Percent	Valid Percent	Cumulative Valid Percent
Between 20 to 25 years	5	5.9	5.9	5.9
Between 25 to 30 years	40	47.1	47.1 5	2.9
Between 35 to 40 years	40	47.1	47.1	100.0
Total	85	100.0	100.0	

Table 11.2: Age group

responses are collected for the participants who are not interested to provide their information
about gender.

Age Group

Table 11.2 shows that the highest number of percentage has been received by the participants
who belong to the 25 to 30 years of age group and the lowest number of percentage has been
received by the participants who belong to the 20 to 25 years of age group.
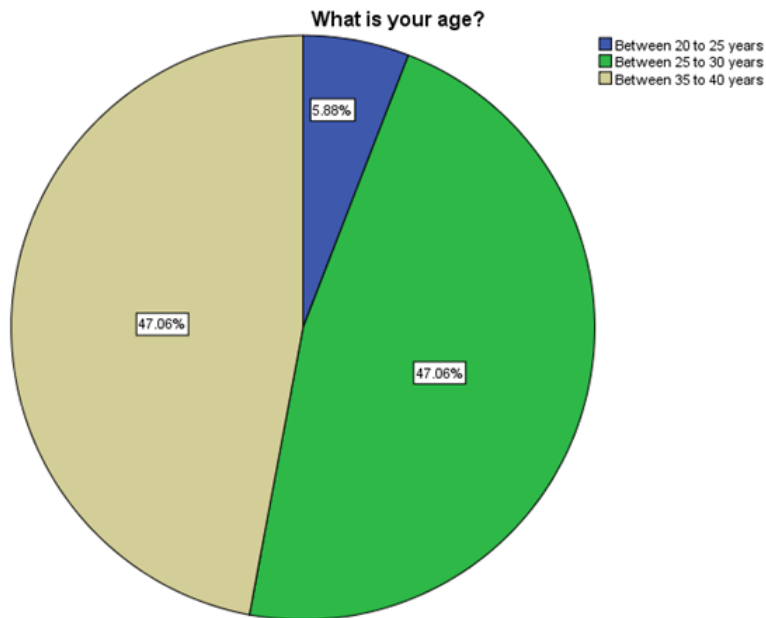
Figure 11.7: Age group

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	Frequency	Percent	Valid Percent	Valid Cumulative Percent
Above Rs. 60000	24	28.2	28.2	28.2
Between Rs. 25000 to Rs. 35000	6	7.1	7.1	35.3
Between Rs. 35000 to Rs. 45000	17	20.0	20.0	55.3
Between Rs. 45000 to Rs. 60000	38	44.7	44.7	100.0
Total	85	100.0	100.0	

<div align="center">Table 11.3: Income Level</div>

	Min	Max	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Stats	Std. Error	Stats	Std. Error
IV	5.00	25.00	10.8824	3.89570	15.176	1.151	.261 2.146	.517
DV	2.00	10.00	360.00	4.2353	1.60836	2.587	1.188	.261

<div align="center">Table 11.4: Descriptive Data Analysis</div>

Figure 11.7 represents a graphical presentation of the participants who belong to the 25 to 30 years of age group are given the most number of responses in the survey analysis process, and on the hand, it has been noticed that the lowest number of responses are collected for the participants who belong to the 20 to 25 years of age group.

Income

Table 11.3 shows that the highest number of percentage has been received by the participants who belong to the income level of 45000 to 60000 Rs and the lowest number of percentage has been received by the participants who belong to the income level of 25000/- to 35000 Rs.

Figure 11.8 where a graphical presentation has been developed. In this graphical presentation, it has been observed that participants who belong to the income level of 45000 to 60000 are given the most number of responses in the survey analysis process, and on the hand, it has been noticed that the lowest number of responses are collected for the participants who belong to the income level of Rs. 25000 to 35000.
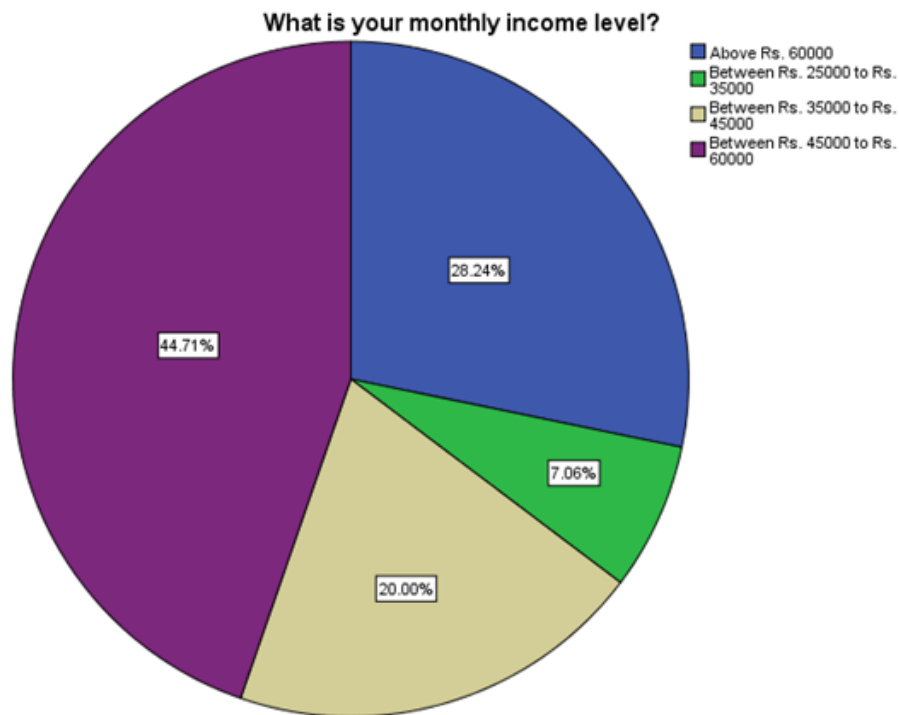
Figure 11.8: Income Level

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.639a	.408	.401	1.24451

Table 11.5: Model summary

Descriptive Data Analysis

Table 11.4 shows that the mean value ranges from 4.23 to 10.88 and the standard deviation value ranges from 1.60 to 3.89. Table 11.5 describes model summary test in which it has been noticed that the obtaining R square value is 0.408.

a. Dependent Variable: DV

Table 11.7 contains the result of the coefficient test, therefore the obtaining beta value of the coefficient test is 0.639.

The test result of the reliability test is described above in the shown table. With the help of

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Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	88.744	1	88.744	57.299	.000b
Residual	128.550	83	1.549		
Total	217.294	84			

Table 11.6: ANOVA

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B Std.	Error			
(Constant)	1.364	.403	3.388	.001	
IV	.264	.035	.639	7.570	.000

Table 11.7: Coefficients

performing Cronbach's Alpha test, the obtaining value is 0.782.

Validity Test

With the help of KMO and Bartlett's test the validity, the test is performed in this conducted research project. Along with this, it has been noted that the Sig value of the validity that is obtained from the above-discussed table is 43.307.

Correlation Test

With the help of a correlation test , the Pearson correlation value can be obtained. Table 11.10 obtains Pearson correlation value is 0.639.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.621	.780	2

Table 11.8: Reliability Test

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KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	43.307
	df	1
	Sig.	.000

Figure 11.9: Validity Test

Correlations

		IV	DV
IV	Pearson Correlation	1	.639**
	Sig. (2-tailed)		.000
	N	85	85
DV	Pearson Correlation	.639**	1
	Sig. (2-tailed)	.000	
	N	85	85

Figure 11.10: Correlation Test

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11.9   Discussion

In this section, a discussion has been developed which is based on the different key aspects that are present in the development process of the internal sector of the organization which is present in industry 5.0. Moreover, it has been observed that as per the survey result the key factors present in industry 5.0 help to perform the process that leads to the industry towards the incorporation of sustainable development in industry 5.0 (Mittal et al., 2021). . Along with this different processes are discussed that also help to promote sustainable development in industry 5.0.

11.10   Conclusion

Thus it can be concluded that in this research project, the researcher select a topic that is based on industry 5.0 and the incorporation process of sustainable development in industry 5.0. Therefore it can be stated in order to conduct the research project in a good manner the researcher needs to collect different types of relevant data and information which help to perform the other task that is required for the further improvement of the conducted research project (Gupta & Tiwari, 2023). Along with this different key factors and ways are indemnified and described in a brief way which is present in the development process of industry 5.0.

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Chapter 12
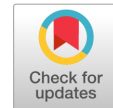
Impact of Machine Learning in Cybersecurity Augmentation

Irsah Nazir [1*] (iD) Sadhana Tiwari [2] (iD)

Abstract The increasing number of cyber threats and attacks has led to the development and implementation of various cybersecurity measures to protect organizations and individuals from potential breaches. The field of machine learning (ML) has become promising technology in the field of cybersecurity, as it can help detect and prevent malicious activities in real time. This report presents a review of the current research on the impact of machine learning in cybersecurity. The research paper begins with an overview of the key concepts of machine learning and cybersecurity. It then provides an overview of the various ML techniques used in cybersecurity, including supervised, unsupervised, and reinforcement learning. The report then explores the various applications of ML in cybersecurity, such as intrusion detection, malware analysis, and anomaly detection. The report also discusses the benefits and limitations of ML in cybersecurity. Benefits include improved accuracy and speed of threat detection. In contrast, limitations include the potential for ML models to be tricked by sophisticated attacks and the requirement for vast volumes of data for the efficient training of ML models. Finally, the report provides a discussion on the future of ML in cybersecurity, including potential research directions and challenges to be addressed. These include the need for better explainability and interpretability of ML models, the development of adversarial ML techniques, and the integration of human expertise with ML-based cybersecurity solutions.

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Overall, this report highlights the significant impact of machine learning on cybersecurity and the potential for continued advancements in this field. With ongoing research and development, ML has the potential to greatly enhance the security of individuals and organizations against cyber threats.

Keywords:Machine Learning in Cybersecurity, Models for Cybersecurity, Machine Learning, Cybersecurity

12.1   Introduction

In recent years, the field of cybersecurity has become increasingly complex, with the emergence of new threats and attack vectors. As a result, organizations are turning to machine learning as a powerful tool to strengthen their defenses measures (Tiwari & Gupta., 2022). Algorithms for machine learning can be trained to detect and respond to threats in real time, allowing security teams to identify and mitigate potential attacks prior to them causing harm. The impact of machine learning on cybersecurity has been significant, with advancements in the field allowing for the development of sophisticated systems capable of detecting and responding to threats with high accuracy (Gupta et al., 2023). However, as with any technological advancement, additionally, there are restrictions and difficulties in using machine learning in cybersecurity. These challenges include the potential for false positives and false negatives, the need for large and diverse datasets, and the potential for adversarial attacks. In this study, we will examine the impact of machine learning on cybersecurity, exploring how it can be used to enhance security measures, as well as the challenges and limitations associated with its use. We will also examine case studies of organizations that have successfully implemented machine learning in their cybersecurity strategies and analyze the effectiveness of these systems. Ultimately, this study aims to provide a comprehensive understanding of the role of machine learning in cybersecurity and its potential impact on the future of security.

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12.2   Literature Review

Apruzzese et al. (2018), this study provided an overview of the use of machine learning techniques in cybersecurity. The authors discussed the potential benefits of using machine learning in cybersecurity, such as the ability to detect and respond to threats in real time. The study also discussed the limitations and challenges of using machine learning in cybersecurity, such as the need for large amounts of labeled data and the potential for false positives.

Makawana and Jhaveri (2018), this study reviewed the literature on the use of machine learning techniques for cybersecurity. The authors discussed the different types of machine learning algorithms that have been used for cybersecurity applications, for example, administered, unaided, and support learning. The concentrate additionally talked about the difficulties of utilizing AI in online protection, for example, the need for real-time analysis and the need for interpretability of machine learning models.

Cybersecurity data science has a wide range of applications. Cybersecurity data science encompasses a wide range of data-driven tasks, including but not limited to intrusion detection and prevention, access control management, security policy generation, anomaly detection, spam filtering, fraud detection and prevention, various malware attack detection techniques, and defense strategies. Security experts, such as researchers and practitioners interested in the domain-specific facets of security systems, may find such tasks-based categorization useful.

A study has overviewed the new writing on the utilization of AI in network protection. The creators recognized a few AI calculations that have been utilized for various online protection applications, like organization interruption identification, malware recognition, and weakness evaluation. The concentrate likewise examined the difficulties of utilizing AI in network safety, like the requirement for logical and interpretable models.

Alzahrani et al. (2021), this study reviewed the literature on the utilization of AI procedures in online protection. The creators recognized a few AI calculations that have been utilized for different cybersecurity applications, such as intrusion detection, malware detection, and phishing detection. The review also highlighted the limitations and challenges of using machine learning in cybersecurity, such as the lack of labeled data and the vulnerability of machine

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learning models to adversarial attacks.

A four phase investigation was conducted using data analysis. Initially, by delineating a four-phase framework for cybersecurity practices, many applications of machine learning technologies in the future can be framed. Secondly, by taking into account the advancements in machine learning today and how they affect cybersecurity. The development of contemporary machine learning and the potential advantages for cyber defenders at every stage of the cybersecurity schema was looked after. Fourth, the authors discussed how the advantages of machine learning might not be transformative as they wrapped up their research methodology.

In the fourth industrial revolution, machine learning (ML) is one of the most widely used technologies because it enables systems to learn from experience and get better without needing to be explicitly designed. Machine learning can be extremely helpful in the field of cyber security by extracting valuable insights from data. Cybersecurity data can come from various sources and be structured or unstructured.

12.3 Objective

- To identify the key challenges associated with the use of machine learning in cybersecurity, such as the lack of quality data, model interpretability, and adversarial attacks.

- To explore the potential of machine learning in enhancing the accuracy, speed, and scalability of cybersecurity systems.

- To evaluate the effectiveness of machine learning techniques in addressing various cybersecurity applications, including intrusion detection, malware detection, network security, and vulnerability assessment.

12.4 Findings and Discussion

The study shows that when it comes to identifying cyberattacks in Internet of Things networks, machine learning-based intrusion detection systems can perform better than conventional rule-

based systems (Mittal et al., 2023). The study does, however, also draw attention to the suggested system's drawbacks, such as its possible susceptibility to hostile attacks and its requirement for a substantial quantity of training data. The findings of this study indicate that IoT network cybersecurity may be enhanced by machine learning-based intrusion detection systems. To overcome the study's flaws and create more reliable and secure solutions, more research is necessary.

The study offers a critical evaluation of machine learning's current status in cybersecurity and points out a number of drawbacks and difficulties, including the possibility of bias, explainability issues, and adversarial attacks. The study offers a thorough analysis of the body of research on machine learning's application to cybersecurity, highlighting recurring themes, emerging trends, and practical issues. The study offers a thorough analysis of machine learning's applicability in a range of cybersecurity applications and highlights both advantages and disadvantages. The goal of the study was to gain an understanding of the potential and issues associated with machine learning (ML) in cybersecurity as it stands today. The results imply that machine learning (ML) is widely applied in cybersecurity to identify threats and assaults; yet, issues with data collection, model selection, and interpretability exist. The study's conclusions imply that ML can be useful in cybersecurity provided the issues are resolved and further research and development is done to make improvements.

The study examined several machine learning methods used to cybersecurity and how well they identified various kinds of assaults. The results imply that machine learning (ML) can be useful in identifying several kinds of assaults, such as phishing, malware, and intrusion. Adversarial attacks, model complexity, and data quality are some of the drawbacks (Mittal, 2020). The study's conclusions imply that ML may be helpful in cybersecurity provided its drawbacks are fixed and additional research is done to create resilient models resistant to hostile attacks(Tiwari, et al., 2021).

The study reviewed various ML techniques used in cybersecurity, including their advantages and limitations. The findings suggest that ML can be effective in detecting and preventing various types of attacks, including malware, intrusion, and phishing. However, there are challenges in terms of data quality, model complexity, and interpretability. The implications of the

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study suggest that ML can be useful in cybersecurity if the challenges are addressed and there is more research to develop more interpretable and explainable models. In addition, the study suggests that there is a need for more collaboration between researchers, industry, and government agencies to improve the performance and effectiveness of ML in cybersecurity (Asif M, et al., 2023).

Overall, these studies suggest that ML has the potential to be effective in detecting and preventing various types of cyber-attacks. However, there are challenges in terms of data quality, model complexity, and interpretability that need to be addressed for ML to be widely adopted in cybersecurity. The studies also suggest that there is a need for more research and collaboration between researchers, industry, and government agencies to improve the performance and effectiveness of ML in cybersecurity.

12.5   Conclusion

The research papers analyzed in this study focus on the impact of machine learning (ML) in the field of cybersecurity. The papers explore various machine learning techniques and their applications in detecting and preventing cyber threats. The article suggest that machine learning holds great promise for improving cybersecurity systems' efficacy and accuracy. Machine learning algorithms enable proactive reactions to possible security breaches by analyzing vast volumes of data in real time and identifying patterns that may be suggestive of cyber threats. The papers also highlight the obstacles to overcome when applying machine learning to cybersecurity, such as the requirement for extensive and high-quality training datasets, the challenge of deciphering and understanding the results of machine learning models, and the possibility of adversarial attacks on machine learning systems. Despite these challenges, the papers suggest that machine learning has a crucial role to play in improving the cybersecurity landscape. The use of machine learning techniques can help reduce the workload on human analysts, allowing them to focus on more complex security issues. It can also assist in identifying previously unknown threats and predicting the likelihood of future attacks.

In conclusion, the findings of the research papers suggest that machine learning has the

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potential to revolutionize the field of cybersecurity. However, further research is required to overcome the challenges associated with implementing machine learning in cybersecurity systems and to develop more robust and resilient ML-based cybersecurity solutions. As the sophistication and frequency of cyber-attacks continue to increase, machine-learning techniques will become increasingly important in safeguarding our digital systems and protecting sensitive information from malicious actors.

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Chapter 13

Leveraging Machine Learning Algorithms for Predictive Analysis of Early Bone Marrow Cancer Detection

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Abstract: For better patient outcomes and higher likelihood of a successful course of therapy, early identification of bone marrow cancer is essential. Machine learning algorithms have emerged as a promising tool for predictive analysis in various medical fields, and they hold great potential for enhancing the early detection of bone marrow cancer. This abstract discusses the significance of early detection, the challenges in diagnosing bone marrow cancer, and the role of machine learning algorithms in improving predictive analysis for this purpose. Bone marrow cancer, including leukemia and lymphoma, remains a significant global health concern. These malignancies originate in the bone marrow and can lead to the proliferation of abnormal blood cells. Early diagnosis is essential, as it allows for timely intervention and tailored treatment plans. However, diagnosing bone marrow cancer is a complex task, as the symptoms can be subtle and mimic other, less severe conditions.

Traditional diagnostic methods often rely on bone marrow biopsies and peripheral blood smears, which can be invasive, time-consuming, and occasionally inconclusive.Machine learning algorithms offer a transformative approach to early bone marrow cancer detection. These algorithms, a subset of artificial intelligence, are capable of processing and analyzing vast

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amounts of medical data, ranging from clinical records to genetic information. They can identify patterns and correlations that may not be evident to human clinicians, ultimately leading to more accurate and timely diagnoses.

Traditionally, cancer detection has relied on pretrained convolutional neural networks and conventional machine learning methods that analyze features extracted from medical images. However, a novel approach for bone marrow cancer detection has emerged, utilizing raw DNA sequences combined with state-of-the-art sentence transformers like SBERT and SimCSE. The results have shown promise, with one machine learning model achieving the highest accuracy. This innovative methodology, while in its early stages, presents a unique and potentially valuable avenue for early bone marrow cancer detection, highlighting the evolving role of machine learning in transforming cancer diagnostics beyond traditional imaging methods.In conclusion, early detection of bone marrow cancer is a critical factor in improving patient outcomes and increasing the chances of successful treatment. Machine learning algorithms offer a promising avenue for enhancing predictive analysis in this domain. By harnessing the power of these algorithms to analyze complex medical data, healthcare providers can improve the accuracy and timeliness of bone marrow cancer diagnosis, leading to more effective treatment strategies. Nevertheless, overcoming challenges related to data quality, ethics, and transparency is crucial for the successful integration of machine learning in the early detection of bone marrow cancer. The potential benefits, however, make it a compelling field of research and development in the ongoing battle against this devastating disease.

Keywords:Machine Learning, Algorithm, SBERT, Treatment strategies

13.1   Introduction

The human skeletal system is a complex network of 206 bones, composed of various tissues, cartilage, connective tissue, blood components, adipose tissue, and nerve tissue. Bone, a dynamic tissue, plays a crucial role in structural integrity and overall health. It undergoes constant regeneration, with about 25% water, 25% collagen fibers, and 50% crystalline mineral salt contributing to its microscopic structure. Calcification, initiated by osteoblasts, leads to bone

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hardening. Cancer, primarily driven by genetic mutations, poses a significant threat to human health. Current treatments involve surgery, radiation therapy, and chemotherapy. Mathematical optimization studies for cancer treatment have gained prominence, with mathematical models being essential for predicting and controlling disease progression. In addition to cancer, mathematical models have found applications in various disease domains, including Parkinson's disease research and optimizing chemotherapy dosages. Model Predictive Control (MPC) is a powerful tool for devising optimal treatment plans, using explicit process models to minimize cost functions and derive control signals.In the context of bone cancer research, mathematical models explore various aspects, including drug resistance, micro environmental interactions between bone cells, and bone metastasis progression. MPC is leveraged to plan treatment strategies for reducing cancer tumor density, incorporating a quadratic cost function.

Pharmacodynamics and pharmacokinetics are crucial in drug modelling and administration. These properties play a pivotal role in drug selection for disease treatment. Pharmacodynamics modelling investigates and identifies drug effects, with the Estimated Least Squares (ELS) method estimating model parameters to determine optimal drug doses. Bone cancer, arising from healthy cells and forming tumours, poses a substantial health threat. Early detection is critical for improving survival rates. An automated system using Support Vector Machines (SVM) and image processing techniques, including pre-processing, edge detection, and feature extraction, facilitates early detection and classification of bone marrow cancer, offering speed and reduced error rates.Various research efforts have focused on developing automated systems for bone cancer detection, such as deep neural networks, augmented image datasets, and k-fold cross-validation to improve performance. Texture features, particularly from the Gray-Level Co-occurrence Matrix (GLCM), have been employed to identify fractured bone regions, with additional metrics like entropy and skewness helping predict cancerous regions. Fusion techniques, combining multiple methods and texture features, enhance the identification and classification of cancerous and healthy bone tissues. SVM plays a vital role in distinguishing between healthy and cancerous long bones. The report explores intersection of mathematical modelling, machine learning, and image processing for the early detection of bone marrow cancer. This multidisciplinary approach offers promising solutions for improving the diagnosis and

treatment of this life-threatening disease, showcasing the potential of cutting-edge technologies in healthcare.

13.2   Literature Review

Bone Marrow Infection

Salajegheh (2017) Bone marrow is a vital component of the human body, containing stem cells responsible for producing blood cells. Bone marrow cancer, also known as hematologic cancer or blood cancer, arises from abnormal growth or functioning of these stem cells within the bone marrow. The condition primarily affects certain bones, including the hip and femur. The overgrowth or abnormal behavior of these cells can lead to a range of life-threatening conditions. Among the cell types in the bone, osteoblasts and osteoclasts play a significant role in bone maintenance. Osteoblasts continuously build new bone tissue, while osteoclasts absorb old bone, ensuring a dynamic renewal process.

MPC Strategy

One avenue of research in the fight against bone marrow cancer involves mathematical modelling to better understand tumor growth and to develop strategies for treatment. This involves not only understanding the tumor itself but also how drugs interact with the body to combat cancer. Mathematical models offer a structured approach to analyzing the dynamics of cancer and drug response. To determine the optimal drug dosage for reducing tumor density, researchers have turned to Model Predictive Control (MPC) algorithms. These algorithms can provide valuable insights into the best treatment strategies. In developing an effective strategy, researchers have utilized the Extended Least Squares (ELS) method. This method is employed to learn the parameters of tumor growth models, allowing for a more adaptive approach to treatment. An adaptive strategy is crucial because tumors can evolve and adapt to different conditions, making it important to adjust treatment plans accordingly.

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Simulation in MATLAB

To validate the effectiveness of their models and strategies, researchers conduct simulations using MATLAB. These simulations, based on the mathematical models, aim to mimic the real-world scenario of treating bone marrow cancer. If the model is accurate and effective, the simulation should demonstrate that the tumor diminishes over time, and bone mass improves. This kind of testing is crucial before applying new treatments to actual patients.

13.2.1   The Significance of Bone Cancer

Bone cancer, in its various forms, poses a significant health concern, with many cases resulting in patient fatalities. It's vital to identify bone cancer accurately and promptly for effective treatment. Traditionally, doctors rely on medical imaging techniques such as X-rays, MRIs, or CT scans to diagnose bone cancer. However, this manual process is time-consuming and requires specialized expertise in the field of radiology. The development of automated systems for bone cancer classification and identification has become increasingly important. Classifying and identifying cancerous bone tissue and healthy bone tissue can be challenging due to the presence of morphological similarities in the dataset. Some cancerous and healthy bone images share common characteristics, making it difficult to distinguish between the two solely based on visual inspection.

Edge Detection and Feature Sets

To address this challenge, researchers have employed edge detection algorithms to enhance the differentiation between cancerous and healthy bone tissues. Additionally, two feature sets have been created: one with Histogram of Oriented Gradients (HOG) features and another without HOG features. The inclusion of HOG features has been found to significantly improve the performance of machine learning models in differentiating between cancerous and healthy bone tissues

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Machine Learning Models for Classification

Based on the data retrieved, two machine learning models have been used to categorise bone
tissues: random forests and support vector machines (SVM). Out of all three models, the SVM
that was trained using the HOG feature set has performed better, with an F1-score of 0.92 as op-
posed to 0.77 for the random forest model. This emphasises how useful it is to use cutting-edge
feature extraction methods for precise bone cancer categorization (Mokoatle, 2023). Moving
beyond bone cancer, the broader field of cancer detection has seen a surge in interest and re-
search. The advent of machine learning and deep learning methods has allowed for the develop-
ment of algorithms that can detect various malignancies using diverse data sources, including
visual, biological, and electronic health records. The study in this context focuses on lung,
breast, prostate, and colorectal cancer, which are the four most common and prevalent cancers
globally. Detecting these cancers using machine learning methods is a critical step toward early
diagnosis and effective treatment.

DNA Sequences and Machine Learning

One novel method for detecting cancer uses only the raw DNA sequences from matched pairs
of tumour and normal tissue (Gupta et al., 2023). This methodology highlights the significance
of genetics in cancer research and marks a divergence from conventional image-based detection
techniques. Modern sentence transformers, such as SBERT and SimCSE, are used to process
and analyse the raw DNA sequences. Although these transformers are usually employed for
tasks related to natural language processing, in this study they are modified to represent DNA
sequences in order to facilitate the identification of cancer. The DNA sequences are fed into
machine learning methods after being converted into feature vectors using SBERT and SimCSE.
To categorise the DNA sequences into cancer and non-cancer groups, the study uses a variety
of machine learning models, such as XGBoost, random forest, LightGBM, and Convolutional
Neural Networks (CNNs).

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13.3   Objectives

- To develop an integrated mathematical model for tumor control in bone marrow cancer that considers tumor growth dynamics and the optimization of drug dosages to reduce tumor density.

- To investigate the effectiveness of an adaptive Model Predictive Control (MPC) strategy in bone marrow cancer treatment, utilizing the Extended Least Squares (ELS) method for parameter estimation to tailor treatment plans to evolving tumor conditions.

- To conduct simulations in MATLAB to validate the proposed mathematical model and treatment strategies, ensuring their accuracy and efficacy in reducing tumor mass and improving bone health.

- To explore the significance of automated systems in the early identification and classification of bone marrow cancer, emphasizing the role of machine learning algorithms and image processing techniques.

- To address the challenges in classifying bone tissues as cancerous or healthy by evaluating the impact of edge detection algorithms and the use of feature sets, including Histogram of Oriented Gradients (HOG) features.

- To examine and contrast how well machine learning models—like Support Vector Machines (SVM) and random forests—perform in the classification of bone cancer tissue, paying particular attention to how well sophisticated feature extraction methods work.

- To expand the study to include the application of machine learning techniques for the early identification of other common cancers, such as lung, breast, prostate, and colorectal cancer, in addition to bone marrow cancer. Investigate the novel use of raw DNA sequences for cancer detection, processing and representing DNA data using cutting-edge sentence transformers such as SBERT and SimCSE.

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- To using phrase transformer-generated sentence representations, assess how well machine learning algorithms—such as XGBoost, random forest, LightGBM, and Convolutional Neural Networks (CNNs)—classify DNA sequences into cancerous or non-cancerous categories.

- To evaluate and contrast various machine learning models' and language representations' efficacy and accuracy in detecting cancer, with an emphasis on how DNA-based detection techniques might transform cancer diagnosis and therapy.

13.4   Findings & Discussion

The results of this study indicate that the XGBoost model, particularly when using SimCSE embeddings, achieved the highest accuracy in cancer detection. The model's accuracy was measured at 73% with SBERT embeddings and 75% with SimCSE embeddings. These findings suggest that leveraging sentence representations from SimCSE marginally improved the performance of machine learning models for cancer detection. It's worth noting that these results are promising, as DNA-based detection methods have the potential to revolutionize cancer diagnosis and treatment.

In conclusion, the literature review covers various aspects of bone marrow cancer, including mathematical modelling for tumor control, the importance of automated systems for cancer identification, challenges in bone cancer classification, advanced feature extraction techniques, and the application of machine learning in cancer detection. It also highlights the potential of DNA-based detection methods in identifying common malignancies and the role of state-of-the-art sentence transformers in this context (Gupta et al., 2023). The results of the study suggest promising directions for improving cancer detection and treatment.

The literature review underscores the multidisciplinary approach to tackling bone marrow cancer and cancer detection at large. The integration of mathematical modeling, machine learning, and genomics has the potential to drive breakthroughs in early diagnosis and treatment. However, there are several considerations and implications to discuss.Firstly, the utilization of mathematical models in bone marrow cancer treatment highlights the importance of personal-

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ized medicine. Adaptive strategies that can adjust to the evolving nature of tumors are essential, as bone marrow cancer, like many other cancers, can exhibit significant heterogeneity. As a result, treatments should be tailored to the specific characteristics and behaviors of each patient's cancer.The use of machine learning in bone cancer classification has the potential to streamline the diagnosis process and reduce the reliance on human expertise in radiology. The performance of SVMs with HOG features is promising, but further research and validation on larger datasets and in clinical settings are necessary. It's important to address issues related to false positives and false negatives to ensure that patients receive accurate diagnoses.

In the context of broader cancer detection, the shift from image-based methods to genomics-driven approaches is ground-breaking. The use of sentence transformers to represent DNA sequences is innovative, and the results suggest that these techniques can contribute to more accurate and efficient cancer detection. However, the study's accuracy levels, while promising, also highlight the need for further refinement and validation to ensure the reliability and clinical applicability of DNA-based detection methods.In conclusion, the research presented in this discussion holds great promise for improving the diagnosis and treatment of bone marrow cancer and other common malignancies. The integration of mathematical modeling, machine learning, and genomics provides a holistic approach to understanding and combating cancer. As technology and techniques continue to advance, the potential for early detection and more effective treatments becomes increasingly achievable, ultimately benefiting patients and the field of oncology as a whole. Nevertheless, ongoing research and collaboration are necessary to further refine and validate these approaches for clinical use.

13.5 Conclusion

In the realm of cancer research, bone marrow cancer presents a formidable challenge due to its life-threatening nature and the complexity of tumor growth within the bone marrow. Mathematical modelling, in conjunction with adaptive strategies and simulation in MATLAB, has emerged as a powerful tool to aid in the development of effective treatments. The utilization of adaptive model predictive control (MPC) algorithms, particularly with extended least squares

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(ELS) methods, offers valuable insights into optimal drug dosages and treatment plans. It is impossible to overestimate the importance of this finding since it could transform the treatment of bone marrow cancer and enhance patient outcomes.Moreover, it is crucial to develop automated techniques for the classification of bone cancer. Using edge detection algorithms and feature sets has helped to overcome the difficulties in differentiating between cancerous and healthy bone tissue, which is characterised by physical similarities. Most notably, machine learning models perform much better when histogram of oriented gradients (HOG) features are included. The excellent accuracy exhibited by support vector machines (SVM) trained on the HOG feature set highlights the promise of sophisticated feature extraction approaches for accurate bone cancer classification.The research explores machine learning-based cancer diagnosis in a wider context than just bone cancer. The research investigates novel methods by utilising raw DNA sequences as input, with a focus on common and prevalent malignancies like lung, breast, prostate, and colorectal cancer. This shift in the early detection of cancer from image-based to genomics-driven detection demonstrates the growing importance of genetic data. Using cutting-edge sentence transformers like SBERT and SimCSE to represent DNA sequences is a fresh and exciting idea in this regard.Interessant insights are obtained from the classification of DNA sequences into cancer and non-cancer categories using a variety of machine learning methods, including as XGBoost, random forest, LightGBM, and Convolutional Neural Networks (CNNs). The findings indicate that the XGBoost model obtains the maximum accuracy in cancer detection, especially when employing SimCSE embeddings. This is a noteworthy discovery because it suggests that DNA-based detection techniques may revolutionise the field of cancer detection and therapy.

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Chapter 14

Earthquake Predictions using Time Series Analysis

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Abstract

As of late, there have been huge headways in utilizing man-made brainpower (simulated intelligence) to foresee quakes. Specialists at The College of Texas at Austin fostered an artificial intelligence calculation that had the option to foresee 70% of tremors seven days before they happened during a preliminary in China. The man-made intelligence was prepared to identify factual examples in seismic information and effectively anticipated 14 tremors inside a 200-mile range of their assessed area with practically careful strength. The scientists intend to additionally test the computer-based intelligence in Texas and at last coordinate it with material science-based models to make a summed-up framework that can be applied anyplace on the planet.

One more way to deal with tremor expectation is utilizing the force of time series examination. An exploration paper named "Disentangling Seismic Tremor Forecast: A Period Series Examination Approach" proposes a one-of-a-kind and imaginative way to deal with quake expectations utilizing time series investigation. The review means to add to the improvement of more exact and solid tremor forecast models by uncovering stowed-away examples inside seismic time series information. The proposed philosophy includes procuring broad seismic time series datasets incorporating different locales and levels of seismic action, trailed by thorough preprocessing and highlight designing to remove significant data. Best-in-class time series ex-

amination procedures, including autoregressive models, Fourier changes, and repetitive brain organizations, are then applied to uncover fleeting conditions and patterns inside the information. Consolidating geospatial data, land information, and natural factors further improves the models' prescient power.

The fundamental goal of the exploration is to foster a prescient system fit for assessing tremor probabilities throughout various time skylines. The aftereffects of this exploration might offer important experiences for early advance notice frameworks, catastrophe readiness, and chance alleviation procedures, eventually lessening the effect of seismic occasions on living souls and foundations. The review plans to overcome any issues between information-driven science and geophysical investigation, making ready for another period in seismic tremor expectation.

Keyword Earthquake Predictions, Earthquake Predictions using Time Series, Disentangling Seismic Tremor Forecast

14.1   Introduction

A seismic tremor happens when the world's outside goes through unexpected development because of the sudden arrival of aggregated pressure along land shortcomings on the inside. This delivered energy goes through the Earth as seismic waves, which are low-recurrence sound waves, starting development. Indeed, even after the issue movement stops, seismic waves continue going through the Earth.

Investigation into seismic tremor expectation has been in progress for nearly a hundred years. In the event that effective, the capacity to foresee the time, area, and greatness of a tremor might actually save lives and forestall huge monetary misfortunes concerning lodging and foundation. Be that as it may, accomplishing fruitful tremor expectations remains incredibly uncommon.

Tremor expectations fall into two essential classifications: long haul estimates, spreading over months to years, and transient forecasts, happening inside the space of hours or days. Long-haul conjectures depend on different exploration strategies, for example, breaking down

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verifiable quake designs in unambiguous districts, examining shortcoming qualities like length, profundity, and division, and surveying strain aggregation. These investigations offer surmised assessments of quake sizes and the time spans between seismic occasions. A striking illustration of a drawn-out tremor estimate includes distinguishing seismic holes, which are segments of plate limits that haven't encountered a significant quake for a lengthy period. These regions are viewed as high-risk destinations for critical seismic tremors from here on out.

Momentary quake forecast stays a critical test, and no technique has been shown to be solid. Because of the complicated and eccentric nature of the quake cycle, there is a developing conviction that accomplishing exact transient forecasts might be intrinsically inconceivable. As innovation has progressed and organized frameworks have become broad, significant volumes of geographic information have been and keep on being amassed through present-day information-securing strategies like worldwide situating frameworks Global Positioning System (GPS), satellites, high-goal remote detecting, area-mindful administrations, overviews, and chipped-in geographic data open on the web. Subsequently, there is a rising interest in instruments and advances able to effectively investigate these broad logical datasets, principally pointed toward deciphering the fundamental actual peculiarities.

Time series information is consistently gathered at characterized time stretches from different frameworks, including everyday securities exchange cost changes, vacillations in gold costs, securities exchange varieties, and yearly populace development in a country. A period series comprises of a significant number of distinct perceptions organized all together in view of equivalent time or spatial spans. Information that is sporadic or happens just once doesn't meet the standards for time series information. Regularly, a noticed time series is separated into three parts:

1. **The Occasional Part:** This reflects efficient or normal developments in the information.

2. **The Pattern Part:** This shows long-haul changes in the information.

3. **The Sporadic Part:** This obliges unsystematic or transient variances in the information

Time series models track down their principal use in factual determining. Different expectation strategies, like relapse, time series, and tumultuous techniques, are accessible, each with its

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own arrangement of assets and shortcomings. For determining future qualities, authentic successions of information are used, with time series models anticipating what will happen without fundamentally giving a clarification as to why it works out.

To create expectations, nonlinear techniques are utilized to change time series values into stage space, and fluffy rationale is then applied to conjecture ideal qualities. Time series information is obtained from different frameworks at ordinary time spans. Regular fixed time series models incorporate Autoregressive integrated moving average (ARIMA) and Least Mean Square blunder-determining techniques. Information mining is applied to extricate significant and relevant data from broad data sets. For expectation purposes, man-made reasoning and example acknowledgement techniques are utilized.

Time series information mining is used to figure quakes, variances in financial exchanges, weather conditions, and changes in gold costs. Fluffy rationale strategies demonstrate particularly productive in foreseeing occasions like tremors and changes in the financial exchange, weather patterns, and gold costs. Fluffy sets, distinguished in light of comparable examples and characterized inside participation capabilities, empower precise expectations of future occasions utilizing fluffy rationale. Time series information digging is also applied for bunching and anticipating regular occasions.

The essential advantage of time series examination is its ability to estimate future qualities by looking at authentic information. The examination of past groupings of authentic information offers significant experiences, helping with the forecast of future successions. Time series strategies are important for pattern examination, estimating in exchange markets, applications in money, climatology, and seismic tremor expectation.

14.2   Literature Review

Preethi & Santhi (2011) showed that in geosciences and economics, time series projections are more significant. Data mining and time series analysis are combined in time series data mining. strategies. Among the historical information gathered are the following combining the time series approach with data mining preprocessing, followed by prediction based on fuzzy

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logic principles. Earthquake prediction has been done by examining the strategy for utilizing past earthquake time data. Taking a step back first, preprocessing large data collections is done with data mining methods. Using this method, data projections are able. Soft computing and statistics are the main topics of this study methods for examining the seismic data.

Amei et al. (2012) reviewed that between 1896 and 2009, it is believed that earthquakes with a magnitude of 8.0 or higher on the Richter scale follow a Poisson process. To predict the occurrence of these significant earthquakes, several Autoregressive Integrated Moving Average (ARIMA) models have been introduced. These models are fine-tuned using time series data of Empirical Recurrence Rates (ERRs), and the most recent five or ten data points are employed for predictive evaluation. The most appropriate model forecasts a total of 12 major earthquakes occurring worldwide in the next 6 years. The use of ERR-based ARIMA models for long-term earthquake prediction not only acts as a link connecting point processes and traditional time series analysis but also broadens the application of statistical methods for predicting various natural disasters.

Shah et al. (2013) studied overviews within the domain of neural networks, computer scientists are increasingly focusing on studying the behaviours of social insects to address a range of intricate combinatorial and statistical challenges. A notable example of this emerging trend is the adoption of the Artificial Bee Colony (ABC) algorithm. This research delves into the practical application of the ABC algorithm, which replicates the intelligent foraging behaviour observed in honey bee swarms. The conventional process of training a Multilayer Perceptron (MLP) using the backpropagation algorithm often involves computationally demanding procedures. One significant hurdle associated with the backpropagation (BP) algorithm is its tendency to generate neural networks with less-than-optimal weight configurations, primarily due to the presence of numerous local optima in the solution space.

To address this challenge, the study employs the ABC algorithm to train the MLP in understanding the complex patterns found in earthquake time series data, as an alternative to the standard BP approach. The experimental findings underscore that MLP-ABC outperforms MLP-BP when it comes to working with time series data, highlighting its superior performance.

Otari & Kulkarni (2012) provided that catastrophic events emerge when regular dangers,

similar to floods, cyclones, typhoons, volcanic ejections, quakes, heatwaves, or avalanches, lead to complex actual occasions. These occasions, including seismic tremors, avalanches, tidal waves, and volcanoes, can prompt huge monetary, natural, and human misfortunes. Foreseeing these geographical calamities is of most extreme significance, however, an intricate cycle relies upon different physical and ecological elements.

Intending for this test, mainstream researchers have explored different logical and factual techniques. Furthermore, information mining procedures have arisen as important instruments for anticipating normal perils. This paper presents an exhaustive assessment of the utilization of information mining in gauging land fiascos, exploring 16 diary articles distributed somewhere in the range of 1989 and 2011 on this point.

The essential information-digging strategies utilized for quake expectation incorporate calculated models, brain organizations, Bayesian conviction organizations, and choice trees. These techniques present promising roads for anticipating quakes, waves, avalanches, and other miniature-seismic occasions. Besides, the paper means to move further exploration in this field and closes by proposing headings for future examination attempts.

Lyubushin (1999) introduced a method for detecting synchronized signals in multidimensional time series data. It relies on estimating eigenvalues of spectral matrices and calculating canonical coherence within moving time windows. The key step involves deriving an aggregated signal, a single scalar signal designed to capture spectral components that are present concurrently across all individual scalar time series. It is acknowledged that an increase in the coordinated behaviour of components within specific systems and the widening spatial extent of parameter fluctuations can serve as a critical indicator of an impending catastrophe, such as a sudden shift in the system's parameter values. From this perspective, the identification of synchronized signals among diverse geophysical parameters recorded at multiple points within a network covering a specific region of the Earth's crust becomes an essential tool for identifying precursors to significant earthquakes. The practical application of this method to real geophysical time series data is illustrated with examples presented in the paper.

Morales et al. (2010) showed that earthquakes strike suddenly, posing a rapid and severe threat to entire cities, resulting in substantial loss of life and significant economic ramifications.

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Currently, extensive efforts are in progress to develop techniques aimed at predicting these unpredictable natural disasters and implementing preventive measures. This study utilizes clustering methods to extract patterns that effectively capture the behaviour of temporal seismic data, ultimately assisting in the forecasting of medium to large earthquakes. In the initial phase, earthquakes are categorized into distinct groups, with the optimal number of these groups, initially unknown, determined through the process. Subsequently, the study identifies patterns associated with the occurrence of medium to large earthquakes. The research presents and discusses its findings based on temporal seismic data from Spain, provided by the Spanish Geographical Institute. These results are further substantiated and confirmed through non-parametric statistical tests, underscoring the remarkable performance and significance of the outcomes derived from the clustering approach.

Ali et al. (2017) talked about estimating time series information is a typical test crossing different logical disciplines, with a long history of exploration around here. Various strategies are accessible for getting ready time series information, and one prominently viable methodology is the utilization of wavelet procedures. These strategies have exhibited their capacity to resolve issues connected with information-lopsided characteristics emerging from anomalies and clamour. In this review, an original model called the Wavelet Multilayer Perceptron (W-MLP) is presented. This model integrates wavelet strategies to preprocess time series information prior to taking care of it into the Multilayer Perceptron (MLP). The model has gone through preparing and testing for the expectation of tremor information in California. The reenactment results relating to seismic tremor time series estimating highlight the W-MLP's better exhibition when looked at than the conventional Multi-facet Perceptron (MLP) regarding expectation precision.

Barkat et.al. (2018) showed that the utilization of time series investigation on soil radon information has been recently proposed for seismic tremor peril expectation, despite the fact that it has not acquired all-inclusive acknowledgement for this reason. In this ongoing review, we play out a period series examination of soil radon information gathered along a functioning issue zone in North Pakistan, meaning to investigate pre-seismic tremor peculiarities during the period from July 24, 2014, to April 30, 2015. Our approach includes geochemical investigation of soil, deterministic investigation utilizing the Hurst type (H), measurement of meteorolog-

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ical impacts, and assessment of soil radon abnormalities with regards to quake anticipating. In particular, in the examination of radon information peculiarities, we apply lingering signal-handling strategies to moderate the customary impacts of meteorological variables. Moreover, we utilize a measurable rule (x ± 2σ) at a 95% certainty stretch. The aftereffects of geochemical examination recommend that any strange expansion in soil radon fixation isn't related to the presence of key radionuclides, for example, 226Ra, 232Th, and 40K. Deterministic examination of radon and meteorological boundaries uncovers that the Hurst example (H) falls inside the scope of 0.5 H 1, showing a persevering pattern with negligible rarity and inconsistency. Essentially, the impact of meteorological boundaries on soil radon is measured through relationship coefficients, recommending a minor effect.

Besides, the fleeting changes in leftover radon around the hour of quake movement demonstrate six critical atypical pinnacles that surpass the measurable basis during the analyzed period. The absence of strange lingering radon conduct for specific quake occasions in the review period can be made sense of by their low extent and high RE/RD esteem. To summarize, our outcomes avow past examination and backing the use of radon as a mark of seismic movement.

14.3   Objective

14.3.1   Ensemble Learning for Robust Predictions

Random Forest Regressor, as an ensemble learning technique, combines the predictive power of multiple decision trees. This approach enhances the model's robustness by mitigating overfitting and capturing complex relationships within earthquake data. The ensemble nature of Random Forest ensures more reliable predictions, making it a suitable choice for earthquake prediction where diverse and intricate patterns may exist.

14.3.2   Handling Multidimensional Data

Earthquake prediction involves analyzing a multitude of factors, such as geological, seismological, and environmental variables. Random Forest Regressor is well-suited for handling

multidimensional datasets and can effectively process a large number of features. This capability allows researchers to incorporate various input parameters, improving the model's ability to discern subtle patterns and correlations contributing to earthquake occurrences.

14.3.3   Non-linear Relationship Detection

Earthquake prediction often involves understanding non-linear relationships between input features and the target variable. Random Forest Regressor excels in capturing complex, non-linear patterns present in earthquake data. Unlike linear regression models, which may struggle to represent intricate relationships, the Random Forest's ability to model non-linearities enhances the accuracy of earthquake predictions.

14.3.4   Resilience to Outliers and Noise

Earthquake datasets may contain outliers or noisy observations that can adversely affect the performance of predictive models. Random Forest Regressor exhibits resilience to outliers and noise due to its aggregation of multiple decision trees. By averaging predictions across the ensemble, the impact of individual outliers is minimized, resulting in a more robust and reliable earthquake prediction model.

14.3.5   Feature Importance and Interpretability

Understanding the contributing factors to earthquake occurrence is crucial for effective risk mitigation and disaster preparedness. Random Forest Regressor provides a measure of feature importance, allowing researchers to identify which variables have the most significant impact on predictions. This interpretability aids in gaining insights into the underlying mechanisms of earthquake generation and can inform targeted interventions and monitoring strategies.

14.4   Data Ananlysis

- **Date:** The date when the seismic event occurred.

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```
In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt

        import os
        print(os.listdir("C:/Users/hp/Downloads/database.csv"))

        ['database.csv']
```

Read the data from csv and also columns which are necessary for the model and the column which needs to be predicted.

```
In [2]: data = pd.read_csv("database.csv")
        data.head()
```

Out[2]:

	Date	Time	Latitude	Longitude	Type	Depth	Depth Error	Depth Seismic Stations	Magnitude	Magnitude Type	...	Magnitude Seismic Stations	Azimuthal Gap	Horizontal Distance	Horizontal Error	Roo Mea Squar
0	01/02/1965	13:44:18	19.246	145.616	Earthquake	131.6	NaN	NaN	6.0	MW	...	NaN	NaN	NaN	NaN	Na
1	01/04/1965	11:29:49	1.863	127.352	Earthquake	80.0	NaN	NaN	5.8	MW	...	NaN	NaN	NaN	NaN	Na
2	01/05/1965	18:05:58	-20.579	-173.972	Earthquake	20.0	NaN	NaN	6.2	MW	...	NaN	NaN	NaN	NaN	Na
3	01/08/1965	18:49:43	-59.076	-23.557	Earthquake	15.0	NaN	NaN	5.8	MW	...	NaN	NaN	NaN	NaN	Na
4	01/09/1965	13:32:50	11.938	126.427	Earthquake	15.0	NaN	NaN	5.8	MW	...	NaN	NaN	NaN	NaN	Na

5 rows × 21 columns

- **Time:** The time of day when the seismic event occurred.

- **Latitude:** The geographic coordinate specifying the north-south position of the earthquake epicentre.

- **Longitude:** The geographic coordinate specifying the east-west position of the earthquake epicentre.

- **Type:** The type of seismic event (e.g., earthquake).

- **Depth:** The depth below the Earth's surface at which the seismic event occurred.

- **Depth Error:** The margin of error associated with the depth measurement.

- **Depth Seismic Stations:** The number of seismic stations that contributed to the depth measurement.

- **Magnitude:** The magnitude of the seismic event, a measure of its size or energy release.

- **Magnitude Type:** The method or scale used to determine the magnitude (e.g., Richter scale, Moment Magnitude Scale).

- **Magnitude Error:** The margin of error associated with the magnitude measurement.

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- Magnitude Seismic Stations: The number of seismic stations that contributed to the magnitude measurement.

- **Azimuthal Gap:** The angular gap between seismic stations that are used to locate an earthquake, providing information about the reliability of the location.

- **Horizontal Distance:** The horizontal distance from the epicenter to a location on the Earth's surface.

- Horizontal Error: The margin of error associated with the horizontal distance measurement.

- **Root Mean Square (RMS):** A measure of the consistency of observed and predicted values.

- **ID:** An identifier for the seismic event.

- Source: The organization or network responsible for reporting the seismic event.

- **Location Source:** The source that provided the location information for the seismic event.

- **Magnitude Source:** The source that provided the magnitude information for the seismic event.

- **Status:** The status of the seismic event (e.g., reviewed, automatic).

data=data [['Data', 'Time', 'Latitude', 'Longitude', 'Depth', 'Magnitude']] By using this code, we are selecting specific columns so that we can get precise results and work on the data that is useful. Another method to do this is PCA (Principal Component Analysis)

As our data was so huge there were so many dates of earthquakes that were not in according to our desired format, so we manipulated the interpreter in converting different formats into similar ones.

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```
In [3]: data.columns
Out[3]: Index(['Date', 'Time', 'Latitude', 'Longitude', 'Type', 'Depth', 'Depth Error',
               'Depth Seismic Stations', 'Magnitude', 'Magnitude Type',
               'Magnitude Error', 'Magnitude Seismic Stations', 'Azimuthal Gap',
               'Horizontal Distance', 'Horizontal Error', 'Root Mean Square', 'ID',
               'Source', 'Location Source', 'Magnitude Source', 'Status'],
              dtype='object')
```

Figure out the main features from earthquake data and create a object of that features, namely, Date, Time, Latitude, Longitude, Depth, Magnitude.

```
In [4]: data = data[['Date', 'Time', 'Latitude', 'Longitude', 'Depth', 'Magnitude']]
        data.head()
```

Out[4]:

	Date	Time	Latitude	Longitude	Depth	Magnitude
0	01/02/1965	13:44:18	19.246	145.616	131.6	6.0
1	01/04/1965	11:29:49	1.863	127.352	80.0	5.8
2	01/05/1965	18:05:58	-20.579	-173.972	20.0	6.2
3	01/08/1965	18:49:43	-59.076	-23.557	15.0	5.8
4	01/09/1965	13:32:50	11.938	126.427	15.0	5.8

Here, the data is random we need to scale according to inputs to the model. In this, we convert given Date and Time to Unix time which is in seconds and a numeral. This can be easily used as input for the network we built.

```
In [5]: import datetime
        import time

        timestamp = []
        for d, t in zip(data['Date'], data['Time']):
            try:
                ts = datetime.datetime.strptime(d + ' ' + t, '%m/%d/%Y %H:%M:%S')

                # Check if the datetime object is within the valid range
                if ts.year >= 1970 and ts.year <= 2038:
                    timestamp.append(time.mktime(ts.timetuple()))
                else:
                    timestamp.append('Invalid Date')
            except ValueError:
                # Handle invalid date/time format
                timestamp.append('ValueError')

        # Now timestamp list contains either valid timestamps or 'Invalid Date'/'ValueError' strings.

In [6]: timeStamp = pd.Series(timestamp)
        data['Timestamp'] = timeStamp.values
```

This is a plot of all the earthquakes that took place over a period of 50 years across the world map.

Total sizes 23413 and we have split the data in 80% training set and 20% testing dataset which means that we will be training our model on 18713 entries and then verify the performance or accuracy of the model on the remaining approx. 4500 entries.

A Random Forest Regressor from scikit-learn is utilized to develop a prescient model for tremor qualities, explicitly Size and Profundity, in view of elements like Timestamp, Scope, and Longitude. The dataset is preprocessed by sifting through lines with invalid timestamps, changing the 'Timestamp' section completely to numeric qualities, and dropping columns with NaN values after transformation. The dataset is then divided into preparing and testing sets, with 80% utilized for preparing and 20% for testing. The Random Forest Regressor is launched, prepared on the preparation information, and in this manner used to foresee seismic tremor attributes on the testing set. The subsequent forecasts are put away in the 'expectations' variable, which

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```
In [7]: final_data = data.drop(['Date', 'Time'], axis=1)
        final_data = final_data[final_data.Timestamp != 'ValueError']
        final_data.head()
```

Out[7]:

	Latitude	Longitude	Depth	Magnitude	Timestamp
0	19.246	145.616	131.6	6.0	Invalid Date
1	1.863	127.352	80.0	5.8	Invalid Date
2	-20.579	-173.972	20.0	6.2	Invalid Date
3	-59.076	-23.557	15.0	5.8	Invalid Date
4	11.938	126.427	15.0	5.8	Invalid Date

```
In [9]: fig = plt.figure(figsize=(12,10))
        plt.title("All affected areas")
        m.plot(x, y, "o", markersize = 2, color = 'blue')
        m.drawcoastlines()
        m.fillcontinents(color='coral',lake_color='aqua')
        m.drawmapboundary()
        m.drawcountries()
        plt.show()
```

All affected areas

can be additionally dissected or considered in contrast to the genuine qualities to evaluate the model's exhibition. Scikit-learn, ordinarily truncated as sklearn, is an open-source AI library for the Python programming language. It gives straightforward and effective devices for information examination and demonstration, including a wide exhibit of AI calculations for errands like characterization, relapse, grouping, and dimensionality decrease, and the sky is the limit from there. Scikit-learn is based on NumPy, SciPy, and Matplotlib, and it is intended to work consistently with these libraries. It is broadly utilized in both the scholarly world and industry for undertakings connected with AI and information examination because of its convenience, broad documentation, and enormous, dynamic local area of clients and donors.

"reg.score" is used to return the coefficient of determination of the prediction.

Keras and TensorFlow are two well-known open-source AI structures, with TensorFlow filling in as the hidden library for Keras.

TensorFlow:

TensorFlow is an open-source AI structure created by the Google Mind group. It is intended for building and preparing profound learning models. TensorFlow gives an extensive arrangement of devices and libraries for mathematical calculation and AI undertakings, including brain network structures.

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Splitting the Data

Firstly, split the data into Xs and ys which are input to the model and output of the model respectively. Here, inputs are TImestamp, Latitude and Longitude and outputs are Magnitude and Depth. Split the Xs and ys into train and test with validation. Training dataset contains 80% and Test dataset contains 20%.

```
In [10]:  X = final_data[['Timestamp', 'Latitude', 'Longitude']]
          y = final_data[['Magnitude', 'Depth']]
```

```
In [11]:  from sklearn.model_selection import train_test_split

          # Your code here
          X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
          print(X_train.shape, X_test.shape, y_train.shape, y_test.shape)

          (18727, 3) (4682, 3) (18727, 2) (4682, 2)
```

```
In [12]:  from sklearn.ensemble import RandomForestRegressor
          from sklearn.model_selection import train_test_split

          # Filter out rows where Timestamp is not a valid numeric value
          final_data_numeric = final_data[final_data['Timestamp'] != 'Invalid Date']

          # Convert Timestamp column to numeric values (excluding 'ValueError' strings)
          final_data_numeric['Timestamp'] = pd.to_numeric(final_data_numeric['Timestamp'], errors='coerce')

          # Drop rows where Timestamp is NaN after conversion
          final_data_numeric = final_data_numeric.dropna(subset=['Timestamp'])
```

```
In [12]:  from sklearn.ensemble import RandomForestRegressor
          from sklearn.model_selection import train_test_split

          # Filter out rows where Timestamp is not a valid numeric value
          final_data_numeric = final_data[final_data['Timestamp'] != 'Invalid Date']

          # Convert Timestamp column to numeric values (excluding 'ValueError' strings)
          final_data_numeric['Timestamp'] = pd.to_numeric(final_data_numeric['Timestamp'], errors='coerce')

          # Drop rows where Timestamp is NaN after conversion
          final_data_numeric = final_data_numeric.dropna(subset=['Timestamp'])

          X = final_data_numeric[['Timestamp', 'Latitude', 'Longitude']]
          y = final_data_numeric[['Magnitude', 'Depth']]

          # Split the data into training and testing sets
          X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

          # Create and train the RandomForestRegressor
          reg = RandomForestRegressor(random_state=42)
          reg.fit(X_train, y_train)

          # Make predictions
          predictions = reg.predict(X_test)

          # Now you can use predictions for further analysis or evaluation
```

TensorFlow backs both undeniable level APIs for speedy model prototyping, (for example, Keras, which was incorporated into TensorFlow) and lower-level APIs for all the more fine-grained command over model engineering and preparing. It can run on computer processors, GPUs, or particular equipment like TPUs (Tensor Handling Units).

Keras:

Keras is an open-source significant-level brain network Programming interface written in Python. Initially created as a free library, Keras was subsequently coordinated into TensorFlow to give an undeniable level connection point to building and preparing brain organizations. Keras is intended to be easy to understand, secluded, and extensible, making it open for the two novices and experienced analysts.

With the mix into TensorFlow, Keras clients can exploit TensorFlow's versatility and execution while profiting from the effortlessness and convenience of the Keras Programming interface. Keras likewise upholds other backends other than TensorFlow, albeit TensorFlow is the most widely recognized backend utilized.

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```
In [13]: reg.score(X_test, y_test)
Out[13]: 0.3838089578361541

In [14]: from sklearn.model_selection import GridSearchCV

         parameters = {'n_estimators':[10, 20, 50, 100, 200, 500]}

         grid_obj = GridSearchCV(reg, parameters)
         grid_fit = grid_obj.fit(X_train, y_train)
         best_fit = grid_fit.best_estimator_
         best_fit.predict(X_test)

Out[14]: array([[  5.8744 , 346.306  ],
                [  5.728  ,  42.78116],
                [  5.6438 ,  10.2708 ],
                ...,
                [  5.7356 ,  32.9166 ],
                [  5.7406 ,  18.26242],
                [  5.6206 ,  41.0392 ]])

In [15]: best_fit.score(X_test, y_test)
Out[15]: 0.387431172690087
```

Neural Network model

In the above case it was more kind of linear regressor where the predicted values are not as expected. So, Now, we build the neural network to fit the data for training set. Neural Network consists of three Dense layer with each 16, 16, 2 nodes and relu and softmax as activation function.

```
In [16]: from keras.models import Sequential
         from keras.layers import Dense

         def create_model(neurons, activation, optimizer, loss):
             model = Sequential()
             model.add(Dense(neurons, activation=activation, input_shape=(3,)))
             model.add(Dense(neurons, activation=activation))
             model.add(Dense(2, activation='softmax'))

             model.compile(optimizer=optimizer, loss=loss, metrics=['accuracy'])

             return model
```

Neural networks in earthquake prediction analyze seismic data through interconnected layers, learning patterns to forecast events like magnitude and depth. Trained on historical data, these models use complex architectures to make predictions, though uncertainties persist, making ongoing research crucial for improving accuracy and reliability in earthquake forecasting.

```
         In this, we define the hyperparameters with two or more options to find the best fit.

In [17]: from keras.wrappers.scikit_learn import KerasClassifier

         model = KerasClassifier(build_fn=create_model, verbose=0)

         # neurons = [16, 64, 128, 256]
         neurons = [16]
         # batch_size = [10, 20, 50, 100]
         batch_size = [10]
         epochs = [10]
         # activation = ['relu', 'tanh', 'sigmoid', 'hard_sigmoid', 'linear', 'exponential']
         activation = ['sigmoid', 'relu']
         # optimizer = ['SGD', 'RMSprop', 'Adagrad', 'Adadelta', 'Adam', 'Adamax', 'Nadam']
         optimizer = ['SGD', 'Adadelta']
         loss = ['squared_hinge']

         param_grid = dict(neurons=neurons, batch_size=batch_size, epochs=epochs, activation=activation, optimizer=optimizer, loss=loss)

         C:\Users\hp\AppData\Local\Temp\ipykernel_10856/372383517.py:3: DeprecationWarning: KerasClassifier is deprecated, use Sci-Keras
         (https://github.com/adriangb/scikeras) instead. See https://www.adriangb.com/scikeras/stable/migration.html for help migrating.
           model = KerasClassifier(build_fn=create_model, verbose=0)
```

Now after using different models, we reached the conclusion of using a random forest regressor for prediction in the above code we are fitting our testing data in our model so that we can find the accuracy of our model.

We have set the epoch limit of 20 iterations which has given us an average accuracy of

```
In [18]: grid = GridSearchCV(estimator=model, param_grid=param_grid, n_jobs=-1)
         grid_result = grid.fit(X_train, y_train)

         print("Best: %f using %s" % (grid_result.best_score_, grid_result.best_params_))
         means = grid_result.cv_results_['mean_test_score']
         stds = grid_result.cv_results_['std_test_score']
         params = grid_result.cv_results_['params']
         for mean, stdev, param in zip(means, stds, params):
             print("%f (%f) with: %r" % (mean, stdev, param))

         Best: 0.800000 using {'activation': 'sigmoid', 'batch_size': 10, 'epochs': 10, 'loss': 'squared_hinge', 'neurons': 16, 'optimiz
         er': 'Adadelta'}
         0.600000 (0.489898) with: {'activation': 'sigmoid', 'batch_size': 10, 'epochs': 10, 'loss': 'squared_hinge', 'neurons': 16, 'op
         timizer': 'SGD'}
         0.800000 (0.400000) with: {'activation': 'sigmoid', 'batch_size': 10, 'epochs': 10, 'loss': 'squared_hinge', 'neurons': 16, 'op
         timizer': 'Adadelta'}
         0.600000 (0.489898) with: {'activation': 'relu', 'batch_size': 10, 'epochs': 10, 'loss': 'squared_hinge', 'neurons': 16, 'optim
         izer': 'SGD'}
         0.200000 (0.400000) with: {'activation': 'relu', 'batch_size': 10, 'epochs': 10, 'loss': 'squared_hinge', 'neurons': 16, 'optim
         izer': 'Adadelta'}
```

```
In [19]: model = Sequential()
         model.add(Dense(16, activation='relu', input_shape=(3,)))
         model.add(Dense(16, activation='relu'))
         model.add(Dense(2, activation='softmax'))

         model.compile(optimizer='SGD', loss='squared_hinge', metrics=['accuracy'])
```

```
In [20]: model.fit(X_train, y_train, batch_size=10, epochs=20, verbose=1, validation_data=(X_test, y_test))
         0.9811
         Epoch 7/20
         1757/1757 [==============================] - 4s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 8/20
         1757/1757 [==============================] - 3s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 9/20
         1757/1757 [==============================] - 4s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 10/20
         1757/1757 [==============================] - 4s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 11/20
         1757/1757 [==============================] - 4s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 12/20
         1757/1757 [==============================] - 4s 2ms/step - loss: 0.5041 - accuracy: 0.9799 - val_loss: 0.5041 - val_accuracy:
         0.9811
         Epoch 13/20
```

0.9810.

```
In [21]: [test_loss, test_acc] = model.evaluate(X_test, y_test)
         print("Evaluation result on Test Data : Loss = {}, accuracy = {}".format(test_loss, test_acc))

         138/138 [==============================] - 0s 1ms/step - loss: 0.5041 - accuracy: 0.9811
         Evaluation result on Test Data : Loss = 0.5040959715843201, accuracy = 0.9810976982116699
```

We see that the above model performs better but it also has lot of noise (loss) which can be neglected for prediction and use it for furthur prediction.

The above model is saved for furthur prediction.

```
In [22]: model.save('earthquake.h5')
```

14.5   Findings Discussion

In this exploration paper, quake expectations are investigated from the perspective of time series examination, utilizing the Irregular Woods Regressor. The review dives into the complicated examples and fleeting conditions inside seismic information, using the vigorous prescient abilities of the Arbitrary Backwoods model. The paper talks about the preprocessing steps, including separating and changing over timestamps, as well as the preparation and assessment process.

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By utilizing the qualities of the Arbitrary Backwoods Regressor, the examination adds to propelling comprehension we might interpret tremor expectation in view of testing and preparing information, offering bits of knowledge into the worldly elements intrinsic in seismic occasions.

14.6   Conclusion

In the ongoing review, an efficient checking of soil radon along with key meteorological boundaries is led inside the setting of quake estimating. Specifically, prior to corresponding vacillations of soil radon with looming quakes, we have performed: (1) a geochemical examination of soil around the checking site, and (2) measurable

In hurst examination of soil radon and meteorological boundaries, our outcomes recommend a reasonable connection between the fluctuation of soil radon and seismic occasions. The primary aftereffects of this study are summed up as:

- Geochemical examinations uncover that the substance of radionuclides in the soil is similar to standard qualities. This proposes that any improvement in radon isn't connected with the event of normal radionuclides as well as other soil properties like soil dampness content, pH, conductivity and so forth.

- The deterministic investigation of radon and meteorological boundaries uncovers an emphatically auto-connected steady lengthy memory pattern demonstrating that the previous pattern of chosen information is bound to proceed than to be upset from here on out.

- The low relationship coefficients among radon and meteorological boundaries unveil that any odd improvement of radon is not credited to a meteorological change.

- The factual examination (lingering signal handling strategy; x $\pm 2\sigma$) of soil radon changeability uncovers the presence of three periods (Zones A, B and C) of huge radon improvements.

   In each period, outstanding pinnacles of lingering radon were related to looming seismic tremor movement. It is worth focusing on that the current factual methodology neglects

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to catch any strange change related to the seismic tremors of low greatness and high RE/RD esteem. Comprehensively, the presence of such a critical relationship between the outcomes noticed for various observing stations embraces the utilization of a thick organization of radon observing for seismic tremor expectation studies.

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Chapter 15
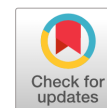
E-Waste Management: A New Dimension for Waste Management in India

Shikha Verma, [1*] (iD) **and Sadhana Tiwari[2]** (iD)

Abstract E-waste is a serious environmental and health challenge for many countries, especially those that are rapidly developing. Some countries, like Switzerland, have successfully implemented a formal system for collecting and recycling E-waste, exceeding the EU target of 4 kg/capita. However, other countries, like India, face many barriers to adopting such a system, such as socio-economic factors, lack of infrastructure, and inadequate legislation. This paper reviews and compares the E-waste management practices of different countries. It also proposes a road map for developing a sustainable and effective E-waste management system in India that ensures environmental and occupational safety and health.

The objective of this research is to examine how e-waste management practices affect environmental sustainability and to investigate the level of awareness of e-waste management among countries. The research is based on an empirical study conducted in India using a structured questionnaire. The study covers six key aspects of e-waste: generation, management, composition, reuse, regulation, and education. The results of the study show that there is a low level of awareness of e-waste generation and its treatment practices, but the concept of extended producer responsibility is gaining traction. Despite the efforts made by the authorities, only a small percentage of the population is aware of e-waste management. The respondents are aware

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of the harmful effects of e-waste and its potential for reuse. The respondents also express the need for 'integrating e-waste in the curriculum' of engineering programs.

Keywords e-waste management, environmental sustainability, empirical3 study, Advance recycling fee

15.1   Introduction

The disposal or recycling of electronic waste is a major challenge for urban solid waste management in India. Electronic waste, or e-waste, refers to discarded electronic devices that come from various sources, such as computers, televisions, phones, air conditioners, toys, and so on (Mittal and Gautam, 2023)The list of e-waste items can be expanded to include other electrical appliances, such as refrigerators, washing machines, dryers, and kitchen utilities, or even airplanes. The rapid development of technology and the changing lifestyle of people have increased the consumption and obsolescence rate of electronic products. Moreover, the import of junk computers from abroad has added to the problem. E-waste contains hazardous materials that can harm human health and the environment if not handled properly.

Computer waste is a major source of e-waste that can harm the environment and human health. A US study estimated that by 2004, more than 315 million computers would be outdated and replaced by new ones. This means that for every new computer sold in 2005, there would be an old one discarded. This creates a huge problem of disposing of the obsolete computers in a safe and sustainable way.

Computers are becoming obsolete faster than ever before, thanks to the rapid pace of innovation and development in the field. Every new breakthrough makes the previous models outdated and less efficient, and consumers are lured by the marketing strategies and incentives to buy new machines instead of upgrading their old ones. This leads to a huge amount of electronic waste, which is often disposed of improperly and without regard for the environmental and health impacts. These devices contain toxic substances that can pollute the Soil, water and air, and harm the living organisms. Therefore, there is an urgent need for better ways of managing and recycling these wastes, and for raising awareness among the consumers about the

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consequences of their choices.

E-waste is a serious environmental and health issue in India. It contains harmful substances that can pollute the land, water and air, and harm the people who work with it or live near it E-waste recycling workers are exposed to many risks and diseases due to the toxic materials. Therefore, it is important to regulate the trade, the technology and the disposal of e-waste in India. This paper examines the e-waste management in India. It focuses on the amount and types of e-waste, as well as the health effects of the toxic substances. It also pays special attention to the computer waste. Moreover, it proposes an integrated plan to improve the e-waste management practices.

15.2   Literature review

Bisoee (2018), Jusco shows plastic road map to four cities, published by The Telegraph study shows plastic road map to four cities by Animesh Bisoee, published in The Telegraph in 2018, discusses how Jusco, a company, has introduced the concept of plastic roads in four cities. The article highlights the benefits of using plastic waste in road construction, such as durability and cost-effectiveness. It also mentions the challenges faced in implementing this technology, including the need for proper waste segregation and recycling infrastructure. Overall, the article showcases Jusco's initiative in promoting sustainable road construction practices using plastic waste.

Bhatt et al. (2017). Mindfulness and affectability of cell phone customers on electronic waste in Delhi-NCR district. In Sustainable shrewd urban communities in India, study focuses on the relationship between mindfulness and the awareness of cell phone users regarding electronic waste in the Delhi-NCR district. It explores the level of knowledge and concern among users about the environmental impact of electronic waste and the extent to which mindfulness influences their behavior towards e-waste management. The chapter sheds light on the importance of promoting mindfulness and raising awareness among cell phone users to encourage responsible handling and disposal of electronic waste in urban areas.

Chandran and Narayanan (2019), report titled "How much e-waste is being generated in

Karnataka?", published on The Deccan Herald website (2019) study focuses on the amount of electronic waste (e-waste) being generated in the state of Karnataka, India. It provides insights into the current e-waste generation levels and highlights the need for effective management and recycling practices. The report aims to create awareness about the environmental impact of e-waste and encourages stakeholders to take proactive measures to address the issue. It explores various approaches and strategies for effectively managing e-waste, including recycling and disposal methods, as well as policy interventions. The study aims to provide insights and recommendations for policymakers, researchers, and stakeholders to improve e-waste management practices and contribute to environmental sustainability.

"How much e-waste is being generated in Karnataka?" The report focuses on the quantification of electronic waste (e-waste) generation in the state of Karnataka, India. It provides insights into the current levels of e-waste being generated and highlights the need for effective management and disposal practices. The report aims to raise awareness about the magnitude of e-waste generation in Karnataka and emphasizes the importance of sustainable e-waste management strategies to mitigate environmental and health risks.

15.3 Objective

- Examining, using examples, the legislative restrictions on efficient e-waste handling strategies for sustainable e-waste improvement.

- Creating guidelines for e-waste management and reverse logistics networks and evaluation of recycling systems for the control of electronic waste.

- Detoxification of metals and India's waste electrical and electronic equipment comparison and disposal.

- Public knowledge and consciousness regarding e-waste in an Indian metropolitan environment and the Effects of unmanaged e-waste dumping on the environment.

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15.4   Findings and Discussion

15.4.1   Management of E-Waste

E-waste is a growing problem as technology advances and devices become obsolete. When consumers discard their electronic products, they enter a long and complicated chain of transactions that involves both formal and informal actors. The formal actors include the manufacturers and retailers of computer items, who may have some responsibility for the disposal or recycling of their products. The informal actors include the recyclers, who extract valuable materials from the e-waste, often using hazardous methods that pose risks to their health and the environment. To address these issues, e-waste management strategies may include the following options .

15.4.2   Reuse of Products

Reusing old electronics helps the environment and saves resources. It reduces the need for new materials and energy, and lowers the pollution from manufacturing and using energy. It also helps people who cannot buy new electronics get them at a lower price or for free. Some ways to reuse e-waste are:

- - Selling or donating working devices to others

- Fixing or upgrading broken or outdated devices

- Salvaging parts from unusable devices and using them to make new ones

15.4.3   Recycling

The process of breaking down old or damaged electronics into parts and materials is done by specialized companies that can recover and sell valuable metals, plastics and other substances. However, this process poses serious risks to the health of the workers who are exposed to toxic substances and radiation. Moreover, recycling can only recover a limited amount of materials from electronic waste, such as copper, gold, silver, aluminum, iron, tin, lead, and plastics. The

current system of recycling and disposing electronic waste in India and the existing management system for e-waste are shown in Figures1 and 2.
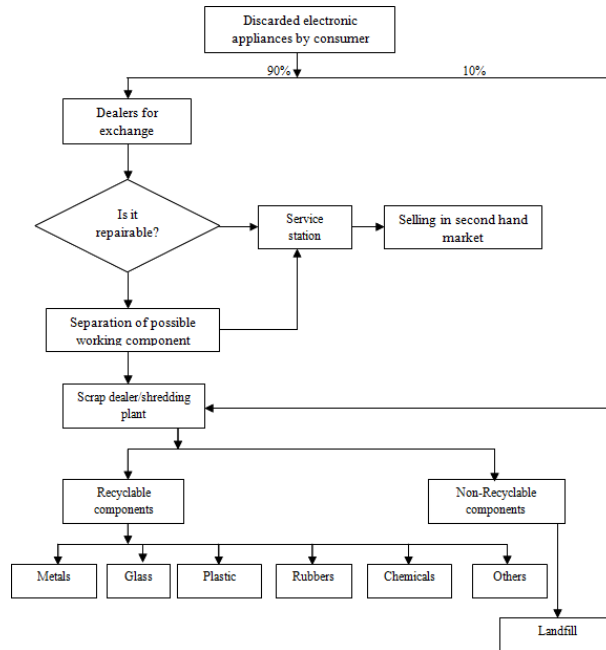
Figure 15.1: E-WASTE MANAGEMENT IN INDIA: OPPORTUNITIES AND PREDICA-MENTS UNDER SWACHH BHARAT ABHIYAN Bhuvanesh Kumar Sharma1 , Avdesh Bhardawaj2 , Raghav Bhardwaj3

15.4.4   Conventional Disposal in Landfills

E-waste is a major environmental problem that affects both soil and water quality. When e-waste is disposed of in landfills, it does not decompose quickly, especially if the conditions are dry. This means that e-waste can stay in landfills for a long time, taking up space and releasing harmful chemicals. Some of these chemicals, such as lead, mercury, and cadmium, can leach into the groundwater and contaminate it. The environmental protection agency (EPA) reported that in 1997, about 3.2 million tonnes of e-waste were sent to landfills in the US . The plastics in e-waste are particularly resistant to degradation and can persist in the environment for centuries.

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15.4.5   Incineration or Open Burning

The process of recovering copper from old motherboards involves a technique called pit burning. This involves breaking down the circuit boards and exposing the copper foils that are embedded in them. The foils are then burned in a pit to remove the plastic and other materials, leaving behind the copper with some carbon residue. The copper is then washed and sent to another facility for further recycling. The unwanted parts of the motherboard, such as the IC chips and condensers, are also burned in a separate enclosure with a chimney to extract the metals from them.
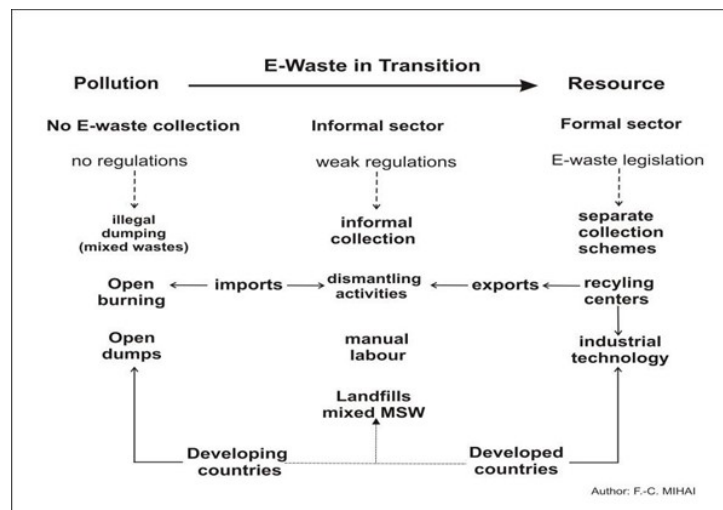
Figure 15.2: E-waste management interactions in a transitional stage

15.5   Conclusion

E-waste is a growing problem in the world, as people buy and discard more and more electronic products, such as mobile phones, computers, TVs, fridges, washing machines and air conditioners. These products contain toxic and hazardous materials that can harm human health and the environment if not disposed of properly. E-waste comes from various sources in India, such as

government, commercial, institutional, research, household and manufacturing sectors. These sectors often sell their waste to the highest bidder, who may be formal or informal recyclers, local collectors or scrap dealers. The current waste management Strategies are mostly technical and environmental, and do not address the social issues and solutions related to E-waste. There is also a lack of public awareness about how to dispose of electronic goods safely and responsibly. The government and the industry agree that E-waste needs to be managed efficiently from a social and environmental perspective, but they need to work together to understand the practical and cultural realities on the ground. The informal sector needs to be integrated into a defined E-waste supply chain, otherwise the goals of the government and industry will be achieved.

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Chapter 16
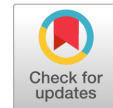
An in-depth Look at the Research on Reducing Lead Times in Inventory Control

Brijesh Kumar [1*] (iD) **Himanshoo Tiwari** [2] (iD)

Abstract

This paper presents an overview, from a specific vantage point, of the popularity of lead time discount in stock control studies in related domains. This overview is offered from the perspective of the lead time discount. to begin, this study suggests a few significant factors that need should be taken into account in the lead time-saving investigations; next, to point of view of the output of the studies, the existing literatures can be split into four categories basically based on the following: The years, namely the range from 1991 to 2000, are the primary basis for the first component. The second component covers the years 2000 through 2004, while the third spans the years 2005 through 2008.

The last part covers the years 2008 through 2012. Literature is analyzed in every course with reference to the topics highlighted above as being most important. The structure presented in this study for doing a literature review provides a clear picture of an overview of the relevant discipline of lead time discount stock. This picture may serve as a starting point for further research by providing a location to begin. Protection stock, cost of crashing, inventory manipulation, inventory versioning, time to provide, and inventory cost.

Keywords:Inventory, Lead time, Stock, Reduction and literature review.

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16.1   Introduction

To be successful in today's business world, which may be highly cutthroat, companies need short wait times, affordable rates, and competent customer assistance in order to continue to exist. As a direct consequence of this, new businesses have surfaced to meet the need of more customers. Because of this, firms have been forced to deploy a significant number of additional workers in order to shorten their lead times.

In the 20th century, the focus of the corporations increasingly shifted to be on the clients and consumers. To prevail in this endeavour is becoming progressively more challenging. According to Gaither et al. (19941605 customers should always be happy . You need to have short lead times in order to supply clients with what they want, which is one of the many things that will help you to compete in a market that is worldwide. Companies that use cycle time as a metric of productivity may reduce delivery times and improve quality, both of which contribute to an increase in the number of customers who are happy with the company's products or services. The amount of time between when a customer places an order on hold and when they get the goods at the conclusion of the process is referred to as cycle time or lead time. According to Silver et al. (1998), the term "lead time" refers to the amount of time that passes between the time an order is placed and the time the order is fulfilled. The length of time it takes for an order to be delivered may also have an impact on the fee of inventory and decide whether or not a customer places an order for the provider.

Reducing lead times may make people more effective and help the company's position within the market, as shown by the case of Japan and the preparation of just-in-time manufacturing, which has proved this. According to Gaither et al. (1998), every aspect of a business has to be concerned with the lives of its stocks. Without it, nothing at all can be accomplished in the world of business, whether it be a provider commercial enterprise such as a health facility or banks, etc., or businesses that create or sell things to consumers. It doesn't matter what kind of business it is; the importance of inventories can easily be shown by seeing the transformation of inputs into outputs. Simply said, stock is a listing of things that you own that have some monetary or other kind of value attached to them. This value might be in the form of goods,

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cash, or labour.

One way to think about inventory is as a collection of products that may be bought, kept, and utilised on a daily basis to keep an employer going. This might be in the form of raw materials, objects that are only partially finished, fully finished items, or even products that have been sold out but were utilised in the manufacturing and assembly processes. The majority of managers despise inventories for the same reason that they dislike storing money in a drawer: belongings investments that aren't bringing in any income and require money to borrow. They must additionally pay for the care of the goods that are being conserved, and things are likely to become very bad for them. obsolescence. There have been several of them during the last two decades, a number of programmes that have been developed by industry, all of which aim to cut stock levels and make the shop floor function more efficiently. Just-in-time manufacturing, con-wip manufacturing, Kanban manufacturing, lean manufacturing, and bendy production are some of the most prevalent types of production methods.

In this paper, we discuss not only the criticality of lead time's effects on inventory but also the unique approaches that have been tried so far to remedy critical lead problems with cutting down on time that result in inventory optimization and control. We do this by using looking at a large amount of literature. In this paper, we discuss not only the criticality of lead time's effects on inventory but also the unique approaches that have been tried so far. Taking into consideration the various outcomes that have been found in published research, the following sections will discuss several novel approaches that may be used.

16.2   Literature Review

16.2.1   Key factors in cutting down to lead timestudy

Demand, the number of orders, cut price, whether or not or no longer to allow shortages, inflation, and the value of money through the years are some of the other elements to recollect further to the product's nice, charge, reorder factor, and protection inventory. When focusing on reducing the amount of time needed to conduct an inventory check, it is essential to remem-

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ber that the amounts of cash on hand are also important factors to take into account. We are able to generate a variety of stock models by combining those additives in a variety of different ways, and basing those fashions on the components that were listed earlier in this paragraph. This allows us to produce a wide variety of stock models. Demand is the most important factor considered by the stock management system as it makes decisions. When conducting an analysis of a stock, one of the most important factors that needs to be taken into consideration is the level of demand for the stock. They thought that the demand for their work followed a normal distribution.There are almost always instances of. The term "demand" refers to one of the categories that might be examined in these most recent studies, and the term "random" or "probabilistic" call for refers to the other category. Due to the fact that customers' needs can vary greatly, it was discovered that only a small percentage of the requests made by customers could be satisfied within the allotted amount of time for production. You can't rely on a single distribution if you want to provide an accurate description of the demand for the time to move. In addition to this, it has been discovered that the reorder factor r can be utilised as a selection variable . [Citation needed] In light of this fact, a great number of researchers from a variety of scientific fields have carried out in-depth studies on the subject of demand. The category of "stochastic demand" encompasses not one but two incredibly different kinds of needs. The first type has a demand that is allotted in a manner that has been predetermined, whereas the second type has a demand that is allotted in a manner that is completely arbitrary. when we allow pass of the perception that call for is predetermined and instead count on that demand is unpredictable, then the difficulty of lead time will become a large problem that has a selection of capacity resolutions.

In the traditional model of inventory management, it is an article of faith that the quality level is constantly maintained at the best possible level. To put it another way, the belief is made that all of the goods are of the same fine and that they are faultless in every respect. This is a piece of religious writing. despite the fact that, in the real international, it is often viable to look, in the context of a production setting, whether or not low-quality products are being made as a consequence of errors that take place all through the manufacturing process. production strategies. Juran turned into one of the first humans to consider about the notion of

how first-rate it's kilometres, and because of this, he turned into one of the first. The "Juran trilogy" that he wrote became evidence of this aspect of the situation. technique of control that extends across several departments and is composed of three control approaches: planning for fine, regulating best, and enhancing high-quality respectively. If nothing is done to improve the current situation, there will always be waste, and when things do change, there may be charges; but, after the situation has been improved, margins may be higher, and the extra expenditures may be paid back. The electronic devices that contain components that are broken should either be thrown away, repaired, or rebuilt; however, if they have already been sold to a buyer, the buyer's money should be repaid. Each scenario involves the undertaking of significant financial investments. Therefore, in the event of a device or manufacturing method that does not perform effectively, the management may take into consideration spending money in improving quality so as to minimize the costs connected with pleasantness. Porteus and Rosenblatt and Lee were among the first people to factor out the significant courting that exists among a large amount and the presence of best defects. Keller & Noori (1988) expanded on what Porteus (1986) had done for a scenario in which the demand for during the lead length is uncertain and there may be the possibility for shortages. This was done for a situation in which there may be the potential for shortages. Hwang et al. (1993)carried out research on the models of financial lot length for a number of different devices. They made the discovery that by making a one-time investment to get things started, one may save costs while simultaneously enhancing the quality of the product while simultaneously improving product quality. Hong J.D. and Hayya (1995) presented a version that may increase quality even as concurrently cutting prices. This version contains a limit on the possible price range in addition to several other non-stop functions. Hong and Hayya's version can be found right here.

Ouyang and Chang (2000) conducted research into the outcomes of the quality of the improved reorder factor for changed lot sizes. models with a wide range of wait times and a healthy backorder volume. The technique that became developed by Ouyang and Chang was extended by means of Ouyang et al. (2001) by using spending cash in the improvement of approach high-quality even though simultaneously putting in region solutions to minimise expenses. It is especially important to eliminate long wait times when there is ambiguity over what consumers

desire, since this makes it far more probable that the company will run out of inventory before a customer's purchase arrives. Long lead times make this much more likely. This is due to the fact that longer wait periods increase the likelihood of the organisation running out of supplies. In this scenario, a number of studies demonstrate that minimising the length of time it takes to fill up may also lower the quantity of safety stock, cut down on stock-out losses, and increase the quality of customer assistance; all of these factors lead customers to anticipate reduced common expenses. The existence of protective stock is a significant factor that has a positive impact on the turnaround time, which has been reduced as a result. In addition to Hsiao, Y.C (2008), Hayya et al. (2011) and Glock (2012) is among the researchers who have carried out the computations required to evaluate the impact that cut down may have on the lead time for protection stock. In addition, it has been shown that the amount of lead time a company has is directly linked to how well the company succeeds in terms of various financial indicators such as "return on investment" (ROI) or "common earnings" (Christensen et al. 2007). This illustrates that when the demand rate increases, the relevance of regulating the lead time will become less significant. In contrary to what an overwhelming majority of people believe, the worth of time spent is best determined by the amount of orders Ben-Daya et al. (1994) and Ouyang et al. (2002).

Within the framework of the traditional stochastic non-stop assessment (Q; r) model, Kim and Benton (1995) developed a linear relationship , which they established between lead time and order length. They illustrated how this correlation can be used to show that firms need to have a significant amount of cash on hand if they take into account the impact that the size of the lot has on the length of time it takes to produce the goods as well as the quantity that must be kept in reserve. Hariga modified Kim and Benton's model by calculating the yearly backorder cost in the correct manner and providing an opportunity technique for the new lot size to narrate to Kim and Benton's lot size, which became smaller . This caused the yearly backorder cost to be calculated in the correct manner. As a consequence of this, the yearly backorder cost was computed in the appropriate way. Hariga's contribution to the research consisted of analysing the return on investment in set-up time reduction, as well as the ways in which it influences lead time, lot size, and the amount of time required to set up. Her participation in the examination

consisted of this contribution. According to the results of Pan et al.(2002) the amount that each item cost, including transportation costs, overtime pay, and extra stock, determined how much it would cost to carry along the journey. It is possible that the charge will be proven because of the combination of a predetermined amount and a portion of the variable amount that was appropriate for the size of the rushed order. This is because there has been a rush of orders. The assessment that Ouyang and Wu conducted took into account the lead time further to the order. large number of backorders as determining factors for a mix of backorders and the lost revenue inventory version, which states that shortages are due to authorised, and think about the demand for the lead time distribution. quantity of backorders should be used as decision variables for a blend of backorders and the lost revenue stock version. A "safety stock" is an additional supply that is kept on hand as a safety net to protect against stock-outs caused by unpredictably changing conditions in nature or the world around us. Keeping this additional supply on hand is known as "safety stock." Additional supplies are kept on hand in the form of "safety stocks." The lead time is an essential component of any inventory management system that's worth the salt it's worth. Ouyang and Wu suggest that they would be able to cut their expenses if they were to cut down on the amount of time it would take to complete the project from start to finish. protecting stock, decrease the number of losses that may be caused by walking out of inventory, increase the level of customer care provided, and make them more competent of competing with other businesses in the marketplace. Fee (amount) discounting is a significant approach that is regularly utilised by the seller as a vital tactic to persuade the customer to shop for in enormous amounts; this method has been employed by a lot of studies. The purpose of this strategy is to persuade the customer to purchase a higher quantity of the product on their shopping trip. modelling of the stock lead time reduction to take into mind with regard to this element.

Whether or not to tolerate scarcity, or whether or not to do so anymore, is another factor. The two assumptions in each scenario might serve as the basis for the development of a stock trading strategy. The majority of the time, scarcities manifest themselves in our day-to-day lives, and this is especially true in times of severe stress. It is possible that the call will need to be put on hold depending on how quickly it is processed. There are more research that

look at the best ways to lessen the impact that wear and tear has on costs in order to draw attention away from the possibility of a shortage. There are ways to cope with the shortage, supposing that the products that are available for rapid delivery will not arrive on time all at the same time. The alternative situation states that a few of the things that are in short provide are backlogged, which implies that customers best want to accept a few of the goods that are now out of inventory and may best be offered with the assistance by the vendor inside the following length of time.

16.2.2   Review of Lead Time Cutting Inventory Study

Following the receipt of an order, it is now accepted practice to assume that the item's travel time will include the time it takes for it to depart from the provider. Most of the time, the lead-time is uncertain or is dictated by arbitrary natural occurrences. On this basis, lots of research articles already published as an electronic book. One of past papers to deal with a variable lead time in a was this one. The writer predicated that lead time could be divided into additives, each of which could have its own piecewise linear crashing fee function for shortening lead time, and that everything could be designed to last for a certain minimum amount of time. Based on the presumptions that the lot's size has previously been accepted and that the request has been provided uniformly, they assess the best way to satisfy the request. Lead time should be reduced, and it should be shown that doing so should likely result in lower predicted costs overall. The models developed by Ben-Daya and Raouf go lower back to Liao and Shyu take lead time as well as order size into account as selection factors. They create two models: one that utilizes an exponential increasing version and the other that employs a value characteristic for lead time crashes developed by Liao and Shyu. A fall in price characteristics is happening. Then, they develop models that demonstrate the link between lead time and cost using a variety of different methodologies, and both the value and the lead time keep becoming shorter. And potential improvements to their work include considering random lead times and taking into account lead times when deciding whether or not to purchase an item in various stock styles. Lacks should be included in the version, according to an addition made by Ouyang et al. People believed that the Ben-Daya and the Shortages may both be approved and prolonged. Raouf's

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model was developed with the assistance of include the cost of stock sales. In a similar vein, backorders and revenue that no longer occurred are combined to determine the total quantity of products that were unavailable for the length of the stock out period.

They eventually realized that this is a problem when the lead time requirement is spread out over a longer period of time . In actuality, a mixed stock strategy has solutions for problems with backorders and missed revenues. They could find that the stock's ability growth is helpful in assisting them accomplish their task. version employing the minimax distribution for no extra expense, for example, a mix of backorders and missed sales. Moon, Choi thought on a strategy that included a continuous evaluation of the inventory, and he discovered that there were a combination of missed sales and backorders. The amount, reorder point, and lead time serve as the only determinants of the variables. This model is more sophisticated than the one now in use, and notwithstanding, it is anticipated that the overall forecasted annual price might fall significantly while still giving a greater grade of service. This analysis was developed with the goal of improving Ouyang, Yen, and Wu's version by optimising the order size and the delivery time reorder point. This served as the impetus for writing that paper. In comparison to the version, it became possible to get significant cost reductions. In order to reduce the overall cost of purchasing, safeguarding, and stocking out value and collapsing price, (Ouyang and Wu,1998) propose a set of models that combine missed sales and backorders. In this study, the lead time and order size were looked at as deciding factors. The authors employ the minimax method rather than making any assumptions about the nature of the opportunity distribution of lead-time demand. There may not be a solution that does not include some kind of financial support. The authors discover that the order volume each cycle is much higher in the event of lost revenue than it is in the case of backorders. Additionally, the order quantity (Q) and the safety concern (ok) are negatively correlated when dealing with a hard and fast lead time (L). It demonstrates the protection component is expanding, which in turn demonstrates the safety stock is expanding, demonstrating the necessity to cut the order's product amount. A non-linear approach could be useful for gaining deeper understanding of that particular situation. There could be a correlation between how long it takes to steer and how much money is lost in an accident. In contrast, the minimax distribution is a free technique, which enables it to be used

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to exclusive inventory styles and allows the examination to proceed similarly.

In contrast to the models offered by Banerjee and Goyal , the net gain may be distributed among them even if one spouse experiences a gain that is bigger than the other's loss by using an ordering approach that is advantageous to both parties. by way of each party in any manner that is deemed reasonable. A paper by Ben-Daya and Hariga was published under the heading "Papers on Lead-Time." Lead-time crashing has a cost, which you should consider to be a recurring pricing charge since it is always there. crashing, you should take the cost of lead-time crashing into account as a value value. The value of crashing is seen as a one-time expense in this newsletter, and a stochastic continuous assessment stock version is employed with lead time as a choice variable. In a nutshell, the report claimed that the whole lag time was divided into its three largest elements, which are the following: time for installation, time for working, and time for not working. These differences in setup costs and lead times are taken into consideration, crashing the lead-time as a result. The number of ways to invest to cut lead time and set-up costs, how well they work together, and the size of the lot lead-time interaction may all be used to determine a wise course of action in the control and management of lead time. Every other element that this article gives is what happens when you investigate within the lead-time part that deals with manufacturing time and the value of production. This essay also offers. When there is only one supplier and one consumer, Ben-Daya and Hariga addressed the problem of linked manufacturing and inventory.

They abandon the premise that require is predictable and, as a replacement, anticipate that it is stochastic in order to handle the lead time issue. However, the lead time expression also took into account the amount of time spent on unproductive tasks. They felt that the relationship between lead time and lot length became linear. The version developed by Ouyang and Wu is enhanced and advanced by Lee, Wu, and Hou . This newsletter adopts the stance that the number of faulty items found in an order upon delivery is a binominal random variable. [Reference required] They developed a modified mixed stock version that took into account backorders and lost revenue. The decision-making criteria in this version include lead time, order quantity, and reorder point. In the future, dealing with the inventory version with a service level obstacle or malfunctioning devices in the inventory version with sub lot sample inspection may be excit-

ing. Sub lot sample examination can be necessary in each of these situations. Pan, Lo, and Hsiao describe a continuous assessment stock device where shortages were permitted and the total amount of stock out was determined by adding the value of backorders and lost sales. The goal is to simultaneously maximise order quantity, lead time, backordering, and reorder factor efficiency. It was anticipated that the retailer would provide impacted customers who still had outstanding orders a backorder price reduction both throughout the duration of shortage and that the backorder ratio would be inversely proportionate to the discount. Additionally, it was believed that the stock's lead time would be managed and that the quantity of orders placed as well as the decreased lead time would be factors in the price of the collapse.

As techniques for the definition of the backorder possibility, they suggested using piecewise consistent capabilities and exponential capabilities. Their strategy has the potential to be effective when there is historical data on a customer's loyalty to a output, and when data is described piecewise steady probability / exponential characteristics. Even though Pan and Hsiao makes a specialty of lowering total machine response time, one of the most prominent topics among lecturers and practitioners is the decrease of stock lead time. Below the level of probabilistic demand, a stock shortage is unavoidable. The retailer may also provide a backorder price discount on cosy orders throughout the scarcity length in an effort to make up for the annoyance and even losses of royal and patient clients. This is done with the purpose of compensating for the inconvenience caused to loyal customers. This paper contributes to the body of work done by Ouyang et al. by advancing their ideas by recommending that lead time and backorder fee discount be negotiated, and by proposing that the lead time crashed value be expressed depending on the order amount as well as the shorter lead time. Chang et al. conduct research to investigate how the integrated stock model is affected by a decrease in lead time as well as ordering fee thresholds. It was predicted that the size of the requested quantity would determine how much the price to shorten the lead time would increase. The order's payment was extra safeguarded by the selection components. During the course of the inquiry, two different models were provided. Within the original model, which made use of a logarithmic financing cost feature, the reductions in ordering cost and lead time had each been implemented separately one at a time.

Order crossover proved to be beneficial for them since it cut down on the amount of waiting time required. Order crossover refers to the process of converting lead instances into strong lead instances, which have an average lead time that is comparable to the one-of-a-kind lead time but a difference that is far less than the one-of-a-kind distinction. Consequently, if they optimized, adding the difference added about by using order crossing may result in a less costly price if safety stocks were low. This could be the case if the difference added about by using order crossing. As a result, companies may do a transaction analysis in order to determine whether or not reducing the average may enable them to repay the cost of shortening the lead time. a procedure with two stages They provided a straightforward method that was easy to grasp and comprehend. There are not many issues to deal with, the demand rate is stable, and the cost of shortening the lead time can be determined. Determine the best possible answer via the use of numerical search, and then utilize that answer to characterize the model. respond due to the fact that it delays the provision of closed bureaucracy for some time. They were able to acquire "closed-form" estimates as a consequence, which may be found in the first part. After then, they launched the second phase of the one, which included using the ones numbers as a starting point. Christoph H. Glock conducted research on a variety of approaches to lead disposal and analysed the effects those approaches had on safety inventory and ability consequences. the overall benefit of using a stock management system with (Q, s) non-stop reviews The strategy of having a single-dealer and a single-buyer developed became the goal of Glock. It was thought that the lead time may vary based on the size of the order, and that the integrated stock model could experience unpredictable demand at times. The manufacturing, the setup, and the transit each need some amount of time. The lead times might be shortened as a result of crashing by speeding up the setup and shipping processes, driving up the cost of manufacture, or lowering the size of the batches. They demonstrate that the lead is when there is a strong demand for it; conserving time is most advantageous when one is doubtful about something. Additionally, his investigation reveals that a combination between the setup and production times has to be shortened in order to reduce predicted average expenditures.

16.3   Discussion

How the Japanese have used Just-In-Time (JIT) production proves that there are pros and cons related to their efforts to keep lead time in check. Manufacturers of Japan are known for making products that last for a long time. Partnership with the people who supply them. This cuts down on lead time and is part of what makes their JIT philosophy work Lead time is something that has interested many writers, such as Das, Foote, et al., and Magson, Naddor, and Das. Before1980, customers were willing to wait for long lead times, which producers to keep product costs as low as possible by using economical size of a batch. When customers started to ask for shorten. They were able to get the lead times they needed from competitors. This is when the problem started, so businesses started looking for changes to be better able to compete. In an effort to cut down on lead when it came down to it, businesses and organizations found that 90%some of the things that are already being done aren't necessary and could be eliminated. Once manufacturers started. They found waste on switching, problems in quality and faults in quality, process control, factory layout, and machine breakdown time after they focus on processes.. So, they looked for ways to cut down on or get rid of waste. Harrington says that by getting rid of the things that don't add value, activities from the processes and putting the information in a more organized way. Flow can be optimized in a way that leads to big gains. In the 1960s and 1970s, companies competed based on how much they cost efficiency. In the 1980s, people were all about quality, and Zero Defects and the Six Sigma method became popular. Price and value are still important for superior operations, but the emphasis now is on straight up about speed.

   Almost every company that makes things today is under Customers put pressure on companies to cut lead times. Making thing quickly pays off in a big way. Let's define what we mean when we say "lead times." Customer lead time means to the amount of time between a customer's order and their delivery receipt. The term "manufacturing lead time" means the amount of time between when the materials are available at the first processing step and when they are finished at the last processing step. In many places that make things, less than 10% of the total number of during the manufacturing lead time, the item is being made product. And less than

5% of the time it takes to get a customer to buy is spent in the making of something. The total amount of time that each of the processes in the value stream are the theoretical limit of how We can cut down on lead times without putting money into different equipment. Clearly, there are many ways to cut down on lead times in most places of work. Getting things done faster doesn't involve speeding up equipment to cut down on cycle times or getting plant personnel to work faster. What is does involve is the speed with which customer orders are filled and production of high-quality goods from raw materials in then as little time as possible. In the competitive world of Companies need short lead times and low costs in the business world and high levels of customer service to stay in business. For this reason, Companies now care more about their customers. As a result, is that companies have been working very hard to cut down on their wait times.

There are a lot of things that affect Those are the costs of buying or making the inventory selling price, cost to buy, cost to hold, cost to sell, demand, number of orders, lead time or delivery leg, supply tiers, and so on. But the main things that affect the demand, cost factors, and lead time. All other things can be taken for granted for supply system. Even though a lot of progress has been made, achieved in the ways we get around, talk to each other, and production, most procurement systems require some lead time in supply, which is often hard to predict. Because of this doubt, the solution to the inventory problem harder to figure out and costs more to keep the same amount of inventory performance. These are well-known effects of lead time, but are too general to be useful in the real world. We must knowhow and to what extent each of the many traits of lead time affects the price of inventory so that the most cost-effective of all the possible ways to supply. Lead Time is a big part of logistics management today.

16.4   Conclusion

The shorter lead time required by the inventory system has garnered a lot of interest from researchers, who have given an increasing amount of attention to conducted a great deal of study in this field. For the sake of this article, we shall employ a We made an effort to examine time-

saving works of literature from a fresh perspective lead. In the actual world, there are several situations in which lead time may be shortened, yet doing so would result in higher costs in the event of a collision. It is possible to stop it. When the lead time was reduced, it was discovered that the amount of safety stock could be decreased. This helped to enhance the quality of customer service, minimize the risk that was resulting from stock outs, and maximize the company's capacity to compete in the business world. When it comes to what makes a company competitive, cost and time are the two most critical factors. A corporation may utilize a variety of different tactics to cut down on the lead time to satisfy the demands of its customers under the Cost-wise heading. The lead time may be partitioned into a number of crashing periods as a means of finding a point of equilibrium between the two factors that are within your direct control. expenses and amount of time Crashing prices may be split down into two categories: manufacturing expenses and transportation costs, and both of these categories are rising as a result of rising output rates among suppliers. In calculating these costs, overtime compensation for employees, additional fees for quick transportation, the cost of new equipment, and the consequences of economic cycles, including inflation and recession have been taken into account. The value of one unit of currency relative to another is affected by deflation.

When the research was completed, a significant issue was discovered. The literature on reducing lead times in inventory models shows that almost all of the authors thought the lead time is not influenced by the number of lots and the size of each lot function is a good way to explain the connection between reducing lead times and the costs of doing so. Cut down on lead times and the costs of doing so. Lead time reduction investment techniques are something that might be investigated more in the future as a potential area of focus for academic inquiry. In addition, research on "Lead time" and "Lead time" were both reduced over the same period of time. The term "uncertainty" may be used to demonstrate a few additional things about producing money that lead time uncertainty reduction cannot perform. It has been proposed that an increasing number of academics look at the possibility that supply chain issues might be resolved by reducing the amount of time it takes for inventory to be replenished. utilising hazy, random, and dynamic research methodologies, only in this manner is the study applicable to real life. only in this way is the research applicable to real life. There is optimism that this article

will be able to provide a broad overview of how lead time in inventory has been researched over the last several years, and that it will thus be able to serve as an avenue for further research in this area.

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Chapter 17
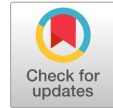
The Role of Triple Bottom Line Reporting in Promoting Corporate Sustainability and Stakeholder Engagement

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Abstract This study delves into the crucial role played by Triple Bottom Line (TBL) reporting in advancing corporate sustainability and enhancing stakeholder engagement. In the contemporary business environment, companies are progressively acknowledging the significance of integrating social, environmental, and economic aspects into their decision-making frameworks. TBL reporting provides a structured approach enabling organizations to evaluate and convey their performance across these dimensions. By investigating how TBL reporting influences corporate sustainability and stakeholder engagement, this research seeks to elucidate the advantages and obstacles linked with its adoption. It explores the three pillars of sustainability—social, environmental, and economic aspects—and illustrates how TBL reporting empowers businesses to assess and reveal their achievements within these realms.

Keywords Triple Bottom Line, Corporate Sustainability, Stakeholder Engagement, Financial Reporting.

17.1   Introduction

Triple bottom line (TBL) reporting serves as a framework that evaluates an organization's social, environmental, and economic performance, surpassing conventional financial reporting. It considers the influence a company exerts on people, the planet, and profits. The term "triple bottom line" encompasses the three pillars of sustainability: social, environmental, and economic aspects. This reporting method empowers businesses to gauge their societal and environmental impact, extending beyond mere financial accomplishments. It advocates for responsible practices, encourages social fairness, minimizes environmental impact, and promotes transparency in operations (Mittal et al.,2021). Through triple bottom line reporting, organizations can assess their overall sustainability performance and make well-informed decisions, steering toward a more sustainable future.

The concept of TBL reporting emerged in the late 20th century as a reaction to the constraints of conventional financial reporting, which concentrated solely on financial achievements. It became apparent that a more comprehensive approach was essential to fully comprehend the influence of organizations on society and the environment. The TBL framework introduced the notion that companies should be responsible not only for their financial outcomes but also for their social and environmental effects.

The human aspect of TBL reporting pertains to the social elements of sustainability, involving matters such as employee well-being, community involvement, and human rights. By considering elements such as ethical labour standards, diversity and inclusivity, and charitable initiatives, organizations can showcase their dedication to making a favourable social difference. Stakeholders, which include employees, customers, and local communities, anticipate companies to play a role in enhancing social welfare beyond mere profit-making.

The 'people dimension' in TBL reporting pertains to the social facets of sustainability, encompassing matters like employee well-being, community involvement, and human rights. By considering elements such as ethical labour practices, diversity and inclusivity, and charitable initiatives, organizations can showcase their dedication to fostering a beneficial social influence (Asif et al., 2023). Stakeholders, which include employees, customers, and local communities,

anticipate that businesses will play a role in enhancing social welfare beyond solely generating profits.

The 'planet dimension' centres on the environmental facets of sustainability, mandating that organizations evaluate their use of resources, energy efficiency, waste handling, and carbon emissions. Through the implementation of sustainable techniques like lowering greenhouse gas emissions, preserving water, and minimizing waste production, businesses can alleviate their environmental impact and aid in conserving natural resources (Tiwari et al., 2022). Stakeholders, including environmentally aware consumers, investors, and regulatory bodies, are progressively calling for heightened transparency and decisive measures concerning environmental concerns.

17.2   Literature Review

The literature review demonstrates that TBL reporting plays a vital role in promoting corporate sustainability and stakeholder engagement. It enables organizations to measure and communicate their social, environmental, and economic performance, fostering transparency, accountability, and informed decision-making. TBL reporting facilitates stakeholder engagement by providing a platform for dialogue, collaboration, and trust-building. While challenges exist, ongoing research and practice continue to refine TBL reporting frameworks and enhance its effectiveness in driving sustainable business practices.

The Triple Bottom Line (TBL or 3BL) stands as a prominent concept in sustainability discussions. Coined by John Elkington in 1994, it has captivated the attention of analysts focusing on sustainability at both macro- and micro-levels. It appeals to those engaged with the challenges shaping global development and governance. The role of Triple Bottom Line (TBL) reporting in promoting corporate sustainability and stakeholder engagement has gained substantial attention in academic research and corporate practice. This literature review aims to explore the existing body of knowledge on the topic, examining key studies, theories, and empirical evidence that highlight the significance of TBL reporting in driving sustainable business practices and fostering stakeholder engagement.

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Masud et al. (2019) explored how organizational strategic performance (OSP) affects corporate social responsibility performance (CSRP) and the mediation impact of TBL elements through the decision-making process of business management. This study discovered a positive link between OSP and CSRP. Economic responsibility didn't act as a mediator, but environmental and social responsibility played a significant role in mediating the OSP-CSRP connection. The study suggests that OSP directly impacts a firm's strategic decisions and CSR outcomes, both directly and indirectly through TBL, showcasing its full mediation power.

By leveraging the resource-based view (RBV) and knowledge-based view (KBV) theories, Mendes et al. (2023) conducted a study to investigate how corporate social responsibility (CSR) impacts firms' innovation, particularly in relation to the influence of cooperation. Additionally, their research explored the factors that shape the evolution of business cooperation. The findings show a positive correlation between CSR and firms' innovation, where business cooperation acts as a partial mediator in this relationship. Additionally, the results highlight that investment in specific types of innovation activities enhances firms' propensity to engage in cooperation.

A thought-provoking study by Pimplapure et al. (2020) elaborated how corporate reporting, traditionally focused solely on finances, has evolved. Purely financial data isn't enough to evaluate business performance effectively. Hence, reporting now extends beyond profit to encompass the Triple Bottom Line (3P's): people and planet. While profit remains a conventional reporting metric, considering people and planet alongside it is crucial in Triple Bottom Line (TPL) reporting. Implementing TBL offers benefits like increased value and the ability to attract and retain top talent.

Literature shows that scholarly circles realise that despite the importance of TBL, challenges persist in adopting TBL methodologies. Srivastava et al. (2022) critiqued the Triple Bottom Line (TBL), asserting that it lacks a novel foundation, presenting no new or innovative concepts. Their criticism suggests that TBL merely reiterates the existing ideas of corporate social responsibility (CSR) and serves as a sustainability measurement tool.

Westerman et al. (2020) highlights a pivotal moment for human resource management (HRM) amid the transition toward sustainable business practices. They query the extent to which HRM addresses sustainability and embraces a multi-stakeholder Triple Bottom Line

(TBL) approach. Their overview article for the special issue gathers papers focusing on forging a more sustainable HRM model, emphasizing a TBL orientation that includes environmental and social aspects alongside economic outcomes. The paper synthesizes these contributions into an integrative framework for sustainable HRM, identifying six key areas for future research advancement. Conceptually, TBL places an equal amount of emphasis on each of the three lines, which brings more balance and coherence into the construct (Elkington, 1997; Jamali, 2006; Saleh, 2020; Savitz & Weber, 2006).

Zaharia et al. (2021) study offer an overview of TBL literature, tracing its historical context and its synonymous connection with sustainability. It also addresses the concept's limitations. Additionally, the chapter explores the interplay between TBL and codes of conduct, emphasizing that while TBL examines a company's social, environmental, and economic impact, codes of conduct remain pivotal in showcasing a company's dedication to sustainability.

Fadli et al. (2021) found that Triple Bottom Line (TBL) and sustainability are often used interchangeably in literature, revealing inconsistent usage of the term sustainability despite its integral link to CSR and voluntary stakeholder engagement. The TBL structure inherently integrates social, environmental, and economic aspects simultaneously, yet the focus on the 4.0 industrial revolution hampers CSR efforts. Rather than favouring one term over the other, the paper aims to present both constructs' prevalence, urging researchers in business, management, and sustainability to be mindful of their usage in studies.

The influence of institutional pressures has spurred organizations to embark on sustainability endeavours, aligning with their external expectations (De Prins et al., 2014; Nursimloo, 2020). Research delving into the most influential institutional and contextual variables shaping the integration or hindrance of sustainability within HRM and organizational practices is crucial. These variables encompass the sustainability attitudes of board members, top executives, and HR managers; shifts in legislation or professional standards, including the impact of initiatives like the UN Global Sustainability Goals (SDGs); consumer concerns; societal and environmental disruptions; and the evolving use of modern propaganda to manipulate public understanding and government policies.

On the other hand, the literature reviewed showed a large number of sustainability studies

where the study topic was sustainability, yet the ultimate focus was on either the environment or society. Therefore, a thorough review of the relevant literature was conducted to understand how each concept appeared in research. The purpose of the literature review was not to support an argument of TBL versus sustainability, but to shed light on how they appear in literature.

Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality, and social equity. That companies aiming for sustainability need to perform not against a single, financial bottom line but against the triple bottom line (Elkington, 1998). Elkington's definition intended to go beyond previous constructions of "sustainable development (SD) and corporate social responsibility (CSR) to encompass an approach that emphasizes economic prosperity, social development and environmental quality as an integrated method of doing business.

Farooq et al. (2021) discovered that the successful use of resources in CV programs heavily relies on employees' intrinsic motivation. This article pioneers the comprehensive compilation and interpretation of CSR concepts from macro to micro levels, employing a holistic approach to enhance the TBL research model by introducing the internal people line (IPL) theory.Studies have shown that TBL reporting positively influences corporate sustainability practices.

For instance, Adams and Frost (2008) found a positive association between the adoption of a sustainability reporting frameworks, including TBL reporting, and improved environmental performance. TBL reporting promotes accountability, transparency, and stakeholder trust by providing a comprehensive company's sustainability efforts. Stakeholder engagement is critical for the success of sustainability initiatives, and TBL reporting plays a pivotal role in fostering meaningful engagement with stakeholders (Henriques and Richardson, 2013; Shad et al., 2019). The reporting process itself can be seen as a form of engagement, as it allows organizations to communicate their sustainability performance to various stakeholder groups. By involving stakeholders in the reporting process, companies can gain insights, address concerns, and establish collaborative relationships.

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17.3 Objectives

- To examine the current state of Triple Bottom Line (TBL) reporting practices in organizations.

- To analyse the impact of TBL reporting on corporate sustainability performance.

- To explore the role of TBL reporting in enhancing stakeholder engagement.

17.4 Findings and Discussion

Triple Bottom Line (TBL) reporting is a framework that fosters corporate sustainability by assessing a company's performance in three dimensions: economic, social, and environmental. This approach enables businesses to evaluate the effects of their operations not only on financial profits but also on people and the planet. TBL reporting plays a vital role in promoting corporate sustainability and stakeholder engagement through several key aspects:

Comprehensive Performance Measurement:

TBL reporting offers a holistic perspective on a company's performance by analysing economic, social, and environmental factors. By evaluating these dimensions, businesses can identify strengths and areas needing improvement. This thorough assessment guides informed decision-making, ensuring the company's long-term sustainability.

Stakeholder Involvement:

TBL reporting encourages active engagement with stakeholders, such as customers, employees, investors, suppliers, and the local community. Transparent communication of economic, social, and environmental initiatives builds trust and credibility. Engaged stakeholders are more likely to support the company's sustainability efforts, invest in its offerings, and advocate for its values.

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Risk Management:

Understanding the social and environmental impact of business operations helps identify potential risks. TBL reporting enables companies to address these risks proactively, minimizing negative consequences. For example, a company might identify environmental risks in its supply chain and take measures to mitigate them, ensuring uninterrupted operations.

Cost-Efficiency and Savings:

TBL reporting often uncovers opportunities for cost savings through sustainable practices. For instance, adopting energy-efficient technologies reduces a company's carbon footprint and utility bills. Efficient resource use, waste reduction, and recycling initiatives not only contribute to environmental preservation but also yield financial savings.

Market Distinctiveness:

Companies emphasizing sustainability and reporting TBL initiatives gain a competitive edge. Consumers increasingly prefer eco-friendly and socially responsible products/services. Aligning business practices with the TBL framework allows companies to stand out in the market, attracting environmentally and socially conscious customers.

Long-Term Investments and Collaborations:

Investors now consider environmental, social, and governance (ESG) factors when making investment decisions. TBL reporting offers valuable insights into a company's sustainability efforts, making it more appealing for long-term investments. Moreover, sustainability-focused businesses are more likely to form partnerships with like-minded organizations, fostering collaborative initiatives for a better future.

Legal and Regulatory Compliance:

Many countries and regions are enacting regulations related to corporate social responsibility and environmental stewardship. TBL reporting ensures companies adhere to these regulations,

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preventing legal issues and penalties. By proactively reporting on sustainability, businesses can stay ahead of changing legislation and demonstrate their commitment to responsible practices.

The results advocate for embracing an open innovation strategy as a straightforward and efficient method to navigate swift trends and transformations. They illustrate how innovation and cooperation complement each other as valuable sources of value creation. Taking a triple bottom line (TBL) stance, it emphasizes that CSR should encompass social, economic, and environmental initiatives, integrating it into firms' innovation strategies. Consequently, managers aspiring to create enduring societal contributions should meticulously plan, oversee, and oversee all dimensions of CSR.

17.5   Conclusion

In summary, TBL reporting encourages corporate sustainability and stakeholder engagement by providing a thorough assessment of a company's economic, social, and environmental impacts. Through transparency, risk mitigation, cost savings, market differentiation, attracting investments, and legal compliance, businesses can positively impact society while ensuring their long-term success. This underscores the importance for managers aiming for long-term societal impact to oversee all CSR dimensions diligently.

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Chapter 18

Dynamics of Blockchain in Supply Chain Management

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Abstract Blockchain technology has gained widespread attention as a potential solution to the challenges faced by traditional supply chain systems. The use of blockchain technology in supply chain management offers numerous benefits, including increased transparency, security, and efficiency. This research paper aims to provide a comprehensive review of the current literature on the use of blockchain technology in supply chain management. The chapter provides an overview of the challenges faced by traditional supply chain systems, including issues related to transparency, trust, and data security. It then discusses the unique features of blockchain technology, including its decentralized and immutable nature, which make it an ideal solution for addressing these challenges.

The literature review examines the potential applications of blockchain technology in supply chain management, such as tracking and tracing products, reducing fraud, and improving inventory management. The paper also provides an analysis of the current state of the industry, including case studies of companies that have successfully implemented blockchain technology in their supply chains. The study also highlights the potential benefits and challenges of using blockchain technology in supply chain management. The benefits include increased transparency, reduced costs, improved efficiency, and enhanced security. However, the challenges include issues related to scalability, interoperability, and regulatory compliance. Overall, this

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study provides valuable insights into the use of blockchain technology in supply chain management, highlighting its potential to transform the industry and offering recommendations for future research in this field.

Keywords Blockchain technology, Supply chain management, Transparency, Security, Decentralization

18.1   Introduction

In recent years, the use of blockchain technology in supply chain management has gained widespread attention. Supply chain management is a complex process that involves multiple stakeholders, including suppliers, manufacturers, distributors, retailers, and customers. Traditional supply chain systems often face challenges related to transparency, trust, and data security. However, blockchain technology offers a solution to these challenges by providing a transparent, secure, and decentralized platform for data exchange.

Blockchain technology is a distributed ledger that allows for secure and transparent data exchange between multiple parties without the need for intermediaries. It is based on a decentralized network of computers, where every participant has a copy of the ledger. This makes it virtually impossible for any single party to manipulate or change the data without the consensus of the network (Gupta , 2023).

The use of blockchain technology in supply chain management offers numerous benefits. One of the primary benefits is increased transparency. Blockchain technology allows for the tracking and tracing of products from the point of origin to the point of consumption. This means that all parties involved in the supply chain can access real-time data about the movement of goods, which helps to improve efficiency and reduce the risk of fraud.

Another benefit of blockchain technology in supply chain management is improved security. Traditional supply chain systems are often vulnerable to cyber-attacks and data breaches, which can result in significant financial losses and damage to reputation. However, blockchain technology offers a high level of security, as every transaction is encrypted and validated by multiple parties before being added to the blockchain (Asif et al., 2023).

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Blockchain technology can also help to reduce costs and improve efficiency in supply chain management. By eliminating intermediaries and reducing the need for manual processes, blockchain technology can streamline supply chain operations and reduce the time and resources required to complete tasks such as record-keeping and contract management.

Despite the potential benefits of blockchain technology in supply chain management, there are also challenges that must be addressed. One of the primary challenges is scalability. As the number of transactions on the blockchain network increases, the network can become congested, leading to slower transaction times and higher transaction fees. This can be a significant barrier to the adoption of blockchain technology in supply chain management. Another challenge is interoperability. As blockchain technology is still in its early stages of development, there are currently several different blockchain platforms that are not compatible with each other. This can make it difficult for different parties in the supply chain to communicate and exchange data (Jora et al., 2023).

Regulatory compliance is also a challenge for the adoption of blockchain technology in supply chain management. As blockchain technology is still largely unregulated, there are concerns about how it will fit within existing regulatory frameworks. This can create uncertainty and reluctance among businesses to adopt blockchain technology in their supply chains.

The objective of this research paper is to provide a comprehensive review of the current literature on the use of blockchain technology in supply chain management. The paper will explore the potential applications of blockchain technology in supply chain management, including tracking and tracing products, reducing fraud, and improving inventory management. It will also analyze the current state of the industry, including case studies of companies that have successfully implemented blockchain technology in their supply chains.

Furthermore, the paper will discuss the potential benefits and challenges of using blockchain technology in supply chain management, including scalability, interoperability, and regulatory compliance. The study will conclude by identifying key trends and potential areas for future research in this field.

Overall, the use of blockchain technology in supply chain management has the potential to transform the industry, offering a transparent, secure, and efficient platform for data exchange.

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However, there are also challenges that must be addressed to ensure the widespread adoption of blockchain technology in supply chain management. This research paper will provide valuable insights into the potential applications, benefits, and challenges of blockchain technology in supply chain management, highlighting its potential to transform the industry and offering recommendations for future research in this field.

18.2   Literature Review

Several studies have explored the adoption of blockchain technology in the supply chain industry. A study by Iansiti and Lakhani (2017) explored the potential applications of blockchain technology in various industries, including supply chain management. The study highlighted the benefits of blockchain technology, including improved transparency, enhanced traceability, and increased security.

Another study by Wang et al. (2020) explored the use of blockchain technology in supply chain management. The study highlighted the benefits of blockchain technology, including improved supply chain transparency, reduced transaction costs, and enhanced data security. The study also identified the challenges associated with blockchain adoption in the supply chain, including integration issues and lack of standardization.

A study by Song et al. (2022) explored the use of blockchain technology in supply chain finance. The study highlighted the benefits of blockchain technology, including improved efficiency, reduced risk, and enhanced transparency. The study also identified the challenges associated with blockchain adoption in supply chain finance, including regulatory challenges and lack of standardization.

Another study by Zheng et al. (2020) explored the use of blockchain technology in food supply chain management. The study highlighted the benefits of blockchain technology, including improved traceability, reduced fraud, and enhanced transparency. The study also identified the challenges associated with blockchain adoption in food supply chain management, including data privacy concerns and lack of standardization.

A study by Jain et al. (2023) explored the use of blockchain technology in the pharma-

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ceutical supply chain. The study highlighted the benefits of blockchain technology, including improved traceability, reduced counterfeiting, and enhanced transparency. The study also identified the challenges associated with blockchain adoption in the pharmaceutical supply chain, including integration issues and regulatory challenges.

18.3   Objectives

1. To examine the current state of adoption of blockchain technology in supply chain management.

2. To examine the regulatory and legal implications of using blockchain technology in supply chain management.

3. To evaluate the challenges and limitations of implementing blockchain technology in supply chain management, such as interoperability issues and scalability.

4. To investigate the potential for blockchain technology to promote sustainability in the supply chain, such as reducing carbon emissions and promoting ethical sourcing.

5. To provide recommendations for companies and policymakers on how to effectively adopt and implement blockchain technology in supply chain management.

18.4   Discussions and Findings

18.4.1   Benefits of using Blockchain in Supply Chain Management:

- **Increased transparency**: Blockchain provides a shared and tamper-proof ledger that all participants can access and verify. This enables greater transparency across the supply chain, allowing all stakeholders to track the movement of goods and monitor transactions in real-time.

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- **Improved traceability**: Blockchain provides an immutable record of every transaction, making it easier to trace the origin and movement of goods in the supply chain. This can be particularly useful for tracking high-value or high-risk items, such as pharmaceuticals or luxury goods.

- **Reduced costs**: Blockchain can reduce costs by eliminating intermediaries, such as banks or brokers, from the supply chain. It can also reduce administrative costs by automating processes and reducing paperwork.

- **Improved efficiency**: Blockchain can automate and streamline processes in the supply chain, reducing the time and effort required to perform tasks such as verifying transactions or tracking goods.

- **Increased trust**: Blockchain's tamper-proof ledger can increase trust between participants in the supply chain by providing a shared record of all transactions. This can be particularly useful in situations where trust is a major issue, such as when dealing with new or unknown suppliers.

- **Enhanced security**: Blockchain provides a secure and encrypted platform for storing and sharing data. This can help protect against fraud and cyberattacks, and ensure the integrity of the supply chain.

18.4.2 Challenges and limitations of using Blockchain in Supply Chain Management:

- **Scalability**: One of the main challenges of using blockchain in supply chain management is scalability. As the number of transactions and participants in the network grows, the amount of data stored on the blockchain can become unwieldy, leading to slower transaction speeds and higher costs.

- **Interoperability**: Another challenge of using blockchain in supply chain management is interoperability. Different blockchain platforms may use different protocols or standards,

making it difficult to integrate data across different platforms and networks.

- **Governance**: Blockchain networks are typically decentralized and distributed, making it difficult to establish clear governance structures and decision-making processes. This can lead to disagreements and conflicts between participants, which can undermine the effectiveness of the network.

- **Security risks**: While blockchain is generally considered to be secure, it is not immune to cyberattacks or other security risks. In particular, there is a risk of 51% attacks, where a group of participants could gain control of the network and manipulate the ledger.

- **Regulatory challenges**: The use of blockchain in supply chain management may also face regulatory challenges, particularly around data privacy and protection. Different jurisdictions may have different regulations around the use of personal data, which could limit the use of blockchain in certain contexts.

- **Adoption challenges**: Finally, the adoption of blockchain technology in supply chain management may also face challenges related to education and awareness. Many supply chain professionals may not be familiar with blockchain technology, and may be hesitant to adopt it due to concerns around cost, complexity, or risk.

18.4.3 Use cases of blockchain in supply chain Management:

- **Product traceability**: Blockchain can be used to track the movement of products through the supply chain, providing a transparent and immutable record of every transaction. This can help improve traceability and reduce the risk of fraud, counterfeiting, or other supply chain disruptions.

- **Supplier verification**: Blockchain can be used to verify the identity and reputation of suppliers, allowing buyers to make more informed decisions and reducing the risk of working with fraudulent or unreliable suppliers.

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- **Payment and settlement**: Blockchain can be used to automate and streamline payment and settlement processes in the supply chain, reducing the time and cost required to perform these tasks.

- **Inventory management**: Blockchain can be used to track inventory levels and improve inventory management, enabling more accurate forecasting and reducing the risk of stock-outs or overstocking.

- **Quality control**: Blockchain can be used to track and verify product quality, ensuring that products meet the required standards and reducing the risk of recalls or other quality issues.

- **Contract management**: Blockchain can be used to manage and enforce supply chain contracts, providing a tamper-proof record of all contractual obligations and reducing the risk of disputes or breaches.

18.4.4 Stakeholders involved in the adoption of blockchain in Supply Chain Management:

- **Manufacturers**: Manufacturers are responsible for producing and delivering products to customers. They can benefit from the use of blockchain technology in supply chain management by improving efficiency, reducing costs, and enhancing product traceability and quality control.

- **Suppliers**: Suppliers are responsible for providing the raw materials and components needed for manufacturing products. They can benefit from the use of blockchain technology in supply chain management by improving transparency and trust with customers, reducing the risk of disputes, and streamlining payment and settlement processes.

- **Logistics providers**: Logistics providers are responsible for transporting products between different locations in the supply chain. They can benefit from the use of blockchain

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technology in supply chain management by improving tracking and visibility, reducing transit times and costs, and enhancing security and risk management.

- **Regulators**: Regulators play a key role in ensuring that products are safe, secure, and comply with relevant regulations and standards. They can benefit from the use of blockchain technology in supply chain management by improving the traceability and transparency of products, reducing the risk of fraud and counterfeiting, and enhancing regulatory compliance.

- **Customers**: Customers are the end-users of products and are ultimately responsible for driving demand and revenue. They can benefit from the use of blockchain technology in supply chain management by improving product traceability and quality control, reducing the risk of fraud and counterfeiting, and enhancing the overall customer experience.

- **Technology providers**: Technology providers play a key role in developing and implementing blockchain solutions for supply chain management. They can benefit from the adoption of blockchain technology in supply chain management by driving innovation, improving efficiency and cost-effectiveness, and expanding their customer base.

18.4.5   Impact of Blockchain on Supply Chain efficiency and cost savings:

- **Improved supply chain visibility**: Blockchain can improve supply chain visibility by providing a shared, immutable ledger that allows all participants to view and track product movements in real-time. This can reduce the need for intermediaries and paperwork, as well as the risk of errors and delays.

- **Streamlined processes**: Blockchain can streamline supply chain processes by automating tasks such as document verification, payment processing, and inventory management. This can reduce the need for manual intervention and lower the risk of errors and delays.

- **Reduced costs**: Blockchain can reduce supply chain costs by eliminating intermediaries, reducing the risk of fraud and counterfeiting, and improving overall efficiency. This can lead to lower transaction costs, lower inventory holding costs, and lower logistics costs.

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- **Faster transactions**: Blockchain can facilitate faster transactions by providing a secure, transparent, and decentralized platform for conducting business. This can reduce the time it takes to complete transactions, and enable companies to respond more quickly to changes in demand and supply.

- **Enhanced trust and security**: Blockchain can enhance trust and security in the supply chain by providing a tamper-proof ledger that ensures the authenticity and provenance of products. This can reduce the risk of fraud, counterfeiting, and supply chain disruptions.

18.4.6 Legal and regulatory implications of using blockchain in Supply Chain Management:

- **Data privacy**: Blockchain technology requires the storage and sharing of data among participants in the supply chain. This can raise concerns about data privacy and the protection of personal information. Companies must ensure compliance with data protection regulations, such as the EU's General Data Protection Regulation (GDPR), to protect customer data.

- **Intellectual property**: The use of blockchain can lead to the creation of new intellectual property (IP) assets, such as smart contracts and digital tokens. Companies must ensure that they have proper ownership and control over these assets and that they do not infringe on the rights of others.

- **Smart contracts**: Smart contracts are self-executing contracts that automatically enforce the terms of an agreement between parties. These contracts raise legal questions about their enforceability and liability in the event of a dispute. Companies must ensure that smart contracts comply with applicable laws and regulations and that they are enforceable in the jurisdiction in which they are used.

- **Jurisdictional issues**: Blockchain technology operates across borders and can raise questions about which jurisdiction's laws and regulations apply. Companies must ensure com-

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pliance with local laws and regulations, such as tax and import/export regulations when conducting business on a blockchain (Mittal,2023)

- **Anti-money laundering (AML) and know-your-customer (KYC) regulations**: Blockchain can be used to conduct anonymous transactions, which can be a concern for regulators who want to prevent money laundering and terrorist financing. Companies must ensure compliance with AML and KYC regulations when conducting transactions on a blockchain.

- **Liability**: The use of blockchain can raise questions about liability in the event of a breach or error. Companies must ensure that they have proper insurance coverage and that they have protocols in place to address liability issues.

18.5   Conclusion

In conclusion, the use of blockchain technology in the supply chain industry has the potential to revolutionize the way that goods are tracked, traced, and delivered. Through the use of a decentralized ledger system, blockchain provides greater transparency, security, and efficiency in the supply chain. The literature review has revealed that blockchain can offer a range of benefits to the supply chain industry, including enhanced transparency, traceability, and trust among stakeholders.

However, there are also several challenges and limitations associated with the implementation of blockchain in supply chain management, including technical barriers, regulatory and legal issues, and the need for collaboration among stakeholders. Several use cases of blockchain in supply chain management have also been discussed, including the use of blockchain in food safety, pharmaceuticals, and logistics.

Overall, the adoption and implementation of blockchain technology in the supply chain industry requires careful planning, collaboration, and investment. While there are challenges associated with blockchain implementation, the potential benefits are significant, including improved efficiency, cost savings, and customer satisfaction. Further research is needed to ad-

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dress some of the technical and economic challenges associated with the implementation of blockchain in the supply chain industry, as well as to explore the potential benefits of interoperability between different blockchain platforms. By addressing these challenges, the full potential of blockchain technology in the supply chain industry can be realized. Few implementations and recommendations recommendations for companies and policymakers on how to effectively adopt and implement blockchain technology in supply chain management:
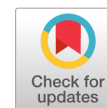
- **Identify key stakeholders**: The adoption and implementation of blockchain technology in supply chain management requires the involvement of multiple stakeholders, including suppliers, customers, regulators, and technology providers. Identify and involve key stakeholders early on to ensure their buy-in and support.

- **Define clear objectives**: Clearly define the objectives of the blockchain implementation and how it will benefit the supply chain. This will help to focus efforts and resources on achieving specific outcomes.

- **Conduct a feasibility study**: Conduct a feasibility study to assess the technical and economic feasibility of the blockchain implementation. This will help to identify any technical or economic barriers to implementation and help to determine whether the benefits of the implementation outweigh the costs.

- **Choose the appropriate blockchain platform**: Choose the appropriate blockchain platform based on the specific needs of the supply chain. Consider factors such as security, scalability, interoperability, and ease of use.

- **Develop a clear implementation plan**: Develop a clear implementation plan that outlines the steps required to implement the blockchain solution, including timelines, resource requirements, and key milestones.

- **Ensure data quality and integrity**: Ensure that the data stored on the blockchain is accurate, complete, and secure. Implement measures such as data validation and verification to ensure data quality and integrity.

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- **Train users**: Train users on how to use the blockchain solution and its associated tools and technologies. This will help to ensure that users can effectively use the blockchain solution and maximize its benefits.

- **Address legal and regulatory issues**: Address any legal and regulatory issues related to the adoption and implementation of blockchain in supply chain management, such as data privacy and intellectual property rights.

- **Monitor and evaluate performance**: Monitor and evaluate the performance of the blockchain implementation to determine whether it is achieving its intended objectives. Use metrics such as cost savings, efficiency gains, and customer satisfaction to assess performance.

- **Foster collaboration and partnerships**: Foster collaboration and partnerships with other organizations to maximize the benefits of the blockchain implementation. This can include partnering with suppliers and customers to create a more integrated supply chain, as well as collaborating with other blockchain providers to develop interoperable solutions.

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Chapter 19

Cyber Crime: A Constant Threat to Indian Banking Sector

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Abstract The Indian banking industry has kept up with developing trends and major operational changes as a result of technological improvements. Banks are now among the largest benefactors of the IT revolution as a result of the enormous potential that the call for expansion has provided this institution. The exponential growth of online transactions. Banking Sector now has shifted its focus on adapting latest emerging technologies i.e., NEFT, RTGS, ECS, Mobile banking, UPI, Blockchain, Fintech, Cloud computing, Artificial Intelligence, Big Data and Virtual Reality which is the evidence of the fact that how technology has upgraded the financial system in the Indian banking sector (Mittal, 2020; Tiwari et al.,2021).

However, opportunities also carry risks, and success has its own unique set of challenges (Mittal & Gautam 2023). In the lexicon of criminal language, the term "cybercrime" is relatively new; it gained traction mostly in the late 1990s when technology was brought to the financial sector. The technological aspects of cybercrimes, their effects on the financial sector, and the challenges and fallout they create are the main topics of this research paper. Additionally, it highlights the need for stronger, more reliable security against upcoming cyberattacks.

Thus, as computer and internet technology quickly advanced, new types of global crimes known the term "Cyber Crimes" has developed. The nature and pattern of cybercrime occurrences have evolved over time to become increasingly complicated and sophisticated. Since the

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last decade, banks and other financial institutions have continued to be targeted by cybercriminals. There is little prospect that this will change anytime soon; most cybercriminal operations are still primarily motivated by financial gain. The technological features of numerous cybercrimes affecting financial units and their effects are the main subject of this article. It further analyses the danger vectors that facilitate these crimes and develops countermeasures to assist fend off subsequent cyberattacks in order to better prevent such assaults in the future for greater security.

Keywords Identity theft, e- Banking, Cybercrime and Fraud Detection.

19.1 Introduction

According to internetlivestats.com, 46.1% of the world's population is currently online, indicating that the online world is expanding quickly. (as on July 1, 2016). A notable occurrence of this phenomenon occurred in India, where the percentage of online users has significantly increased over the past three years (18% in 2014, 27% in 2015, and 34.8% in 2016), (as on July 1, 2016). (Mittal , 2020) Today, internet usage is not just for geeky technical purposes; rather, every second person is taking advantage of the easy availability and accessibility of the internet for everyday needs like banking, e-Online services are in high demand, but due to multiple obtrusive actors generally known as "Cyber-Crime," it appears to be a difficult issue to provide balanced security and convenience (Rao, 2019; Gupta et al., 2023).

Goel (2016) analyzed that due to the ease, affordability, and speed of online transactions, Indian consumers are rapidly favoring online services. Furthermore, financial institutions are making clients more alluring incentives in an effort to increase the number of cashless transactions because they have relatively lower operating expenses.

The banking industry in India cannot stop transactions that are conducted electronically, and is facing the outcomes of cybercrime which is a more serious offence than traditional crimes. To combat this issue, victims can submit their cases to the closest police station as well as the cyber-fraud council inside banks. To prevent these problems, lawmakers should closely supervise the way banks operate, enforce laws strictly to prevent wrongdoings of this kind, and

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encourage banks to regularly inform their clientele about the dangers of cybercrime.

Sarkar et al. (1998) in a study highlights that a range of email-borne viruses, spyware, adware, Trojan horses, phishing attacks, directory harvest assaults, denial-of-service attacks, and other dangers combine to attack businesses and clients despite the fact that it is difficult to conceive a workplace without access to the internet. This essay makes an effort to review phishing, a hazard to Internet-based business transactions that is continually expanding and changing. We'll talk about several phishing techniques like vishing, spear phishing, pharming, key loggers, malware, web Trojans, and more. This article also presents the most recent phishing analyses produced by the Korean Internet Security Center and the Anti-Phishing Working Group (APWG).

Despite a number of highly publicized cyberattacks in recent years, very few businesses have taken the required precautions to isolate industrial control systems and critical data and to reduce the harm an attack can cause. Dealing with technological challenges, which are usually simple and tactical, is only one aspect of security. The key strategic challenge is governance: coordinating efforts across departments to make sure that information technology, physical security, and legal requirements all operate together (Asif et al., 2023).

19.2 Finding of the Study

1. Hacking and identity theft are the main causes of cybercrimes in this industry.

2. Due to the fact that banks hold all of the reserves in the form of currency, banks are frequently attacked.

3. Customers' security is much at stake because of how easy it has become to hack into people's personal information.

4. Fraud detection software is frequently either outdated or takes a very lengthy time to operate.

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5. These crimes, especially those involving the financial industry, are not specifically covered by law.

19.3   Discussion & Suggestions

- Since there is no specific law enforcement, the principal effects of these crimes are frequently unresolved, hence legislation must be implemented to stop this type of threat.

- The law enforcement should be highly strict and provide regular updates in order to maintain track of such offences.

- It should be possible to resolve these conflicts, handle public complaints, and promote public trust through the use of fast track mobile courts.

- With the aid of Big Data Banks, the government should also maintain tabs on the actions taking place within the operating network.

- To lessen the effects of these problems and punish the assailants, severe punishments and penalties must be used.

- Awareness campaigns should be launched to alert the public of the current situation and impending dangers.

- Instead of only sending these situations to the banks, the public should report them to the Cyber Crime Branch in order to ensure swift and rigorous action.

19.4   Conclusion

In this research paper, researcher investigated the new types of crimes in the chosen area of study. The criminals of modern day try to carry out these new crimes using computers and the Internet by abusing cyberspace. According to estimates, cash is used in 95% of transactions in India, but as the use of computers, smartphones, and internet access grows, Indians are

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increasingly using digital channels for their financial needs. Because of this, cybercrime is becoming a bigger problem.

The RBI defines bank fraud as any transaction involving deceit, carelessness, misappropriation of funds, or the use of false documents. The RBI stated that "increased audacious attacks by organized gangs with or without backing from state players have come to light," in addition to straightforward attacks utilizing phishing, vishing, and social engineering. The RBI advised banks to purchase preventative software and regularly review the risks at hand, not just for internal operations but also for the third parties the lenders use. If executed properly, this can be seen as a brilliant approach because hackers frequently access the personal information of customers and/or banks, depending on the situation. They frequently come up with creative ways to perpetrate these crimes, so before anyone can figure. The speed and intensity of these fraudulent transactions, which happen in a matter of seconds, is what went wrong; the harm has already been done. The time has come to take into account how such crimes affect society from a fair standpoint in order to prevent online criminals from getting away with their crimes. Cybercrime is a common form of international crime.

Since the financial security of the banking industry determines the financial security and safety of our country's assets as a whole, it is imperative that we acknowledge the urgency of the situation and take a strong stand against cybercrime. This is because the jurisdiction in this area is complicated and still unclear. India cannot jeopardize the security of such a crucial plant at its level of development. We will be able to accelerate the rate of overall growth and development and get closer to improvement if we are able to stop these attacks, one by one, shortly in the future.

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Chapter 20
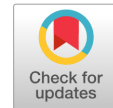
Impact of Social, Psychological & Emotional Well-being of an Employees' working Capability and Performance

Shashank Kumar [*] iD

Abstract

The purpose of this study is to understand various aspects of wellbeing. The different definitions of wellbeing propounded by different researchers in recent years, types of wellbeing, different dimensions, indicators or measures of wellbeing were studied and they are included in this paper. British Psychological Society in the year 2010 has established the importance of psychological well-being of employees & how it impacts organizational success (Sandilya, 2018). This is relevant to this study, because the wellbeing of a person is an indication of emotions and emotions are an outcome of psychological state of mind. Some of the most popular journals and readings were referred for this study, some of them are Oxford Handbook of Wellbeing, Journal of Psychology, and International Journal of HR. Since this is a conceptual paper, no empirical study was done or no data analysis performed.

To some extent, meta-analysis of wellbeing was covered, which helps in understanding various dimensions of wellbeing, e.g. living standard, health, freedom, personal and community relationships, peace and security, which are considered to be the significant livability factors of wellbeing. The eight dimensions of wellbeing, which are categorized as internal & external,

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were studied and they are briefly explained. Index of Psychological Wellbeing was studied only at the conceptual level, not practically tested. PERMA model of wellbeing, which helps in the study & measurement of five determinants of subjective well-being has been covered in this paper.

Keyword : Wellbeing, Psychology, Emotions, Employees, Subjective wellbeing.

20.1   Introduction

There is much debate between researchers about arriving at one standard definition of wellbeing. One of the simplest definitions of wellbeing suggests that it is a combination of feeling good and experiencing positive emotions that helps an individual in performing well and up to their fullest potential. On the other hand, another definition suggests the opposite of the above definition.

According,ly wellbeing is defined as the state of having no anxiety, uneasiness, depression, and other psychological disorders in an individual's life. Other views on wellbeing consider it as a positive outcome that is meaningful for people and for many sectors of society. In generic terms, well-being includes the presence of positive emotions and moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life, fulfillment as well as positive functioning.

Defining well being has been the subject of research for the past few centuries, and over that period multiple variables have been considered by scholars to arrive at the most precise indicators of people's satisfaction. The two main indicators of wellbeing are satisfaction & happiness (Çankır and Yener, 2017). According to a report, the term subjective well-being is synonymous with positive mental health (Ruggeri, 2020). The scope of this paper does not involve looking into the mental health aspect of wellbeing. Wellbeing is also linked to the success of an individual at a personal, professional and interpersonal level. Thus, it is interpreted that people with high level of wellbeing measures, show greater productivity at the workplace, can do more effective learning, can have increased creativity as well as show more social behaviors and positive relationships (Diener, 2012).This paper will use qualitative means such as meta-analysis to try to argue that emotional wellbeing is integral to organizational

success.

20.2   Objective

- The objective of this study is to understand the impact of psychological and emotional wellbeing of a person on his/her working capabilities and performance.

- Understand what are the various methods & tools to measure the level of wellbeing, which can then be put into different categories as – normal, stressed or depressed.

- How the wellbeing of a person can be improved by adopting different practices, wellness programs or by self-meditation and other activities.

- Establish some theory or derive some conclusion up to what extent the performance of an individual can be improved by applying NLP (Neuro Linguistic Programming) techniques.

20.3   Type of well beings

The two broad categories carved out for types of wellbeing are – subjective & objective. While subjective wellbeing consists of three interrelated components: life satisfaction, pleasant effect, and unpleasant effect. Effect refers to pleasant and unpleasant moods and emotions, whereas life satisfaction refers to a cognitive sense of satisfaction with life. On the other hand, objective wellbeing is determined by gender, age, ethnicity and social acceptance. In this paper, I have focused primarily on subjective wellbeing, thus I provide a brief concept of the types of subjective wellbeing. Subjective wellbeing is comprised of social wellbeing, psychological wellbeing and emotional wellbeing.

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20.3.1 Social Wellbeing

A person is considered to have better social wellbeing when they are in a good social relationship, have social stability and are at peace. As the legendary Greek philosopher Aristotle has said "man is by nature a social animal". People are mutually dependent, relying on others for wellbeing, either within family, friends or society. It also depends, to some extent, on factors like freedom, trust and equal rights.

20.3.2 Psycological Wellbeing

Psychological wellbeing (PWB) is an individual's level of psychological happiness which comprises their life satisfaction and sense of accomplishment. It is usually conceptualized as some combination of positive affective states such as happiness. PWB is a core feature of mental health, and it can be explained as hedonic and eudemonic. Psychological wellbeing measures the happier dimension of individual feelings. Psychological well-being has three defining characteristics. The first of these is the idea that wellbeing is a phenomenological event. This implies that people are happy when they subjectively believe themselves to be so.

Secondly, wellbeing involves some emotional conditions. This means, people who are psychologically well are more likely to experience positive emotions and less prone to experiencing negative emotions. Lastly, wellbeing refers to one's life as a whole. It is a global evaluation.

20.3.3 Emotional well being

Definition of emotional wellbeing as given by the Mental Health Foundation is 'A positive sense of wellbeing which enables an individual to be able to function in society and meet the demands of everyday life'. Emotional wellbeing is conceptualized as a balance of positive and negative feelings experienced in life and the perceived feelings of happiness and satisfaction. It can also be understood as the overall effectiveness of an individual's psychological functioning as related to the major aspects of their life, i.e. work, family, community etc. The World Health Organization describes 'wellbeing' as a "resource for healthy living" and "positive state of health"

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that is "more than the absence of an illness" and enables us to function well: psychologically,
physically, emotionally and socially.

20.4   Measurement of Wellbeing

There are different models and methods that are applied for measuring the level of wellbeing.
Which measures of wellbeing and the method used, are most appropriate depends on what
context it is being measured. Various studies have been done to measure wellbeing, and they
involve the use of an eight-item Index of Psychological Well-Being developed by. In this model,
the respondents were asked how often they felt – (i) very lonely or remote from other people
(ii) very unhappy (iii) bored or de-motivated (iv)extreme restless so that they couldn't sit long
in a chair (v) vaguely uneasy about something without knowing why (vi) particularly excited
or interested in something (vii) pleased about having accomplished something and (viii) on top
of the word. Another most widely used measuring index of wellbeing is '5-item World Health
Organization Well-Being Index (WHO-5)' which focuses on assessing subjective psychological
wellbeing. Author suggested five components of well-being based on his research of many years
and he developed a new multi-dimensional model of well-being which is called as PERMA
model. This model includes study & measurement of five components of subjective well-being
- Positive emotion, Engage¬ment, Relationships, Meaning, and Accomplishment.

20.5   Dimensions of Well Being

There are eight Dimensions of Wellness: occupational, emotional, spiritual, environmental, fi-
nancial, physical, social, and intellectual. Each dimension is interconnected. Each dimension is
equally vital in the pursuit of optimum health. One can reach an optimal level by understanding
how to maintain and optimize each of the dimensions.

- **Physcial Wellbeing:** It relates to maintaining a healthy body and seeking care when
  needed. Physical health is attained through exercise, eating well, getting enough sleep
  and paying attention to the signs of illness and getting help when needed.
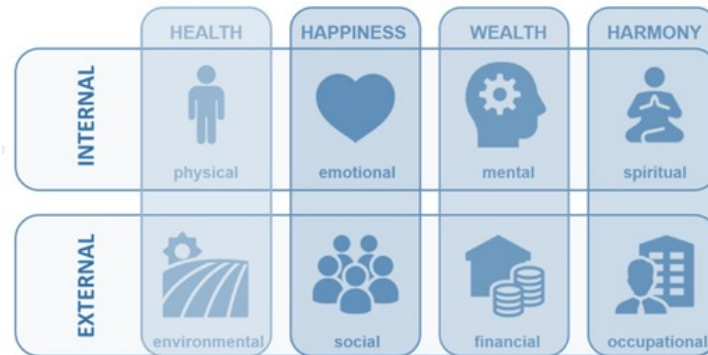
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Figure 20.1: Dimensions of Well Being

- **Emotional wellness:** It relates to understanding our feelings and coping effectively with stress. It is important to pay attention to self-care, relaxation, stress reduction and the development of inner resources so we can learn and grow from experiences.

- **Occupational wellness:** It is about enjoying our occupational endeavors and appreciating our contributions. This dimension of wellness encourages personal satisfaction and enrichment in one's life through work.

- **Intellectual wellness:** It involves having an open mind when we encounter new ideas and continuing to expand your knowledge. It encourages active participation in scholastic, cultural and community activities.

- **Environmental wellness:** Inspires us to live a lifestyle that is respectful of our surroundings. This realm encourages us to live in harmony with the Earth by taking action to protect it. Environmental well-being promotes interaction with nature and the personal environment. Everyone can have a strong environmental conscious simply by raising their awareness.

- **Financial Wellness:** Involves the process of learning how to successfully manage financial expenses. Money plays a critical role in our lives and not having enough of it

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impacts health as well as academic performance. Financial stress is repeatedly found to be a common source of stress, anxiety and fear for college students.

- **Social wellness:** Helps us in performing social roles effectively and comfortably, and create a support network. This dimension allows not only to develop encouraging relationships with peers, but also intimate relationships with romantic partners.

- **Spiritual wellness:** Allows us to develop a set of values that help one seek meaning and purpose. Spirituality can be represented in many ways, for example, through relaxation or religion. But being spiritually well means knowing which resources to use to cope with issues that come up in everyday life.

20.5.1 Positive Psychology & Wellbeing

Psychology is not just the study of disease, weakness, and damage, it is also the study of strength and virtue. Treatment through psychology, is not just fixing what is wrong but it is also building what is right. Psychology is not just about illness or health; it also is about work, education, insight, love, growth, and play. Positive psychol¬ogy is a scientific field that studies the optimal functioning of individuals, groups, and institutions (Fisher, 2006)

Positive psychology focuses on aspects of the human condition that lead to happiness, fulfilment, and flour¬ishing. The positive psychology characterizes wellbeing as a positive and sustain¬able characteristics which enables individuals and organizations to prosper and succeed. The main objective of positive psychology is to facilitate happiness and subjective wellbeing.

20.5.2 Social Psychology of Employee Well Being

According to Social Psychology, there are two aspects to the study of wellbeing. These are subjective or hedonic and psychological or eudemonic. Subjective well-being is the approach focusing on descriptions of well-being concerning avoidance from grief or pain and obtaining satisfactipon and happiness. Psychological well-being is the approach defining psychological well-being as felicity in private and work life of individual and the state of optimal efficiency.

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Psychological well-being means that life goes on well and person feels good and carries out works impressively (Semiz, 2018) .
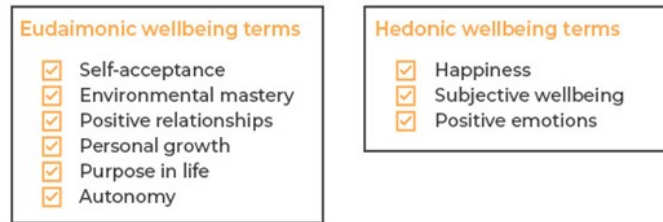

Figure 20.2: Social Psychology of Employee Well Being

20.5.3 Meta-analysis of wellbeing

Wellbeing is defined as a global, subjective evaluation of one's quality of life. There are many studies done in which more than one measures of well-being has been used for meta-analysis. Taking a practical approach, more of global measures were considered over simpler or specific measure. The global measures are –simple measures & composite measures (measures created by composite of scores based on more than one scale). Measures of well-being are summarized broadly into three categories as shown in the table 20.3.

20.5.4 Psychology & Emotions

Philosopher and psychiatrist Dr. Neel Burton examined a variety of human emotions in his book Heaven & Hell: The Psychology of Emotions. In this book, Dr. Neel has said that we humans are always guided by our emotions since primitive age. It is our emotions that determine our choice of profession, partner, social beliefs and our relation to money, sex, and religion. Further, the study of emotional psychology allows researchers to dive into what makes humans react as they do to certain stimuli and how those reactions affect us both physically and mentally. According to many psychologists, our physiological responses are likely how emotion helped us evolve and survive as human beings. Physiological response is the result of the autonomic

Broad category	Description	Well-being measure
Simple	simple measures of elements of well-being	Rosenberg self-esteem (Rosenberg, 1965)
		Subjective Happiness Scale (Lyubomirsky & Lepper, 1999)
		Satisfaction with life scale (SWLS) (Diener et al., 2010)
Composite	measures created from composite of scores on more than one scale	Composite created from 2 or more measures, most commonly SWLS combined with positive and negative affect balance. Some include a measure of stress in the composite.
		Concise measure of subjective well-being (Suh & Koo, 2011)
Optimal functioning	measures of well-being as optimal functioning	Meaning in Life Questionnaire (Steger, Frazier, Oishi, & Kaler, 2006)
		Psychological well-being (Ryff & Keyes, 1995)
		Mental Health Inventory – 38 (Veit & Ware, 1983)
		Warwick Edinburgh Mental Well-Being Scale (Tennant et al., 2007)
		World Health Organization's Quality of Life scale (short version) (The WHOQOL Group, 1998)

Figure 20.3: Meta-analysis of wellbeing

nervous system's reaction to the emotion we are experiencing. Emotions are made up of three parts: subjective experiences, physiological responses and behavioral responses.

- **Subjective Experiences:** Subjective experiences can range from something as simple as seeing a color to something as major as losing a loved one or getting married. No matter how intense the experience is, it can provoke many emotions in a single individual and the emotions each individual feel may be different.

- **Physiological Response:** Physiological response is the result of the autonomic nervous system's reaction to the emotion we are experiencing. The autonomic nervous system controls our involuntary bodily responses and regulates our response to fight (overcome) or give up (get deeper into emotions).

- **Behavioral Response:** The behavioral response aspect of the emotions is the actual expression of the person. Behavioral response can include a smile, a grim face, a laugh or a sigh, along with many other reactions depending on societal norms and personality. A study in the Journal of Abnormal Psychology found that while watching negative and positive emotional films, suppression of behavioral responses to emotion had physical effects on the participants.

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The physiological and behavioral responses associated with emotions illustrate that emotion is much more than a mental state. Emotion affects our entire behavior and our health. In emotional psychology, emotions are split into two groups - basic and complex. Charles Darwin was the first to suggest that emotion-induced facial expressions are universal, which are considered to be basic emotions. Whereas complex emotions are the ones which are an aggregate of two or more basic emotions.

20.5.5   Antecedent Variables

An antecedent variable is a variable that is used before the independent and dependent variables under study can explain the relationship between the two. Now in our study of wellbeing, we can consider antecedent variable, independent variable and variable dependent as

$Work\ Stress \longrightarrow Emotion/PositivePsychology \longrightarrow Wellbeing$.

While studying this antecedent variable, researchers have used different methodology to control or see how this can get related to the independent and dependent variables. Just to give an example here, one approach that was used in which participants were made into groups and different kinds of stress, e.g. work related, finance related, family stress or any other kind of anxiety, was studied for each group. Irrespective of the type of stress and anxiety, positive psychology and emotions of the individuals plays a major role and it is an indicator of wellbeing. Further, researchers include the antecedent variables into a Regression Model to control their effects.

20.6   Conclusion

Employee wellbeing or the lack of it can play a critical role in the life of organizations. It may influence rates of absenteeism, or fluctuation, workplace conflict and cooperation, as well as personal performance. Overall, it has a significant impact on organizational success. Hence it is strongly recom¬mended that wellbeing at workplaces should be assessed from time to time.

There is a positive indication that many large corporations, with guidance from behavioral scientists, are implementing various measures through innovative employee engagement pro-

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grams to ensure that employees are empowered to manage stress. The Economic Times published report which says 81% Indian employers sensitized their workforce on mental well-being. In a Times Jobs survey, 59% HR managers said that they had set up a crisis management team to address employees' well-being issues effectively. A majority (35%) of HR managers claimed to have introduced policies such as one-on-one counseling, staff mentoring, virtual mindfulness workshops, etc to help employees cope up with anxiety amid COVID-19. Around 50% of HR managers said that their employees reported facing stress or unease during the COVID-19 lock down. Furthermore, improving employees' well-being at work leads organizations to - (a) strengthen their personal resources (b) flourish and take pride in their roles within the organizational system (c) function to the best of their abilities, both as individuals and in collaboration with their colleagues and (d) have a positive overall experience of work.

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