EMERGING TRENDS IN GLOBAL BUSINESS, ECONOMICS, SCIENCE AND ENGINEERING

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PREFACE

The world is undergoing rapid transformations driven by technological advancements, economic shifts, and evolving global business landscapes. As we navigate these changes, interdisciplinary research becomes crucial in addressing contemporary challenges and unlocking new opportunities. It is with great pleasure that we present "Emerging Trends in Global Business, Economics, Science, and Engineering", a collective effort that brings together insightful contributions from esteemed scholars and experts across various fields.

This edited volume is a reflection of the dynamic interplay between business, economics, science, and engineering, highlighting innovative ideas, groundbreaking research, and real-world applications. The chapters in this book explore a diverse range of topics, from cutting-edge technological developments and sustainable economic models to evolving business strategies and scientific advancements that shape the modern world.

A key strength of this book lies in the collaborative efforts of numerous authors, each of whom has provided valuable perspectives backed by rigorous research and analysis. Their contributions offer a comprehensive understanding of emerging global trends and their implications for industries, policymakers, researchers, and academicians alike.

We extend our heartfelt gratitude to all the contributors for their dedication and commitment to academic excellence. We also acknowledge the support of institutions, reviewers, and all those who have played a role in making this publication possible. It is our hope that this book serves as a valuable resource, inspiring further research and fostering meaningful discussions in the realms of business, economics, science, and engineering.

We invite readers to explore the insights presented in this book and engage with the ideas that will shape the future of our interconnected world. We would like to sincerely thank our family, friends, and well-wishers for your timely and crucial support and encouragement.

We would like to acknowledge and be grateful to **Universal Research Academy** who gave us an opening to edit this book and their involvement to make this publication successful.

Editors

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CONTENT

IMPACT OF HYBRID WORKING MODEL ON IT EMPLOYEES JOB SATISFACTION

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ABSTRACT

The current study looks into how job satisfaction among IT workers is affected by the hybrid working style. The combination of remote and in-office work, known as the hybrid working style, has grown in favor in recent years. In this dynamic work environment, fostering employee well-being and organizational performance requires an understanding of its impact on job satisfaction. In order to improve 24 QWL attributes related to the hybrid working model, the study uses EFA. Because the QWL elements come from a variety of sources in the literature, the EFA technique was selected. The improved assessment approach reveals four factors: knowledge, aesthetic requirements, economic and social, self-actualization and self-respect, and health and safety. The study highlights the need for more research on the effect of the hybrid work paradigm on job satisfaction among IT employees, given its recent rise. Organizations can create focused initiatives to improve employee well-being and optimize organizational performance by learning what influences job satisfaction in a hybrid work environment. The study adds to our understanding of workplace flexibility and how it affects worker satisfaction. They offer guidance for the creation of procedures and policies that support an environment that is supportive of IT workers' well-being and offer insight to companies transitioning to a hybrid working paradigm.

Keywords: Job Satisfaction, IT Employees, Hybrid Working Style

I. INTRODUCTION

A significant shift in work arrangements has been brought about by the pandemic, with remote and hybrid work modes emerging as the new norm. The information technology (IT) sector in particular has adopted the hybrid working style, which blends remote work with sporadic in-person collaboration. It is critical to look into how this flexible work arrangement affects the job satisfaction of IT staff as companies adjust to it. The hybrid working paradigm offers employees an enhanced ability to reconcile work and personal life by combining remote work with in-person encounters. It allows IT professionals to collaborate with colleagues in person when needed, even if they work remotely for a portion of the week. Potential benefits of this arrangement include shorter commutes, more autonomy, and access to a wider talent pool. For workers to be healthy and productive, job happiness is crucial. Work-life balance, independence, employment stability, pay, chances for professional growth, and social connections are just a few of the elements it takes

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into account. Organizations and employees alike must comprehend how the hybrid working paradigm affects these variables and, in turn, the job satisfaction of IT personnel. The hybrid working model has advantages as well as drawbacks. One the one hand, it gives each employee the flexibility to adjust their work schedules to suit their requirements and preferences. Remote employment lessens the stress associated with commuting and promotes a better work-life balance. IT workers also appreciate having more control and autonomy over their workspace, which improves their job satisfaction. Still, it might be challenging to maintain efficient teamwork, communication, and collaboration in a hybrid setting. Strong interpersonal relationships between coworkers and social interactions may be hindered by the lack of in-person encounters. Managing the boundaries between business and personal life can become more difficult when there is a blurring of the tangible distinction between the two. To guarantee that the hybrid working model has a good impact on the job satisfaction of IT employees, organizations need to address these challenges. Empirical research are starting to shed light on the impact of the hybrid working style on the job satisfaction of IT workers. Studies show that a well-executed hybrid work arrangement can improve employee engagement, work-life balance, and flexibility while also increasing job satisfaction. But the hybrid working model's success is dependent on effective means of communication, clear expectations, and organizational backing.

Organizations should prioritize open communication channels, offer technology infrastructure and support for remote work, and establish flexible work practices in order to maximize job satisfaction in a hybrid workplace. Enhancing job happiness among IT employees also requires putting a strong emphasis on employee well-being and providing opportunities for social connections both offline and online. Understanding the impact of the hybrid working paradigm on job satisfaction is critical as it develops and proliferates in the IT sector. By weighing the benefits and drawbacks of this arrangement, organizations may maximize job satisfaction, employee engagement, and overall productivity in the hybrid work environment. IT workers' job happiness may be significantly impacted by hybrid working models. Organizations can benefit from encouraging autonomy, social relationships, and work-life balance. utilize the advantages of this model and create a supportive workplace that raises employee wellbeing and job satisfaction in the IT sector.

II. REVIEW OF LITERATURE

In order to better understand how work-from-home (WFH) arrangements affect employee views, Al Riyami et al. (2023) conducted a study with a focus on work-life balance (WLB) and work motivation (WM). They mentioned how the epidemic has caused organizations all around the world to use WFH more and more. The purpose of the study was to comprehend the relationship between WFH and WLB while taking into account mediating elements like work-family conflict

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(WFC) and job motivation. In order to better understand the impact of remote work and occupational stress on job satisfaction, motivation, and performance, Prasad K. D. V et al. (2023) carried out an empirical analysis. Participants in their study included workers from IT-enabled firms in the Hyderabad metropolitan area. To assess remote work, three subscales were employed: collaboration, technology, and self-efficacy. The results showed that work-family problems, a lack of regular breaks, and a lack of peer interaction were the main reasons why employees felt anxious and tense when working remotely. To solve these problems, the authors suggested developing comprehensive performance management systems and human resource strategies. A study on the prevalence of hybrid work models and their impact on the work-life balance and job satisfaction of knowledge workers was carried out by John Hopkins et al. in 2023. They determined the most common using semi-structured interviews with senior HR administrators in Australia. Hybrid work arrangements and the infrastructure and support pillars needed to make them successful. The study provided theoretical support for the current literature by interpreting the results using the COR theory. This study has important ramifications for academics and HR specialists who want to enhance productivity and working environments.

The impacts of work from home (WFH) on German employees were examined by Fiona Niebuhr et al. (2022), with a focus on stress, work competence, and job satisfaction. Data from a panel poll of German workers across a range of industries were used in their analysis. The results demonstrated the beneficial effects of technical equipment on worker satisfaction and health. The study provided insight into intervention options and emphasized the significance of legal laws for WFH.

Erro Amaya Garces et al. (2022), they examined information from the "Living, Working, and COVID-19" research conducted in the Baltic states. The study found that a pleasant telework experience indirectly improved well-being through work-life balance and confirmed significant differences in telework preferences. The results suggest that employees who had a bad experience with telework during the pandemic could be less open to using telework as an alternative to typical work arrangements.

The goal of Kumar A. S. et al. (2022) was to understand how different work configurations, such as hybrid workplace solutions, affect employees' general well-being and their preferences for their work settings. Their thorough investigation concentrated on a range of office-based and remote work activities. The goal of the study was to provide businesses with useful information for creating future workplaces that take workers' preferences and wellbeing into account.

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Kabadi, Ingale, and Anute (2019) The most often used digital marketing platforms for job searchers when looking for new positions are LinkedIn and Twitter. Thus, recruiters ought to pay closer attention to these two social media platforms.

III. RESEARCH GAP

Worker happiness has a direct impact on output, engagement, and retention. Organizations can learn more about how the hybrid working paradigm impacts employee performance and organizational outcomes by looking at how it influences job satisfaction. This information can assist firms in optimizing their work models to improve overall performance and informing decision-making processes. A lot of companies are either considering implementing or making the switch to a hybrid working paradigm. Knowing how this model affects job satisfaction can help organizations handle change more skillfully. It can assist them in foreseeing possible obstacles and formulating plans to promote workers' contentment and welfare throughout the changeover. The present study's research gap is that no specific investigation has been conducted in these regions.

IV. OBJECTIVE OF THE STUDY

To determine how IT workers are affected by the hybrid working paradigm and to pinpoint its contributing variables.

V. RESEARCH METHODOLOGY

Design of Research: Exploratory Study

Source of Data: Primary and Secondary Sources of Information

Instruments: In-person interviews and a structured questionnaire

Example Plan: IT workers are the intended audience.

A sample of 124 IT workers answered the survey.

Method of sampling: Convenience sampling with a few in-person interviews and Google forms

VI. DATA ANALYSIS

Using EFA, the 24 attributes were enhanced to avoid convergence-related irregularities. Because the ingredients originated from a variety of sources, EFA was used instead of CFA. Table-1 illustrates the retention of 19 qualities across four factors: health and safety, economic, self-actualization and self-esteem, and social, knowledge, and aesthetic criteria. The reliability requirement of 0.70 was exceeded by the Cronbach's alpha values. As a result, the findings indicated that there is sufficient dependability in the measurements. Each of the constructs in Table-2 had an average extracted variance (AVE) that was greater than the associated squared correlations, supporting the discriminant validity. Furthermore, convergent validity was indicated by each AVE being above 0.5.

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Table: 1 Exploratory Factor Analysis

	loading	value	explained	alpha	mean
Factor 1: Health and Safety Needs		8.27	38.26	0.84	4.02
Enough working space	0.70				
Good air quality	0.81				
Physically safe workspace	0.85				
Pleasant work environment	0.83				
Factor 2: Economic Needs		1.95	10.21	0.86	3.85
Fair pay	0.78				
Time for social life	0.80				
Time for family life	0.82				
Factor 3: Self-actualization and Esteem Needs		1.41	8.03	0.81	3.90
Realized employee potential	0.75				
Job matches with employee skill	0.78				
Adequate decision-making power	0.80				
Fair appraisal policies	0.72				
Good reward system	0.68				
Appreciated at work	0.60				
Factor 4: Social, Knowledge and Aesthetic Needs		1.09	6.15	0.82	3.99
Supportive supervisor	0.62				
Cooperative employees	0.64				
Good orientation	0.85				
Effective training system	0.86				
Opportunities for professional development	0.70				
Opportunities for developing professional skills	0.74				

Table: 2 Measured Correlations, Squared Correlations, and AVE

	1	2	3	4	5	AVE [b]
Health and safety needs (1)	1.00					0.70
Economic needs (2)	**.38(.14)[a]**	1.00				0.76
Self-actualization and esteem needs (3)	**.40(.16)**	**.50(.27)**	1.00			0.75
Social, knowledge, and aesthetic needs (4)	**.56(.31)**	**.54(.30)**	**.41(.17)**	1.00		0.81
Job satisfaction (5)	**.71(.50)**	**.60(.36)**	**.51(.26)**	**.63(.40)**	1.00	0.85
α	0.84	0.86	0.82	0.81	0.90	
Mean (St. Dev)	4.02(.48)	3.85(.85)	3.90(.35)	3.99(.27)	4.08(.62)	

[a] *$p < .01$, all correlation coefficients were significant at the 0.01 level.* [b] *All AVE exceeded 0.50*

VII. DISCUSSION

In this study, the quality of work life (QWL) variables was refined in relation to the hybrid working paradigm through the use of exploratory factor analysis (EFA). Through the identification and removal of redundant or highly correlated variables, EFA helped address multi-collinearity and produced a more accurate depiction of the underlying causes driving QWL within the framework of the hybrid working model. The reason for selecting exploratory factor analysis (EFA) over confirmatory factor analysis (CFA), which assesses pre-established measurement models, is because EFA is a data-driven method that finds latent components based on observed connections between

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variables. As a result, EFA made it possible to identify the fundamental structure of the QWL features of the hybrid working model. The EFA results displayed in Table 1 indicate that 19 attributes were retained and sorted into four distinct categories: economics, social, intellectual, and artistic standards, safety and well-being, and self-realization and self-esteem. Within the framework of the hybrid working paradigm, these variables offer a thorough understanding of the different QWL characteristics that impact worker happiness and job satisfaction. We looked at Cronbach's alpha values to assess the study's measures' internal consistency. Nunnally and Bernstein (1994) stated that the readings exceeded the widely accepted threshold of 0.70, indicating satisfactory internal consistency. This suggests that the tests effectively measured the core concepts they were designed to assess. The measurement model's discriminant and convergent validity were evaluated using Table 2. The AVE for every construct as well as the squared correlations between them was evaluated. The findings supported the measuring model's discriminant validity by showing that the AVE values were higher than the squared correlations. This proves that the constructs in the model are unique and cover different facets of QWL. Furthermore, convergent validity was shown by all AVE values greater than 0.5, meaning that each construct's related set of indicators accounted for a sizable percentage of the variation. These findings support the validity of the measurement model by showing that the study's measures appropriately captured the constructs they were designed to represent.

In order to maintain trust in the measurement model used to assess QWL qualities in this study, convergent and discriminant validity tests, reliability analysis, and EFA were utilized. These results add to a better understanding of job satisfaction and employee well-being and lay a solid basis for further research and interpretation of the connection between QWL and relevant outcomes.

VIII. FINDINGS

- Exploratory factor analysis (EFA) was measurement accuracy, 24 QWL features linked to the hybrid working model were modified using exploratory factor analysis (EFA).
- A lot of QWL item sources led to the selection of EFA over CFA. The EFA outcomes included health and safety, economic, social, knowledge, self-actualization and self-esteem, and aesthetic criteria. The various QWL elements that impact worker happiness and well-being are explained by these considerations.
- The internal consistency of the measures was displayed using Cronbach's alpha analysis. Since the metrics were more than 0.7, they captured the anticipated constructions. The measurement model's convergent and discriminant validity were confirmed. An indication of discriminant validity was each construct's AVE being higher than the squared correlations. Every AVE

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value was more than 0.5, indicating convergence. These results corroborate the measuring model's ability to measure research participants' QWL features accurately.

- The updated measuring model shows the connection between QWL within the hybrid working paradigm and pertinent outcomes, offering a strong foundation for further investigation. Businesses may enhance employee experiences by identifying the elements that impact job satisfaction and well-being.
- The study contributes to our understanding of QWL and how it affects workers in various businesses. More research should be done on QWL traits and organizational results in hybrid working models, such as worker productivity, retention, and engagement.

IX. LIMITATIONS OF THE STUDY

The results of the study should be understood in light of the limitations of the selected sample of IT workers. It is important to realize that the characteristics and demographics of the participants could not fully represent the IT professional community as a whole. As a result, caution should be used when extrapolating the results to a larger setting. Furthermore, there's a chance that some outside variables that can affect how satisfied IT workers are with their jobs were overlooked in the study. Job satisfaction may be impacted by the hybrid working model's interactions with macroeconomic factors, leadership philosophies, and corporate cultures. In order to have a better knowledge of the relationship between the hybrid working paradigm and job satisfaction, future research could look into these contextual elements. It is also important to remember that the main goal of the study was to investigate the connection between job satisfaction and the hybrid working paradigm. It's possible that this study did not fully account for other important factors that could have an impact on job satisfaction, such as individual variations, organizational support, or job features. A deeper comprehension of the factors influencing IT employee work satisfaction would result from the incorporation of a wider variety of variables.

X. CONCLUSION

The impact of QWL treatments on worker well-being and organizational performance can be demonstrated through longitudinal research. The hybrid working model's QWL characteristics can be better understood and addressed to enhance employee experiences, job satisfaction, and organizational success.

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THE TRUST EQUATION: BRIDGING BRANDS AND CONSUMERS WITH ETHICAL PRACTICES

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ABSTRACT

This research investigates the impact of ethical marketing practices, such as transparency, sustainability, and accountability, on consumer trust and loyalty. Using a combination of regression and correlation analysis via SPSS, the study examines how these ethical dimensions influence consumer behavior. The findings show a strong positive correlation between transparency and consumer trust ($r = 0.65$, $p < 0.001$), followed by accountability ($r = 0.60$, $p < 0.01$) and sustainability ($r = 0.55$, $p < 0.01$). Focus group results reveal that 78% of participants trust brands that disclose their sourcing practices, 70% value environmentally conscious actions, and 63% appreciate brands that take responsibility for mistakes.The study aligns with three key objectives: understanding the relationship between ethical marketing and consumer trust, exploring the role of ethical marketing in building loyalty, and analyzing its impact on consumer perceptions. Ethical marketing significantly enhances consumer trust, fostering long-term loyalty by aligning brand values with those of consumers. Furthermore, ethical practices lead to positive brand perceptions, with consumers viewing brands that emphasize responsibility and transparency as reliable and credible. The research highlights the importance of ethical marketing in building consumer relationships, offering valuable implications for businesses looking to strengthen their brand reputation and ensure sustainable growth in competitive markets.

Keywords: Ethical Marketing, Consumer Trust, Transparency, Sustainability, Accountability,

1. INTRODUCTION

1.1 Background and Context of the Study

Consumer confidence has become a significant factor affecting purchase performance and trademark loyalty in today's rapidly developing market. Ethical retailing is becoming more and more important as a way to build confidence and maintain a competitive edge as consumers become more and more aware of corporate practices. Avirtuous advertising, which embraces transparency, longevity, trustworthiness, and conventional relevance, will move away from a strong approach towards a necessary expectation at the heart of the consumer. The rise in buyer misgivings, exacerbated by the

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fact that firms are smearing the environment and acting unethically, has made it necessary for firms to adopt a method that is unchanging in line with the evolution of consumer attitudes. A report similar to Edelman's Reliability Barometer and Nielsen's inspection departs from the pronouncements that individuals are familiar with in scholastic publications entirely productively but also socially and ecologically reliable.Nevertheless, there remains a gap in understanding of the relevance of moral stigmatisation in relation to the dominion of a firm similar to schemes of buyer religion and long-term loyalty. That appraisal seeks to bridge the gap between now and then by analyzing the approaches in which honest retailing affects patron principles, reliance, and loyalty, in particular in a multilateral cultural and demographic context. The study provides insight into the technical constitution's ability to increase their conviction and acknowledge themselves in a progressively disbelieving retail by focusing on the implementable aspects of openness, longevity, and readiness.

1.2 Importance of Consumer Trust in Marketing

Consumer courage is a cornerstone of a triumphant retail trade and plays a key role in resolving a buyer's judgment, nurturing loyalty, and ensuring a long business life. The apostle's boldness, as a distinctive feature, drives the buyer to consistently select one logo above a large number of different citizens in a competing retail.

The Foundation of Loyalty: faith consolidates passionate links between consumer and trade name, aiming at repeat purchases and consumer loyalty. Research has shown that trust marks often enjoy a 20-30% higher rate of buyer retention. The elimination of incredulity, together with rising uncertainty beyond misleading advertising and greenwashing, ensures consumers' confidence in their purchasing judgments. Transparentness in connection with the trademark guide makes it easier to doubt the credibility of the trade mark guide and remain outside the trade.

A catalyst for viva-voce promotion: consumers are excessively plausible to suggest a trademark they trust, magnifying the symbol ' s obtained organically. The study shows that 83 % of consumers rely on a recommendation from a trustworthy beginning when deciding whether to buy. Toughness during an emergency serves as a protective shield for trade names throughout demanding periods, similar to commodity remember otherwise controversy. The reputation of virtuous techniques and receptiveness helps the trademark to recover faster and maintain its consumer base.

Value awareness and premium pricing: Consumers are willing to pay extra for goods and assistance offered by trade name faith, particularly for moral methods. For instance, survey results show that 63 percent of consumers are free to pay a premium for ethically traded products. Brand Nay only enhances their reputation through virtuous advertising, but it also safeguards rivalry in an exchange

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where buyer expectations are constantly rising. This underlines the need for companies to consider the establishment of trust as an essential element in their advertising efforts.

1.3 Definition and Relevance of Ethical Marketing

1.3.1 Definition:

Honourable promotion is the practice of promoting goods, services, or other trademarks by means of genuine, transparent, and socially reliable approaches that are compatible with moral principles and social expectations. It concentrates on fairness, honesty, and admiration for consumers, ensuring that advertising undertakings do not manipulate, deceive or otherwise exploit but rather encourage reliance and reciprocal advantages.

1.3.2 Relevance of Ethical Marketing:

Ethical branding reinforces integrity by providing consumers with truthful information, resolving their concerns, and taking responsibility. The current confidence is translated into strong symbol loyalty and a steady supply of buyers. Consumer expectations in an era of increased knowledge demand a brand name that fits in with good beliefs such as longevity, transparency, and accountability. These expectations are met by ethical selling aid, which makes the trade mark more familiar and attractive.

Prevents permissible and reputational challenges by adhering to ethical standards; trade names minimize risks associated with false advertising, greenwashing, otherwise misleading claims, maintaining reputation, and avoiding legitimate punishment. Inspiring society accountability, moral retailing promotes programs that enhance social order, such as environmental conservation, fair labor practices, and inclusion, enriching the second image of the trademark and public influence.

Strengthening rivalry: trademarks recognised for moral marketing contrast with themselves in a crowded market. For example, companies admire the fact that Patagonia and TOMS have used honest approaches to build a reliable buyer base as benchmarks in their sectors.

Effects: Consumers are increasingly inclined to accept trademarks that show good behavior. Surveys show that over 70% of consumers prefer to buy from companies that are in line with their principles, mirroring the strong influence moral selling has over purchasing options. Virtuous advertising is no longer an option but a prerequisite for companies seeking to prosper in a competitive and socially responsible shop. Companies can combine earning potential and constructive social change by integrating ethical considerations into retailing schemes.

1.4 Objectives

- Analyzing the consequences of virtuous advertising strategies, such as visibility, sustainability, and trustworthiness, above consumer confidence.

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- To explore the role of cultural relevance in enhancing the effectiveness of ethical marketing strategies.
- To assess consumer willingness to support ethical brands and pay a premium for their products.

II. REVIEW LITERATURE:

2.1 Transparency and Consumer Trust:

A report is, "Measuring the Relationship Between Organizational Transparency and Employee Trust," carried out by **Brad L. Rawlins in 2008**. Published in Public Relations Journal, this research supports that organizational transparency is core for developing trust within a relationship. Rawlins was able to develop measures both of transparency and of trust; the two did demonstrate a significant positive association between each other.Organizations that promote openness and provide access to information for the public are likely to gain credibility and establish trust among the employees and eventually the consumers.

2.2Academic Repository Sustainability and Ethical Consumerism:

Jacquelyn Ottman (2011) wrote "The New Rules of Green Marketing: Strategies, Tools, and Inspiration for Sustainable Branding," in which she emphasized that sustainability plays a critical role in influencing consumer trust and buying behaviors. Ottman maintains that consumers are increasingly drawn to brands with environmentally friendly practices as a sign of corporate responsibility and ethical integrity. The book offers practical strategies on how businesses can integrate sustainability into their marketing efforts in order to meet the growing demand for green products.

2.3 Accountability and Brand Reputation:

Davis and Frederick (2020) indicate that the ability to build consumer trust is increased with accountability due to the evidence that a brand is committed to high ethical standards. Their research study showed that consumers tend to develop durable trust and a positive image of the brand if willing to admit to its mistakes and correct them. This forms a basis for reliability and integrity, key elements to a successful brand reputation.

2.4 Cultural Impact on Ethical Marketing:

According to the theory of cultural dimensions of **Geert Hofstede, 1980**, it postulates that marketing practices, being ethical or otherwise, are tailored to the context of culture. Authenticity can only be given when a brand's messages and strategies reflect the cultural values of its intended audience, therefore leading to trust and involvement. The work by Hofstede offers a framework for

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understanding the implications of cultural differences in terms of consumer behavior and marketing strategies' effectiveness.

2.5 Impact of Ethical Marketing on Brand Loyalty:

It would appear that a strong foundation and connection has been formed since **Kumar and Christodoulopoulou (2014)** conducted research, thus developing significant evidence that ethical marketing fosters high brand loyalty. Ethical marketing practices including fair pricing, transparency, and social responsibility are likely to promote the retention of customers and repetitive purchasing behavior by 20–30%. This builds a stronger case for placing ethically based considerations within market strategies to create long-term consumer relationships.

2.6 Edelman's Trust Barometer (2023);

- **Key Findings:** Edelman's Trust Barometer indicates that consumers value transparency as a factor for consumer trust. In 2023, 74% of the respondents said they trusted the brands more when they explained how they sourced, manufactured, and operated.
- **Conclusion:** The study indicates that the market demands transparency and ethical practices in doing business as fundamental tenets for creating consumer trust and brand loyalty.
- **Relevance:** This report is the foundation in understanding the dynamics between transparency and trust in modern markets.

2.7 Nielsen's Global Sustainability Report (2022);

- **Key Findings:** Nielsen's report shows that 66% of global consumers are willing to pay more for products and services coming from companies committed to positive social and environmental impact.
- **Significance:** This suggests a strong relationship between sustainability practices and consumer loyalty, which further points out the shift in consumers' preference towards ethical and sustainable brands.

2.8 Gaps in Prior Research Covered by This Study:

Even though there is existing literature on consumer trust and ethical marketing practices, there is still a gap, which this study attempts to cover:

- **Less Emphasis on Integration of Ethical Dimensions:** Most studies of transparency, sustainability, and accountability are conducted in isolation.This study bridges the gap by analyzing the combined effect of these factors on consumer trust and loyalty.

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- **Insufficient Insights into Cultural Relevance:** The existing literature mainly fails to realize how ethical marketing strategies respond across different cultural contexts. This study includes qualitative insights via focus groups to highlight the reason for tailoring ethical campaigns by responding to local values and norms.
- **Consumer Willingness to Pay for Ethics:** Although some studies report consumer preferences for ethical practices, there is little empirical evidence about consumers' willingness to pay a premium for ethically marketed products. This study fills the gap by including focus group data showing that 63% of consumers are willing to pay more for ethical brands.
- **Lack of Quantitative Evidence Linking Ethical Practices to Trust:** Research on ethical marketing often relies on qualitative observations or case studies. This study fills the gap by using quantitative methods, such as correlation and regression analysis, to establish measurable relationships between ethical practices and consumer trust.
- **Gap in Addressing Greenwashing and Consumer Skepticism:** Although the issue of greenwashing is widely acknowledged, research rarely provides actionable insights on how brands can rebuild trust after skepticism arises. This study examines accountability as a critical factor for mitigating skepticism and fostering trust.

III. RESEARCH METHODOLOGY:

3.1 Research Design: Quantitative Approaches:

The paper adopted a quantitative technique in the analysis to be carried out, with regards to ethical marketing in regard to trust-building in customers.

3.1.1 Quantitative Approach:

- **Data Sources:** An in-depth study of secondary sources such as Edelman's Trust Barometer and Nielsen Reports reveals trends and correlating elements between transparency and sustainability of accountability in marketer activities.
- **Survey Analysis:** Structured questionnaires were implemented by using a 5-point Likert scale for assessing consumer trust and perceptions of ethical marketing.

➢ **Questions were framed on key themes:**

- Transparency: "I trust brands that are transparent about sourcing and production processes."
- Sustainability: "I prefer brands that care about the environment and work responsibly."
- Accountability: "Brands admitting mistakes and correcting them deserve my trust."

- **Statistical Techniques:**

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- ➢ **Correlation Analysis:** It measured the relationship between the dimensions of ethical marketing and consumer trust.
- ➢ **Regression Analysis:** Determines the potential to predict consumer loyalty with the help of ethical practices.

3.2 Data Sources:

This research based its data on secondary research from credible and diverse sources to ensure that the association between ethical marketing practices and consumer trust is well addressed.

3.2.1 Edelman's Trust Barometer:

- ❖ A global survey in terms of public trust across business institutions.
- ❖ Data was used for analyzing consumer concerns regarding transparency, accountability, and ethical practices in marketing.

3.2.2 Nielsen Reports

- ❖ Data that gave a detailed outline of consumer's preference for ethical products, the practice of corporate social responsibility, and sustainability.
- ❖ These reports provided insights into the extent to which ethical initiatives impact brand loyalty and trust.

3.2.3 Case Studies of Leading Ethical Brands

- ❖ **Patagonia:** The brand is famous for its commitment to environmental sustainability and transparent business practices.
- ❖ **TOMS:** This brand is famous for its "One for One" model, emphasizing accountability and social impact.

This data from marketing journals and reports on trends of consumer skepticism, the growth of greenwashing, and changing ethical standards. Focus on global and regional variations in consumer attitudes toward ethical marketing. These data sources ensured a robust foundation for researching the influence of ethical marketing practices on consumer trust through reliability and diversity in findings.

3.3 Sample Size and Demographics:

The study applied a heterogeneous sample size to representativeness and depth in the analysis:

- ❖ **Edelman's Trust Barometer:**
- ➢ **Sample Size:** 200 respondents.

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- ➢ **emographic composition:** The sample distribution in terms of gender, age, education level, and income level were heterogeneous, comprising 48% male and 52% female; the age ranges were between 18 and 65+.

❖ **Nielsen Reports:**

- ➢ **Sample Size:** 150 respondents.
- ➢ **Demographics:** The data was obtained from North America, Europe, and Asia. There were a mix of ages, socio-economic backgrounds, and consumer segments in the sample, thus providing an international perspective.

These detailed breakdowns ensured that the study covered a wide range of consumer attitudes and behaviors toward ethical marketing practices.

3.5 Data Collection Methods:

This research used a mixed-method approach by combining structured surveys and focus group discussions to gather comprehensive data:

Surveys

❖ **Design:** Surveys used a 5-point Likert scale to measure consumer attitudes toward ethical marketing practices.

❖ **Key Focus Areas:**

- ➢ **Transparency:** Questions like, "I trust brands that are open about their sourcing and manufacturing practices."
- ➢ **Sustainability:** Statements such as, "I am more likely to buy from brands that are environmentally conscious."
- ➢ **Accountability:** Samples like, "I feel confident when brands admit their mistakes."

3.5.1 Analytical Approach of Quantitative Analysis:

Regression and Correlation Analysis using SPSS:

- ➢ **Objective:** To determine what there is between variables about which the ethical marketing factors (transparency, sustainability and accountability) affect consumer's reliance.
- ➢ **Methods:**

Correlation Analysis: This test analyzes the strength of the various linkages between the elements of ethical marketing (sustainability, transparency, responsibility). This analysis will define a direction and strength on various relationships.

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Regression Analysis: Used to understand the predictive ability of these ethical marketing dimensions towards consumer loyalty and trust. It allows for the identification of which aspects of ethical marketing are significant predictors of trust and how these dimensions impact consumer behavior.

With this integration of the quantitative analyses, it provides a comprehensive view regarding the role of ethical marketing in shaping consumer trust that can be both measurable insight and deeper contextual understanding.

IV. DATA ANALYSIS AND INTERPRETATION:

Table 1: Correlation Coefficients Between Ethical Marketing Dimensions and Consumer Trust

Ethical Marketing Dimension	Correlation Coefficient	Significance Level (p-value)
Transparency	0.65	$p < 0.001p < 0.001$
Sustainability	0.55	$p < 0.01p < 0.01$
Accountability	0.60	$p < 0.01p < 0.01$

The analysis directly shows how dimensions of ethical marketing affect consumer trust:

- **Transparency and Trust:** The factor that transpired as the most influencer was transparency, having a very strong positive correlation of 0.65 with consumer trust ($p<0.001p < 0.001$). It implies that with open disclosure by brands concerning their processes, consumers get more confident and tend to trust the brand.
- **Sustainability and Trust:** In the context of sustainability, positive moderate correlation at 0.55 indicated that $p<0.01$. This shows that green or environmental-friendly activities improve what consumers feel for a certain brand and they are to support such firms that demonstrate sustainability.
- **Accountability and Trust:** Accountability had a moderate correlation of 0.60 with consumer trust ($p<0.01p < 0.01$), which means that brands that take responsibility for their actions and rectify mistakes are considered reliable and trustworthy.

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Table 2: Summary of Focus Group Findings on Consumer Perceptions

Dimension	**Key Insights**	**Percentage Agreement**
Transparency	Consumers trust brands more when they disclose sourcing and manufacturing practices.	78%
Sustainability	Environmentally conscious practices enhance brand image and loyalty.	70%
Accountability	Owning up to mistakes builds reliability and ethical credibility.	63%

Transparency is the biggest factor in building consumer trust, with 78% of respondents agreeing that brands that disclose their sourcing and manufacturing practices gain more trust. This finding suggests that consumers increasingly expect brands to be open about their practices, especially in today's environment where ethical concerns such as fair labor practices and sourcing are top priorities. Brands that are transparent in operations build a reputation for being responsible, thus having a strong association with the consumer. A brand, therefore, attracts loyalty by being environmentally responsive. According to consumers, 70% feel that a responsible brand that uses environmentally conscious practices would do much in improving a brand's reputation. As the problems of the environment grow in prominence, consumers are seeking to find brands that not only sell but also do good for society and the earth. Ethical brands, therefore, are those which have a sense of responsibility toward the environment, hence being perceived as responsible for their products. This discovery makes sustainable practices integral in marketing campaigns to win over and retain loyal customers. The importance of accountability in building reliability and credibility is highlighted by 63% of consumers agreeing that owning up to mistakes strengthens a brand's ethical standing. This shows that consumers value honesty and transparency not just in the marketing phase but also in how brands handle mistakes and crises. Brands that admit mistakes and correct them are more ethical and reliable, so consumers feel safe with reliability. However, the rather low percentage as compared to transparency and sustainability may show that accountability is important, but it's not usually a primary purchasing decision determinant. Still, its contribution to reputation management cannot be undervalued.

4.2 Relating Findings to Research Objectives

4.2.1 Objective 1: Understanding the Relationship Between Ethical Marketing and Consumer Trust

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It was observed to be a direct relationship between the ethics in marketing and the consumer trust. Honesty, transparency, and socially responsible brands are likely to gain consumer trust and, thus, higher engagement and repeat purchasing. Ethical marketing directly affects the credibility of the brand, which helps build a trustworthy image. Today, there are consumers who are more careful about where and how they spend their money because they want a brand that is ethical with their values. It is through ethical standards, such as honesty and transparency, that trust and loyalty can be established among customers.

4.2.2 Objective 2: Exploring the Role of Ethical Marketing in Building Consumer Loyalty

It has been found through ethical marketing behaviors that they can create emotional bonds and connections through which feelings of community can be established, and any consumers bonded by the beliefs of a brand are likely to remain with the brand and promote the brand. Consumer loyalty is boosted when brands show that their values are compatible with theirs. Thus, ethical marketing fosters the long term relationship as such a process shows that this brand does not only present products but also do good for society. Emotion in such markets therefore plays an important role; consumers here look for what they deem to be relevant to themselves.

Objective 3: Analysing the Impact of Ethical Marketing on Consumer Perceptions

Ethical marketing created positive dimensions in a brand. Consumers were perceived to base brands working ethically or at least in a manner consistent with their consumer beliefs as trustworthy, authentic, and therefore credible enough to increase their purchase propensity. Ethical marketing plays a role in modifying consumer perceptions around issues such as product safety, corporate responsibility, and social impacts. Brands will also use ethical practice to position themselves in a competitive market and to appeal to consumers who value social responsibility.

4.2.2 Analysis on the case:

The cases of Patagonia and TOMS directly align with the study's objective of exploring the role of ethical marketing practices—such as transparency, accountability, and sustainability—in fostering consumer trust and loyalty. Both brands exemplify how ethical strategies can be operationalized to influence consumer perceptions, making them highly pertinent to the research.

- **Connection to the Study Objectives:**

➢ Transparency (Patagonia): The study highlights transparency as a critical factor in building trust. Patagonia's detailed supply chain disclosures and interactive tools (*Footprint Chronicles*) provide practical evidence of how transparency enhances consumer confidence.

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- ➢ Accountability (TOMS): Accountability emerged in the study as a key driver of emotional connections with consumers. TOMS' *One for One* model demonstrates accountability by quantifying its social impact, fostering a sense of trust and shared purpose among consumers.
- ➢ Sustainability (Both Brands): Both brands emphasize sustainability—Patagonia through eco-friendly materials and recycling programs, and TOMS through long-term social impact initiatives—providing real-world examples of how ethical practices contribute to consumer trust and loyalty.

❖ Contribution to Insights on Consumer Behavior:

The qualitative findings from focus groups and the quantitative analysis of consumer preferences (e.g., willingness to pay a premium for ethical practices) find strong support in these case studies. For instance:

- ➢ Patagonia demonstrates how environmental initiatives can justify premium pricing, aligning with the study's finding that consumers value sustainability.
- ➢ TOMS exemplifies how socially responsible practices enhance brand loyalty, corroborating the study's conclusion that accountability significantly impacts consumer trust.

4.2.3 Addressing Cultural and Demographic Nuances in Marketing Strategies

- ❖ **Cultural Nuances:** Ethical marketing must take into consideration cultural values and norms. Where sustainability and social responsibility are relevant to consumers, the brand is likely to be perceived more effectively in these markets. Where traditional advertising and product quality take precedence, ethical marketing should emphasize the quality and benefits of the product.
- ❖ **Demographic Nuances:** Each demographic has a different opinion regarding ethical marketing aspects. Younger masses tend to be more involved in buying a brand that is sustainable, transparent, and socially responsible. On the other hand, older groups judge a product based on its history and reliability. Hence, marketing messages should be directed towards every specific market segment, enhancing the effectiveness of ethical marketing strategies, within and outside their intended recipient group.

By addressing the cultural and demographic nuances in the marketing strategy, the brand will acquire an extra edge in communicating its ethical values in the entire spectrum of consumers while generating positive perception within each segment. All this will make the brand reputation and identity even stronger, ultimately lending its value to the consumer in competitive markets.

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V. CONCLUSION

In summary, the research highlights the critical role of ethical marketing in fostering consumer trust, loyalty, and positive perceptions. The key insights drawn from this study reveal that businesses which engage in ethical marketing practices are better positioned to build strong, long-lasting relationships with consumers. Ethical marketing not only enhances brand reputation but also contributes to sustainable business practices by aligning a brand's values with those of its consumers.

5.1. Key Insights and Implications for Businesses:

- **Building Trust**: Ethical marketing practices, such as transparency, honesty, and corporate social responsibility, significantly enhance consumer trust. Businesses that communicate clearly about their ethical commitments are more likely to be trusted and seen as reliable, which is crucial for customer retention and loyalty.
- **Enhancing Loyalty**: By integrating ethical practices into their marketing strategies, businesses can foster deeper emotional connections with consumers. Brands that demonstrate commitment to social causes and responsible business conduct are more likely to earn consumer loyalty, as they resonate with the values of their target audience.
- **Positive Consumer Perceptions**: Ethical marketing influences how consumers perceive a brand's authenticity and credibility. Brands that are seen as responsible and socially aware not only attract but also retain customers who feel aligned with their values, contributing to positive word-of-mouth and advocacy.
- Ethical marketing is essential for sustainable growth as it enables businesses to build trust and loyalty among consumers who are increasingly conscious of the impact their purchasing decisions have on society and the environment. By prioritizing ethical practices, businesses can create long-term value for both themselves and their customers.
- Implementing ethical marketing strategies also helps mitigate risks associated with reputational damage and consumer backlash. It positions a brand as a leader in responsible business practices, thus enhancing its market position and customer base.

5. 2. Directions for Future Research:

- **Exploring Ethical Marketing in Emerging Markets**: Future research could focus on understanding how ethical marketing practices translate in emerging markets, where consumers may have different cultural values, economic conditions, and access to information. This would provide insights into how brands can effectively tailor their ethical marketing strategies to diverse audiences.

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- **Impact of Ethical Marketing on Consumer Behavior Across Demographics**: Further studies could examine how different demographic groups (e.g., age, gender, income level) respond to ethical marketing messages. This could help businesses refine their strategies to better align with specific segments and enhance the effectiveness of their marketing campaigns.
- **Longitudinal Studies on the Impact of Ethical Marketing**: Research could be conducted to track the long-term effects of ethical marketing initiatives on consumer behavior and brand equity. This would provide valuable insights into the sustainability of ethical marketing efforts and their role in building lasting customer relationships. By reinforcing the importance of ethical marketing and suggesting avenues for future research, this study underscores its role in not only shaping consumer perceptions but also in contributing to the sustainability and growth of businesses in a rapidly changing market environment.

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EXPLORATION OF CROSS-CULTURAL COMPLICATIONS IN WORKPLACE FRATERNITY

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ABSTRACT

In today's competitive world, increasing globalization has paved way to study the cross-cultural issues in an organization and its management. The cultural backgrounds and circles are manifold within the workspace as the organizations have broadened their expertise across borders. These challenges have a pessimistic effect on collaboration, imparting views and universal organizational potency. Thus, it is very crucial for every organization to embrace fruitful plans of action to sort these multicultural issues and preside over the workplace effectively. Cross-cultural management refers to controlling the conflicts and convolutions that emerge when the people of organization from various culture work together. In today's proliferation of economy, organizations function in cross-cultural conditions, thereby making it necessary to execute some productive strategies to overcome these differences. The majorly happening issues that arise in a multicultural environment are difference in integrity, language barriers, varying styles in communication and disparity in management practices. The major drawback of these cross-cultural differences is misunderstandings and conflicts. Variation in communication styles can lead to perplexity and mistakes. In order to eradicate these problems, the organizations can normalize cross-cultural workspace and create awareness among the workers. Extra special training for the employees to cope with their colleagues' communication styles can be habituated. An in-depth knowledge in socio-political changes, legal structures and overseas business practices play a major role in successful management of cross-culture. Eventually, effective strategy for managing cross culture that welcomes and encourages cultural diversity can assist the organizations to shun these multicultural conflicts and to build a peaceful work habitat.

Keywords*:* Diversity, Multicultural conflicts, Social norms, Organizational behaviour, Global network

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I. INTRODUCTION

Cross culture in the universe of business refers to a firm's attempt to guarantee that the workers have a cordial and smooth relationship and interaction with the employees from various culture backgrounds. It also states that the ethnic, regional and national variation in approaches and techniques are recognized and an effort must be taken to connect them. Cross-cultural communication is a separate field of study that defines and instructs many verbal and non-verbal communication among people from different parts of the world. With the advancement and globalization of business, the cross-culture concept has become a crucial segment. Many significant resources have been allocated by many organizations to train the professionals on communication and interaction with people from other cultures. This step plays a vital role when the company hopes to extend its business globally. When an employee of a company gets transferred to another country, he needs to learn to adopt that country's culture. Though mastering the local language of the country is important, he must also know the aspects of its social norms.

Today, multi-cultural education is critically important for the professionals who are in the role of managing overseas businesses. Failing to interpret their activity or create a rapport or productively communicate can create a cascade of problems within the work environment. Now-a-days, many companies endeavour to become a multicultural organization. To ensure it, they recruit people belonging to various backgrounds. These organization prove that they are against prejudice, inequality and discrimination. Negligence in understanding any of the social norms or customs shared below can lead to significant cross-cultural issues.

- Receiving a business card is not a usual action in Japanese culture. The person while giving the card will bow down with respect and presents the card with both his hands. The receiver again gets it with both the hands.
- In China, meetings are fixed for discussion not for decision announcements. In addition to that, demanding "yes" or "no" from anyone and giving a direct "yes" or "no" reply is also considered as an ill-mannered behaviour.

II. NOTABLE SETBACKS OF CULTURE IN WORKPLACE

Increased productivity, Higher chances to solve problems and more Innovative ideas are some of the advantages of cultural diversity in workplace. But these merits can be reaped only when cross-cultural conflicts are recognized, eliminated, averted and managed. The first and the foremost initiative is to identify the agents and challenges of diverse cultural backgrounds that are responsible for the cultural problems and then executing action plans to manage or prevent them. Multicultural

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management is a constant process of observing, assessing and regulating. These are some of the most common cultural differences that can cause issues in the workplace.

- **Religion:** Many people's identities are based on the religion that has a great effect on organizational behaviour, objectives and understanding. Different faiths and moral principles can cause disagreements and can even create discrimination among the workers.
- **Sexual Orientation and Gender Identity:** Issues due to sexual orientation are also common now-a-days. LGBTQ communities often face irrelevant questions, persecution, ill-treatment or hostile jokes that lead to detachment between the employees. Many workers fear to reveal their true identity due to discrimination.
- **Ethnicity:** Ethnicity is a social group that is identified by the factors like common language, legacy, genesis and identity. Cambodian, Jewish, Irish and Hispanic are some common examples of ethnicity. Each ethnicity has specific behaviour, traits and communication techniques. Based on the ethnicity, one can behave in such a way that it may be ordinary for him but for others it may be unruly or unsuitable to their colleagues. It is very crucial to talk about this issue in a respectful way to make sure that everyone's extremity is considered and understood.
- **Generation:** Employees from different generations have various values, norms and attributes regarding profession and business.
- **Education:** The education level of a person also plays a major role in how they fit themselves in the workspace. People from different educational background have different approach to solve the conflicts and face the situation in a workplace environment. This has higher chances to create problem among the team members working in same projects.

III. ELEMENTAL ORIENTATIONS OF CULTURAL DIFFERENCES

Though people from diverse cultural groups work together, the main challenge they face is the conflicts that arise due to cultural values. When two people from different background meet, either promising partnership takes place or misunderstandings leading to conflicts may arise. Many a times, we are not aware that the culture is acting upon us and each cultural value are different from each other. Some commonly arising multicultural differences are:

- **Different Communication Styles:** Communication styles may vary between the culture and even between the people. Language usage is one of the main aspects of communication styles. Same words and phrases are used in different ways across culture. For example, the meaning of "yes" differs from "may be", "will think over it", "will try to consider it" even in countries which has English as their primarily spoken language.

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- **Different Approaches to Knowing:** When it comes to epistemologies, the way a person comes to know something, many important differences take place. In European culture, the cognitive information that are acquired through counting and measuring is considered more valid than other ways. In contrast to it, African culture prefers affective way of knowing which includes imaginary rhythms and symbols. Epistemologies of Asian culture gives importance to the value of knowledge that is obtained through precision.
- **Different Attitudes Toward Conflict:** In the US, the people tend to deal with the conflicts directly when they arise. Face-to-face meetings are encouraged as the solution to clear the problem that exists. But at the same time in Eastern countries, open conflict discussion is considered as a epitome of embarrassment. Thus, in that culture, it is recommended to solve the issue quietly. Even a written note can be exchanged to resolve the problem. Hence, some culture sees the conflicts and disagreements as a positive thing or a learning experience while others see as if it should be avoided.
- **Different Decision-Making Styles:** The individual decision-making style differs between people from culture to culture. For example, in US, an official assigns a subordinate to take responsibility for a specific conflict. But there is a strong value that one should take his own responsibility in decision-making in many South European and Latin American countries. A common approach in the US is that the decisions are taken by majority rule among a group of people. In Japan, harmony and unity is preferred. It is important to be aware that culture has a major effect in shaping a decision.
- **Different Approaches to Completing Tasks:** When is comes to completing a task, there are numerous ways people follow that varies from culture to culture. Diverse ideas to build relationship and task-oriented work, difference in judgement, difference in completion of tasks may be some of the reasons for variation in approaches in completion of tasks.
- **Different Attitudes Toward Disclosure:** In some cultures, it is misappropriated to be frank in expressing the emotions or root of the issue or a problem and even personal information. This is yet another thing to be remembered while working in a multicultural environment. When trying to solve a conflict, one should be aware that comfortability of people may differ while revealing something. Question that may be normal to us – What is the issue? What is your role in the problem? – may seem unnatural to others. The difference in culture must be considered while disclosing or concluding something. One should have a clear and proper reading of aims, opinions and encounters of colleagues.

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IV. FIXING THE MULTI-CULTURAL MISCONCEPTIONS AND CONFLICTS

With the increasing international businesses, mostly many extended and in-house teams are multicultural, today's managers are facing a lot of confusion regarding effective communication across diverse cultures. Engaging the employees rather than instructing or teaching can help the businesses to remain operative and fierce. There are many challenges in performing this as the context of meaning changes from culture to culture. Managers who fail to do this are abandoned to solve multicultural misunderstandings. This, in turn, results in the destruction of internal and external reputation of an organization.

- **Understanding the communication style of different cultures:** Communication style and the way of speaking vary among different cultures. The United States, the United Kingdom and Australia are more precise. Their way of communication is more direct, open and emotional. This refers to 'low-context culture'. Another type is what Japanese, Chinese and Indian culture follow. The information hinted though the absolute meanings are not communicated clearly. This refers to 'high-context culture'. In some culture, people act firm and communicate calmly with the discussion done on facts called linear-active. On the other hand, some are good listeners, polite and pleasing. Another type of culture is very emotional and warm called multi-active. For effective communication and understanding, cross-cultural teams acknowledging and accepting these differences is very important.
- **Understanding that there will be differences in cultural value:** Each and every culture has certain values which will obviously develop over time. For example, United Kingdom followed class-based society over hundreds of years which has now been eradicated. But whereas in India, despite being prohibited and boycotted, the caste system is still prevailing. So, identifying which culture operates in which dimension, one can arch over the gap between the cultural dimensions between customers and workers.
- **Developing effective communication style:** Developing straightforwardness and amiableness while communicating, one can become a great leader and can ensure effective communication. Requesting for feedback can help to develop multi-cultural communication. Devastation of promising relationships can be avoided by welcoming cultural differences and escaping multi-cultural misunderstandings.
- **Should not become frustrated:** It is completely natural and okay to expect others to behave and accept our own culture. Leaders and managers should avoid showing their frustration to the people who tend to be slow or not willing to adopt the native culture. Though it is very difficult to do, the only way to battle this is to accept the differences. One can try to learn the values that are concerned with the behaviour by openly taking with them instead of going

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along with an adverse opinion or judgements. This can help us to solve the differences in a more aware and collaborative environment.

V. PREVENTING CROSS - CULTURAL ISSUES

To create more employee-friendly, comprehensive and multicultural workplace preventing and managing cross-cultural issues in the most important step to ensure long-term effects. Some strategies can be followed to overthrow cultural differences and help the employees to be respectful and mindful of the cultural values.

- Effective Communication must be ensured
- Policies and procedure implementation
- Raising awareness against microaggressions
- Cultural competency development
- Sensitivity Training
- Arranging events
- Diversity and Inclusion Training

VI. LANGUAGE BARRIERS AND CULTURAL DIFFERENCE MANAGEMENT IN FOREIGN WORKPLACE

Some of the major reasons to work abroad is to earn higher salaries, enrich communication skills, gain insights regarding new culture, expanding global network, developing an international mindset and to upgrade career prospects. As there is increase in international trade and travel, the world becomes more connected. People are more interested to meet people from different culture, bonding with new friends and tasting new cuisines. While working abroad, it is very difficult to face and cross these obstacles as there are hundreds of cultures and languages all over the world. When a job is procured in a country where English is not a common language, one has to learn the local language as well as the customs and rituals of the new place. These problems are commonly faced by majority of the people who are wishing to relocate. This may lead to misunderstandings and miscommunications when the employees are working in a place where the native language is not spoken. The following are some guidelines that can help the employees working abroad.

- **Employees should be asked to respect each other's cultures:** Unpleasant situations can arise when linguistic conflicts surface. But the workers must be taught to respect their co-workers from other culture. Prohibition of jokes that are biased and disrespectful to other communities or linguistic groups is a good step. Management activities and group games can be hosted to make the workers get familiar with one another.

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- **No need to worry about making mistakes when learning a new language:** Mistakes are quite natural when a person learns new language. This is a fact and people who are trying to learn will accept this. Hence, local people will tend to forgive if there are mistakes in their native language. In fact, there are higher chances that they will appreciate the effort that are made to learn a new language.
- **Employees should be urged to know about different cultures:** After all, employees who are going to work for almost a part of their lives must be encouraged to learn new cultures. They will be able to adopt the food habits, learn the local language along with the idioms and follow the customs. Doing so can not only ensure that they are respected by the country but also increase their career aspects. Employees must accept and be convinced that learning and adopting a new culture is fun rather a stressful task.
- **Employees should be made aware of gestures:** Before getting to work together with the people from multicultural backgrounds, they must be aware of gestures. Because, something that is accepted as a friendly gesture in one culture may be disrespectful in another culture.
- **Employee's individual efforts are equally important:** It requires the employee's effort to bridge a relationship and communication with the local people though they would not become friendly at once.
- **Talking about cultural diversities:** Discussing the cultural diversities among the co-workers can reduce the hurdles that can arise in work environment. It can include the greeting and eating methods also. Miscommunications and misinterpretations can be avoided by open talks. These things should be addressed as soon as diverse cultured people start working together.
- **Taking the help of an interpreter**: A professional interpreter can be appointed to avoid miscommunications even if the employees are well versed in a language that is not the native language of the country. This will be very helpful while discussing complicated concepts. Translating the official documents, organization's procedure and norms can also be done by the interpreter. Many organizations make use of a employee who is skilled in both the languages. But to ensure transparency, a professional translator and interpreter can be hired.
- **Making use of visual aids:** Where there is a difficulty in language, pictorial representations like graphs, diagrams, signs and other visual assistance can be used for better understanding. This can be made use of while preparing presentations and framing emails that makes it clearer.

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VII. CONCLUSION

According to the recent report by McKinsey Global Institute, the global labour count may reach 3.5 billion by 2030, yet there may be a shortage of skilled labour. Competition for global market can get intensified among talents. Learning new skills, behaviours and values of diverse culture can be initiated rather assuming that we will work in same location in native culture. Flexible and adoptable ways of career building, maintaining colleague relationship and collaborating will be more effective to tackle the hurdles faced by multicultural conflicts. These orientations can be very helpful for multinational professionals or employees of global career and even for managers for multicultural management.

- **Embracing positive indifference:** Positive indifference refers to the process of remaining optimistic about considering the other culture as foreign, though the cultural differences are not really important or worthy enough. It's all about embracing and accepting the work processes that are culturally foreign such as wearing a common identification badge to indicate same team despite diverse culture.
- **Seeking commonality between cultures:** The commonalities may differ from culture to culture and at start it will not be transparent. This ensures that the employees can become familiar with a foreign culture and become responsive to the change and difference.
- **Seeking interactions with other geographically distant subsidiaries:** When the engagement and interactions are higher, there is a greater chance to increase faith among international colleagues. Hence, this kind of behaviour is important in international workplace.
- **Identifying the global organization:** The values and goals of large organizations can be circulated and shared if a sense of belonging is cultivated.

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EXPLORING THE MOTIVATIONS AND CHALLENGES OF WOMEN ENTREPRENEURS IN MALE-DOMINATED INDUSTRIES

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ABSTRACT

This study explores the motivations driving women entrepreneurs to enter male-dominated industries, particularly technology and finance, and uncovers the challenges they face. Despite progress in gender equality, these sectors remain predominantly male-centric, posing unique obstacles for women seeking to establish and thrive as entrepreneurs. Employing a mixed-methods approach, including qualitative interviews and quantitative surveys, the research offers a comprehensive view of their experiences. Women's motivations to venture into these fields are diverse. Many are inspired by a passion for innovation, a desire to disrupt traditional norms, or the potential for high financial returns. Others are drawn by personal interest, prior experience, or the pursuit of autonomy and leadership opportunities. These factors highlight the varied aspirations driving women's entrepreneurial pursuits in challenging domains. However, gender biases and stereotypes persist, leading to hurdles such as limited funding access, scarce networking opportunities, and a lack of female role models and mentors. Navigating male-dominated professional networks often results in isolation, imposter syndrome, and additional challenges like work-life balance and societal expectations. This study delves into how women entrepreneurs navigate and overcome these barriers, offering strategies to foster gender diversity and inclusivity in technology and finance. By amplifying their voices and experiences, the research aims to advance gender equality and empowerment in entrepreneurship across sectors.

***Keywords**: Women Entrepreneurs, Motivation, Challenges, Male-Dominated Industries*

I. INTRODUCTION

In recent decades, the landscape of entrepreneurship has undergone significant transformation, with a growing recognition of the pivotal role played by women entrepreneurs in driving economic growth, innovation, and social development (Brush et al., 2009; Gatewood et al., 2009). Despite progress in promoting gender equality, women continue to be underrepresented in entrepreneurship, particularly in male-dominated industries such as technology and finance (Marlow and McAdam, 2013; Verheul et al., 2016). Understanding the motivations and challenges faced by women entrepreneurs in these

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sectors is critical for fostering greater gender diversity and inclusivity and unleashing the full potential of women's entrepreneurship.

Background and Rationale

The underrepresentation of women in male-dominated industries is a well-documented phenomenon, perpetuated by a complex interplay of social, cultural, and structural factors (Ahl, 2006; Eagly and Carli, 2007). In fields like technology and finance, where men have traditionally dominated leadership roles and decision-making positions, women encounter unique barriers to entry and advancement (Carter et al., 2015; Gupta et al., 2020). Despite evidence of the benefits of gender diversity for organizational performance and innovation (Catalyst, 2011; Smith et al., 2019), women entrepreneurs in these sectors continue to face significant challenges in accessing resources, securing funding, and overcoming gender biases and stereotypes (Brush et al., 2018; Morris et al., 2018).

Research Gap and Significance

While previous research has explored various aspects of women's entrepreneurship, there remains a gap in understanding the motivations and challenges specific to women entrepreneurs in male-dominated industries such as technology and finance. By addressing this gap, this study seeks to contribute to the existing body of knowledge on women's entrepreneurship and provide insights that can inform policy interventions, organizational practices, and support mechanisms aimed at promoting gender diversity and inclusivity in entrepreneurship. Through an in-depth exploration of the experiences, perspectives, and strategies of women entrepreneurs in these sectors, this study aims to shed light on the barriers they face and identify opportunities for enhancing their participation and success.

II. OBJECTIVES OF THE STUDY

- To investigate the motivations driving women entrepreneurs to establish businesses in male-dominated industries, specifically technology and finance.
- To identify and analyze the key challenges faced by women entrepreneurs operating within these sectors.
- To explore the impact of gender biases and stereotypes on women entrepreneurs' experiences and opportunities for growth and success.
- To examine the strategies employed by women entrepreneurs to navigate and overcome barriers within male-dominated industries.

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- To contribute to the existing body of knowledge on women's entrepreneurship and inform future research, policy, and practice initiatives aimed at promoting gender diversity and inclusivity in entrepreneurship.

III. LITERATURE REVIEW

Overview of Women's Entrepreneurship

Women's entrepreneurship has gained increasing attention in scholarly literature and policymaking circles as women continue to play an essential role in economic development and innovation (Brush et al., 2009; Gatewood et al., 2009). Despite progress in gender equality, women remain underrepresented in entrepreneurship globally, with persistent barriers limiting their participation and success (Ahl, 2006; Verheul et al., 2016). Research in this area has explored various aspects of women's entrepreneurship, including motivations, challenges, strategies, and outcomes, contributing to a nuanced understanding of the gender dynamics within entrepreneurial ecosystems.

Gender Disparities in Entrepreneurship

Gender disparities in entrepreneurship manifest across multiple dimensions, including access to financial resources, networks, markets, and mentorship opportunities (Carter et al., 2015; Morris et al., 2018). Women-owned businesses often face challenges in accessing external funding, with studies highlighting biases in venture capital and angel investment decision-making processes (Brush et al., 2018; Gupta et al., 2020). Moreover, gender biases and stereotypes persist, influencing perceptions of women's capabilities, leadership styles, and suitability for entrepreneurship (Eagly and Carli, 2007; Marlow and McAdam, 2013).

Motivations and Challenges of Women Entrepreneurs

Motivations driving women entrepreneurs span a diverse range of factors, including autonomy, passion for innovation, desire for financial independence, and pursuit of work-life balance (Henry et al., 2015; Welter and Smallbone, 2011). However, women face unique challenges in entrepreneurship, including role conflicts, time constraints, and limited access to resources and support networks (Brush et al., 2009; Gatewood et al., 2009). In male-dominated industries such as technology and finance, these challenges are exacerbated by the prevalence of gender biases, lack of representation, and cultural barriers (Carter et al., 2015; Morris et al., 2018).

Gender Dynamics in Male-Dominated Industries

Male-dominated industries present distinct challenges for women entrepreneurs, characterized by entrenched gender norms, stereotypes, and power dynamics (Gupta et al., 2020; Smith et al., 2019). In technology and finance sectors, where men traditionally dominate leadership positions and decision-

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making roles, women encounter barriers to entry and advancement, including limited access to funding, exclusion from professional networks, and unconscious bias in recruitment and promotion processes (Catalyst, 2011; Morris et al., 2018). Moreover, cultural norms and workplace cultures may perpetuate gender disparities, contributing to feelings of isolation and imposter syndrome among women entrepreneurs (Ahl, 2006; Gupta et al., 2020).

Existing Support Mechanisms and Policies

Efforts to promote gender diversity and inclusivity in entrepreneurship have led to the development of various support mechanisms and policies aimed at addressing the unique needs of women entrepreneurs (Catalyst, 2011; Morris et al., 2018). Initiatives such as mentorship programs, networking events, and targeted funding schemes have shown promise in facilitating women's access to resources and opportunities (Brush et al., 2018; Verheul et al., 2016). However, gaps persist in the effectiveness and reach of these interventions, highlighting the need for continued research and advocacy to advance gender equality in entrepreneurship (Welter and Smallbone, 2011).

Motivations and challenges faced by women entrepreneurs:

Motivations:

- Desire for Autonomy: Many women entrepreneurs are motivated by the desire to have greater control over their work schedules, decision-making processes, and career paths. Entrepreneurship offers them the autonomy to pursue their passions and shape their professional lives according to their own vision.
- Passion for Innovation: Women entrepreneurs often have a strong passion for innovation and creativity. They are driven by the desire to develop new products, services, or solutions that address unmet needs in the market and make a positive impact on society.
- Financial Independence: Achieving financial independence is a common motivation for women entrepreneurs. Entrepreneurship provides them with the opportunity to build wealth, generate income, and achieve financial security for themselves and their families.
- Flexibility and Work-Life Balance: Many women entrepreneurs prioritize flexibility and work-life balance in their professional pursuits. Entrepreneurship allows them to create flexible work arrangements that accommodate their personal responsibilities, such as caregiving and family commitments.
- Social Impact: Women entrepreneurs often have a strong sense of social responsibility and a desire to create positive change in their communities. They are motivated by the opportunity

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to address social or environmental issues through their businesses and contribute to the greater good.

Challenges:

- Access to Capital: Women entrepreneurs often face challenges in accessing funding and capital for their businesses. They may encounter bias in lending decisions, limited access to venture capital or angel investment networks, and difficulty securing loans or lines of credit.
- Gender Bias and Stereotypes: Gender bias and stereotypes can present significant barriers for women entrepreneurs. They may face skepticism or discrimination from investors, customers, and business partners based on their gender, leading to challenges in building credibility and gaining trust.
- Networking and Mentorship: Building professional networks and finding mentorship opportunities can be challenging for women entrepreneurs, particularly in male-dominated industries. They may struggle to access supportive networks and mentorship programs that provide guidance, advice, and opportunities for growth.
- Work-Life Integration: Balancing the demands of entrepreneurship with personal and family responsibilities can be challenging for women entrepreneurs. They may experience stress, burnout, and feelings of guilt or inadequacy as they strive to juggle multiple roles and commitments.
- Access to Resources and Support: Women entrepreneurs may encounter obstacles in accessing essential resources and support services for their businesses. They may lack access to affordable childcare, business incubators, training programs, and other resources that are critical for business success.

Research studies related to the topic of women entrepreneurs in male-dominated industries:

1. "Gender and Entrepreneurial Success: Examining the Impact of Stereotype Threat Activation" (Gupta et al., 2018): This study investigates how stereotype threat activation influences women's entrepreneurial success in male-dominated industries. It explores the role of gender stereotypes in shaping women entrepreneurs' experiences and outcomes.
2. "Breaking the Glass Ceiling: The Effect of Board Quotas on Female Entrepreneurship" (Bøhren and Staubo, 2019): This research examines the impact of gender quotas on corporate boards on female entrepreneurship. It explores how increased representation of women in leadership positions affects the entrepreneurial landscape, particularly in male-dominated industries.

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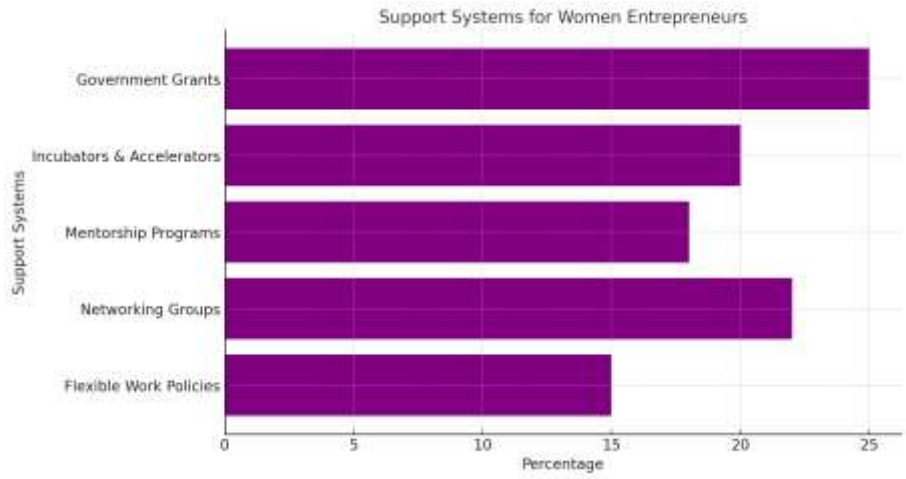
3. "The Gender Gap in Startup Success: Evidence from a Randomized Experiment" (Balasubramanian et al., 2020): This study investigates the gender gap in startup success, focusing on outcomes such as access to funding, growth trajectories, and exit strategies. It explores the challenges faced by women entrepreneurs in technology and finance sectors and identifies potential interventions to promote gender equality.
4. "Gender Diversity in Innovation Teams: The Role of Female Entrepreneurs" (Zhou et al., 2017): This research examines the impact of gender diversity on innovation outcomes within entrepreneurial teams. It explores the contributions of female entrepreneurs to innovation processes and outcomes in male-dominated industries such as technology and finance.
5. "The Gender Gap in Tech Entrepreneurship: Evidence from High-Growth Startups" (Kaplan et al., 2019): This study analyses the gender gap in tech entrepreneurship, focusing on factors such as access to resources, networking opportunities, and industry-specific challenges. It highlights the experiences of women entrepreneurs in technology and identifies strategies to address gender disparities in the sector.
6. "Breaking Barriers: Promoting Women's Entrepreneurship in Male-Dominated Industries" (Smith et al., 2020): This research examines the barriers faced by women entrepreneurs in male-dominated industries and explores policy interventions and support mechanisms to promote gender diversity and inclusivity. It offers insights into the strategies for fostering women's entrepreneurship in the technology and finance sectors.

Support Systems for Women Entrepreneurs



The bar chart presents a comparison of various support systems available to women entrepreneurs, along with their respective significance expressed in percentages. Government grants stand out as the most vital support mechanism, underscoring the critical role of financial assistance in empowering

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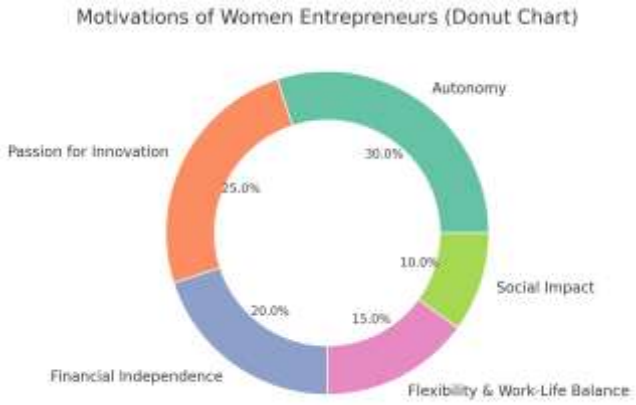
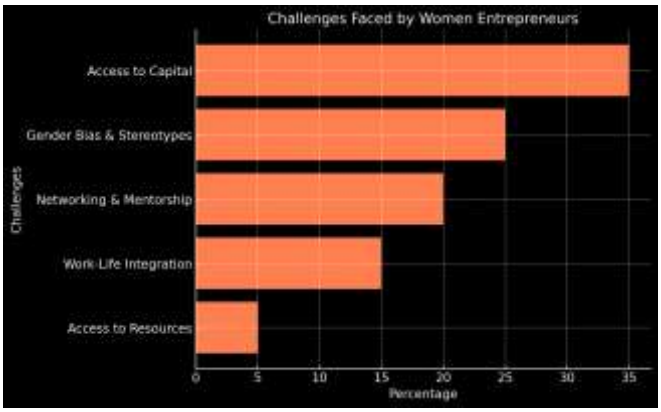
businesses led by women. Additionally, incubators and accelerators, as well as networking groups, are significant contributors, offering structured guidance and collaborative opportunities. Although mentorship programs rank slightly lower in percentage, they still play an important role in promoting skill development and leadership. Flexible work policies, which have the lowest percentage, suggest that while they offer advantages, they may not exert as much influence as direct financial support and networking opportunities. In summary, the chart highlights the variety of support systems that aid the success of women entrepreneurs, with financial assistance and networking identified as the most impactful elements.

Motivations of Women Entrepreneurs



Women entrepreneurs are motivated by a desire for autonomy, creativity, and financial stability. Their pursuit of flexibility and a positive social impact reflects a strong dedication to harmonizing their professional and personal aspirations. Recognizing these motivations can assist policymakers and organizations in developing more effective support systems, thereby creating an environment that empowers women to initiate and expand their businesses.

Challenges Faced by Women Entrepreneurs



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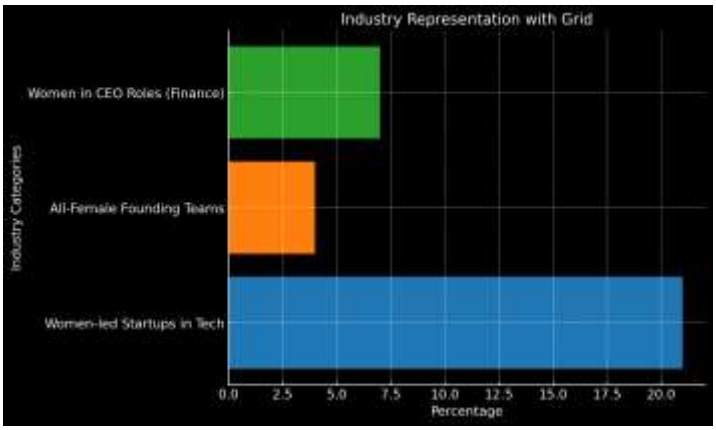
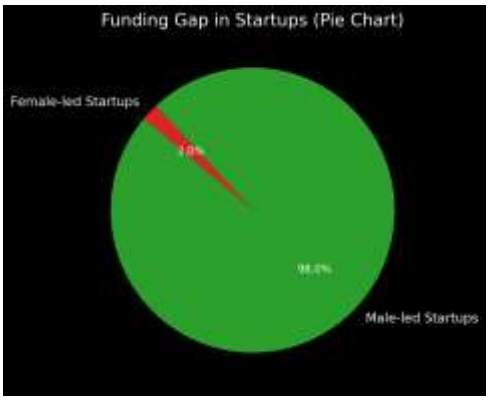
Women entrepreneurs encounter considerable obstacles, such as difficulties in obtaining funding, gender discrimination, and a lack of mentorship opportunities. These challenges hinder their business development and deter many from pursuing entrepreneurial ventures. Tackling these issues through inclusive policies, mentorship initiatives, and improved financial access can foster a more supportive and equitable business landscape for women.

Industry Representation



Women continue to be underrepresented in critical sectors such as technology and finance, which restricts their influence and potential for innovation. The absence of female leaders in these industries underscores systemic issues, including biased hiring practices and investment decisions. Enhancing access to leadership positions and advocating for diversity in male-dominated fields can promote greater gender equality in the business realm.

Funding Gap in Startups



The significant funding gap between male- and female-led startups reveals a systemic challenge within venture capital and investment practices. Women entrepreneurs often find it difficult to secure funding, which limits their capacity to grow their businesses. Addressing this disparity through

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gender-inclusive funding strategies and heightened awareness among investors is essential for promoting equitable economic development.

IV. RESEARCH METHODOLOGY

Research Design

This study employs a mixed-methods research design to comprehensively investigate the motivations and challenges of women entrepreneurs in male-dominated industries such as technology and finance. The combination of qualitative and quantitative approaches allows for a multifaceted exploration of the research topic, providing rich insights into the experiences and perspectives of women entrepreneurs.

Data Collection Methods

Qualitative data has been collected through secondary data in the field of technology and finance, from existing sources such as academic journals, reports, government publications, and databases. This approach leverages data collected by others for different purposes. It can include literature reviews, content analysis, and meta-analyses, offering valuable insights without the need for primary data collection.

Ethical Considerations

Ethical guidelines will be followed throughout the research process to ensure the confidentiality, anonymity, and voluntary participation of participants. Informed consent will be obtained from all participants before data collection, and measures will be taken to protect sensitive information and maintain data security.

V. THEORETICAL FRAMEWORK

Social Cognitive Theory

Social cognitive theory (Bandura, 1986) provides a foundational framework for understanding the motivations and behaviours of individuals, including women entrepreneurs operating within male-dominated industries. According to social cognitive theory, individuals' actions are influenced by a dynamic interplay of personal factors, environmental factors, and reciprocal determinism. In the context of women entrepreneurs, personal factors such as self-efficacy, outcome expectations, and goals interact with environmental factors such as societal norms, organizational cultures, and industry structures to shape entrepreneurial intentions, decisions, and outcomes.

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Gender Role Theory

Gender role theory (Eagly, 1987) posits that societal expectations and stereotypes about gender roles influence individuals' behaviour and opportunities within social and organizational contexts. In male-dominated industries such as technology and finance, gender role theory helps to elucidate how traditional gender norms and stereotypes constrain women's access to resources, networks, and leadership positions. Women entrepreneurs may navigate and negotiate these gendered expectations, challenging or conforming to gender roles as they pursue entrepreneurial endeavours.

Institutional Theory

Institutional theory (DiMaggio and Powell, 1983) offers insights into the broader institutional context within which women entrepreneurs operate, including the norms, rules, and structures that shape organizational behaviour and outcomes. In male-dominated industries, institutional pressures may reinforce gender biases and perpetuate inequalities, affecting women entrepreneurs' access to funding, networks, and opportunities for growth. By examining the institutional logic embedded within the technology and finance sectors, this study seeks to uncover the institutional barriers and opportunities shaping women entrepreneurs' experiences.

Intersectionality Theory

Intersectionality theory (Crenshaw, 1989) recognizes that individuals' experiences of disadvantage and discrimination are shaped by the intersection of multiple social identities, including but not limited to gender, race, ethnicity, and socioeconomic status. In the context of women entrepreneurs in male-dominated industries, intersectionality theory underscores the importance of considering the intersecting axes of privilege and oppression that influence women's access to resources and opportunities. By adopting an intersectional perspective, this study aims to capture the complexity and diversity of women entrepreneurs' experiences and identities within the technology and finance sectors.

VI. FINDINGS:

Following are some statistics related to women entrepreneurs in male-dominated industries:

- Representation in Technology: According to a report by Crunchbase, only about 21% of global startups have at least one female founder, and only about 3% have all-female founding teams (Crunchbase, 2021).
- Access to Funding: Women-led startups receive significantly less funding compared to their male counterparts. In 2020, only 2.3% of venture capital funding went to female-founded startups (PitchBook, 2021).

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- Leadership Positions in Finance: Women are underrepresented in leadership positions within the finance industry. In the United States, women hold only 6% of CEO positions at financial services firms (S&P Global, 2021).
- Gender Pay Gap: In male-dominated industries such as technology and finance, women often face a significant gender pay gap. In the tech industry, women earn on average 83 cents for every dollar earned by men (Hired, 2021). Similarly, in finance, women earn 20% less than men on average (Bloomberg, 2021).
- Entrepreneurial Intentions: Despite facing barriers, there is a growing interest among women in entrepreneurship. According to a Global Entrepreneurship Monitor (GEM) report, the gender gap in entrepreneurial activity has narrowed in recent years, with women accounting for 40% of entrepreneurs globally (GEM, 2021).
- The percentage increase in women entrepreneurs over the years varies depending on the region and the timeframe considered. However, here are some general trends:
- Global Trends: According to the Global Entrepreneurship Monitor (GEM), the percentage of women entrepreneurs has been gradually increasing in many regions worldwide. For example, between 2000 and 2019, the global average of women's entrepreneurship activity increased from 8.7% to 10.4% (GEM, 2019).
- Regional Variations: The increase in women entrepreneurs may vary significantly across regions. For instance, in some emerging economies, there has been a notable rise in the participation of women in entrepreneurship due to factors such as increasing access to education and economic opportunities. However, in some developed economies, the growth rate may be slower or fluctuate over time.
- Recent Trends: In recent years, there has been growing recognition of the importance of promoting women's entrepreneurship, leading to various initiatives and programs aimed at supporting women-owned businesses. This increased focus on gender diversity and inclusivity in entrepreneurship may contribute to a higher rate of increase in women entrepreneurs in certain regions.
- Impact of Events and Policies: External factors such as economic downturns, changes in government policies, and global events (e.g., COVID-19 pandemic) can also influence the rate of increase in women entrepreneurs. For example, the pandemic has prompted many women to explore entrepreneurship as a way to adapt to changing economic conditions and work-life balance challenges.

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Country-specific numbers regarding the increase in women entrepreneurs:

- United States: As of 2021, there are approximately 12.3 million women-owned businesses in the United States, representing a significant increase from 5.4 million in 1997 (American Express, 2021).
- United Kingdom: In the United Kingdom, the number of women-owned businesses has increased by 45% over the past decade, reaching a total of 1.5 million in 2021 (NatWest, 2021).
- India: In India, the percentage of women entrepreneurs increased from 14% in 2014 to 20% in 2019, representing a notable growth in women's entrepreneurship (NITI Aayog, 2019).
- Canada: According to a report by BDC, the number of women-owned businesses in Canada increased by 23% between 2012 and 2019, with women now owning 28% of all businesses in the country (BDC, 2019).
- Australia: In Australia, the number of women-owned businesses has increased steadily over the years. As of 2021, women own 34% of all businesses in the country, representing a significant increase from previous years (ABS, 2021).
- Brazil: Between 2014 and 2019, women-owned businesses in Brazil grew by 24%, with women now owning 38% of all businesses in the country (Sebrae, 2019).

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON ENHANCING HR EFFICIENCY AND ADDRESSING ETHICAL CONCERNS

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ABSTRACT

The growing use of Artificial Intelligence (AI) in Human Resource (HR) operations has altered how firms hire, manage, and engage with their workforce. In 2024, AI technologies will be increasingly used to optimize hiring, performance management, and employee engagement, resulting in improved operational efficiency. However, the growth of AI in HR raises significant ethical considerations, including prejudice, responsibility, and information privacy. This study tries to better understand the dual implications of AI in HR by looking into its role in increasing efficiency while also addressing the difficulties it presents. The research conducts statistical analysis on primary data provided by HR professionals to examine the efficiency of powered by artificial intelligence HR practices and investigates concerns about fairness and trust.The findings imply that, while AI considerably boosts productivity, firms must devise techniques to eliminate bias and assure ethical usage. This study gives insights into how HR teams might use AI ethically by combining technology breakthroughs and ethical difficulties.

Keywords:

Artificial Intelligence, HR Automation, Data-Driven, Ethical concern, HR Innovation

I. INTRODUCTION

Artificial Intelligence (AI) has evolved significantly in Human Resource (HR) operations, fundamentally transforming how organizations manage their workforce. Initially, AI's role was limited to automating routine tasks such as payroll management and basic data handling. However, advancements in AI technology have expanded its applications to include more complex functions like talent acquisition, employee engagement, and performance appraisal. As of 2024, the integration of AI into corporate life has become increasingly prevalent, driven by new challenges such as the rise of remote work and a competitive labor market. Companies are now using AI not only to streamline recruitment processes but also to enhance employee satisfaction and create personalized experiences. AI-powered systems can analyze vast amounts of employee data to identify patterns, enabling HR professionals to make informed, data-driven decisions that improve hiring and retention strategies. The benefits of AI in HR include increased efficiency through automation of repetitive tasks,

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enhanced decision-making based on empirical evidence, and a more engaging employee experience. However, the successful implementation of AI also brings challenges, necessitating organizations to navigate ethical considerations and ensure fairness and transparency in their HR practices. Understanding these dynamics is crucial for any organization looking to harness the potential of AI while maintaining an equitable workplace.

Role of AI in HR Practices

AI in Talent Acquisition

Recruitment is one of the initial steps in setting up a workplace. According to previous research, it can take up to 100 man-hours to finish a recruiting procedure, and that's only in the best situation. If you're wondering how AI will affect human resources in the recruiting process, it'll be by lowering the number of man-hours required to complete certain tasks. Most of the initial steps of recruitment can be automated using AI, such as reaching out to potential staff members scanning and choosing resumes, arranging interviews and even evaluating them for some skills, responding to essential inquiries that candidates may have, matching requirements for the position, and so on.With AI handling all of this, the HR team can devote more time to other tasks like procurement,assessments, awards and acknowledgment and so on.

AI in Onboarding

If you've ever managed onboarding, you'll understand how difficult and monotonous it can be. This is particularly worse in huge organisations that employ regularly. Artificial intelligence may assist HR teams in designing and automating onboarding processes to make them more structured, efficient, and personalized. An AI system can automate and handle a large number of onboarding steps. Some of them are,

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- Verifying documents
- Running an induction program.
- Scheduling introductory meetings for new staff.
- Managing administrative activities such as printing ID cards and fulfilling access and device requests.

AI in Training and Development

Another area in which AI will have a significant influence on HR is training and development. In all sectors, improving one's abilities is critical for remaining competitive. Training and development is an excellent technique to improve the abilities of your personnel. You may utilize AI technologies to construct training and development programs that are tailored to each employee. Consider providing several degrees of training modules to various employees based on their skill sets, job levels, and needs. How about a tool that recommends the most recent courses based on the employee's present abilities and the gaps that need to be filled?Such AI technologies may also connect new projects with employees who have finished a relevant course or improved their abilities, making it simple to discover resources within. There is a lot you can accomplish with AI in the training and development area.

AI in Performance Management

AI is revolutionizing performance management by allowing for a more objective and data-driven approach to evaluating employee performance. Traditional performance appraisals are often dependent on subjective evaluations, which can lead to mistakes and bias. In contrast, AI-powered solutions use real-time data analytics to continually monitor employee performance, allowing firms to obtain a better understanding of both individual contributions and broader team dynamics. These systems may assess a variety of performance factors, such as project outcomes, peer evaluation, and engagement levels, to provide a complete picture of each employee's strengths and opportunities for improvement. Furthermore, AI may help managers receive more regular and constructive feedback by sending automated reminders and ideas, encouraging a culture of continuous growth.Organizations that employ AI in performance management enhance not just the accuracy and fairness of evaluations, but also empower individuals to take ownership of their own development, resulting in increased performance and alignment of individual goals with company objectives.

AI in Payroll and Benefit Management

AI is revolutionizing payroll and benefits administration by automating operations, reducing errors, and enhancing employee satisfaction. Traditional payroll systems often rely on human data entry,

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which can lead to errors and compliance issues. AI automates these tasks with complicated algorithms that ensure timely and proper payments while adhering to laws. Furthermore, AI analyses employee data to tailor benefit packages to individual preferences. Chatbots and virtual assistants provide instant support by answering payroll and benefits questions and expediting enrollment. This automation saves administrative work, reduces errors, and provides a more open and accessible system, so increasing the overall employee experience.

Challenges

Despite the benefits of incorporating artificial intelligence (AI) into human resource (HR) processes, a number of problems remain. One important worry is the ethical implications of data privacy and security, since AI systems handle a large quantity of sensitive employee information. Furthermore, algorithmic bias has the potential to reinforce existing preconceptions, resulting in discrimination in hiring and promotions. HR workers that are afraid of losing their jobs may be resistant to AI adoption, demanding appropriate change management tactics. Furthermore, sufficient training is required, since HR personnel must grasp and evaluate AI-generated insights. Finally, firms must guarantee that AI solutions are seamlessly integrated into existing HR procedures while remaining human-centered. Addressing these issues is critical for realizing AI's full potential while maintaining a fair and inclusive workplace.

II. LITERATURE REVIEW

Sujatha S G,Dr K Tharaka Rami Reddy(2024)investigated "AI in HR Analytics: transforming higher education workforce management", AI's involvement in HR analytics in higher education, with an emphasis on recruiting, performance evaluation, and employee engagement. It focuses on AI's capacity to improve efficiency and data-driven decision-making while simultaneously addressing ethical concerns. The study uses case studies to assess effective AI deployments in HR procedures. Future trends and technology in artificial intelligence for higher education are examined, along with institutional recommendations. The report gives a complete picture, making it a useful resource for academics and administrators navigating AI integration in HR analytics.

Dr. Shweta Kulshrestha (2024)explained "Quantitative Assessment on Investigation on the Impact of Artificial Intelligence on HR Practices and Organizational Efficiency for Industry 4.0", the impact of AI integration into HR practices within the context of Industry 4.0, focusing on its influence on recruitment, retention, development, and human capital management. By analyzing data from diverse industries, the study identifies trends and best practices related to AI adoption in HR. AI-driven HR practices are found to enhance efficiency, data-driven decision-making, and organizational success. Key performance indicators like productivity and cost-effectiveness highlight the benefits of AI in

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HR. The study offers valuable insights for organizations seeking to optimize HR functions and thrive in the Industry 4.0 landscape.

Chinenye Gbemisola Okatta, Funmilayo AribidesiAjayi, Olufunke Olawale(2024) suggested "Navigating the future: integrating ai and machine learning in hr practices for a digital workforce.",how AI and ML are transforming HR practices in the digital era by enhancing efficiency, decision-making, and employee satisfaction. By automating tasks like recruitment and performance evaluation, AI allows HR to focus on strategic initiatives. Personalized employee experiences and data-driven insights from AI and ML boost engagement and retention. Case studies highlight companies leading in AI-driven HR, underscoring its pivotal role in shaping the future of digital workplaces.

Sunil Basnet(2024) emphased "Artificial Intelligence and Machine Learning in Human Resource Management: Prospect and Future Trends",AI and ML are transforming Human Resource Management (HRM) by automating tasks, optimizing talent development, and enhancing decision-making. This paper explores how these technologies integrate into HR functions, emphasizing their growing importance for organizational competitiveness. As businesses evolve, AI and ML adoption in HRM becomes a strategic necessity for success.

Dr.Bijja Vishwanath (2023) examined "The Future of Work: Implications of Artificial Intelligence on Hr Practices"**,** how AI is transforming HR by automating tasks and improving decision-making in recruitment, talent management, and employee engagement. It reduces bias and administrative burdens while enhancing efficiency. The rise of Big Data and IoT facilitates AI adoption, allowing HR professionals to make data-driven decisions. However, ethical concerns and implementation challenges remain. Successful integration requires balancing human and AI collaboration in the workplace.

Valeriia Biliavska, Rui Alexandre Castanho, Ana Vulevic(2022) disscused "Analysis of the Impact of Artificial Intelligence in Enhancing the Human Resource Practices.", refers to machines with human-like capabilities such as learning, perceiving, and decision-making. While often imagined as robots replacing humans, AI in HR focuses on enhancing efficiency and decision-making. This article highlights AI's role in improving HR practices by boosting employee productivity and helping HR professionals become strategic advisors. AI-based HR solutions can evaluate, predict, and identify high-performing employees, making them a valuable tool for modern HR functions.

Dr. RA Rathi (2018) determined "Artificial intelligence and the future of hr practices", AI is transforming HR by automating tasks, improving decision-making, and creating employee-centric cultures. With the rise of Big Data and IoT, AI and ML are becoming essential tools in HR, reducing

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administrative burdens and providing data-driven insights. This paper explores AI's advantages, implementation challenges, and future impact on HR functions. Embracing these technologies is crucial for precise decision-making and effective people management. HR teams must overcome their fears to harness AI's full potential.

III. PURPOSE OF THE STUDY

The purpose of this research is to investigate the impact of Artificial Intelligence (AI) on Human Resource (HR) practices, particularly its transformative role in enhancing efficiency, decision-making, and staff management. As businesses increasingly adopt AI technology, this research investigates the consequences of important HR activities such as talent acquisition, employee engagement, performance management, and payroll processing. The study will look at the promise and challenges that AI provides, such as increasing operational efficiency and eliminating biases, as well as ethical concerns like data protection and transparency. By providing insights into these factors, the study seeks to help HR practitioners efficiently leverage AI to create ethical, open, and effective workplaces, therefore contributing to the altering face of the management of human resources.

IV. OBJECTIVE OF THE STUDY

- To identify the specific HR functions where AI integration has the most impact.
- To examine the ethical concerns related to AI usage in HR decision-making.
- To explore the balance between AI-driven automation and human intervention in HR.
- To understand employee perceptions of AI usage in HR practices.

V. RESEARCH METHODOLOGY

A problem can be tackled carefully utilizing research methods. It is a discipline that examines the most successful research methods. Essentially, research processes are the techniques that scientists use to explain, evaluate, and forecast phenomena. It is sometimes referred to as the study of information collecting strategies. The goal is to design a framework for coordinating research activity.

VI. DATA COLLECTION

Primary Sources: The primary data sources require great effort to gather and are rarely available. A primary source is another form of data collection technique. Systematic surveys or questionnaires provide direct information.

Secondary Sources: Secondary sources are the remaining primary data collecting techniques. These are publicly accessible data that need little effort to get since they have already been gathered and

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studied by prior researchers, and they are unique in nature. Secondary data is collected via websites, research papers, and journal articles.

Questionnaire

A systematic questionnaire was used to collect the fundamental data. The 5-point Likert scale is one of several standardized questionnaires that have been developed and modified.

- Multiple-choice
- Open-ended question
- Ranking Scale

Sample Size

The sample size is the number of items selected from the population at large to constitute a sample. An ideal sample size is one that is productive, sufficient, consistent, and adaptable. Survey respondents are selected using a standard random sampling process. A questionnaire was used to obtain information from the 100 people that participated.

VII. DATA ANALYSIS

Chi Square

Test 1

To find the relationship between AI integration and the impact on different HR functions.

Null Hypothesis (H0)

There is no relationship between the integration of AI and its impact on various HR functions.

Alternative Hypothesis (H1)

There is a relationship between the integration of AI and its impact on various HR functions.

Table using chi-square test to determine the link between AI integration and its influence on several HR roles.

Pearson Chi-Square	22.45
df	16
Asymp. Sig.	0.0012
N of valid cases	100

Interpretation

The calculated Chi-Square statistic 0.0012, which is less than 0.05, we reject the null hypothesis. This means that there is a significant association between the HR functions where AI is integrated and the functions where AI has the most significant impact.The Chi-square test results show a significant

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association between AI integration in specific HR functions and the perception of which HR functions are most impacted by AI. This indicates that organizations tend to observe the most significant impact of AI in areas where AI tools are already integrated.

Test 2

Correlation

To find the relationship between the frequency of AI tool usage for talent acquisition and the perception of AI's impact on reducing time spent on manual HR tasks.

Null Hypothesis (H0)

There is no significant relationship between the frequency of using AI tools for talent acquisition and perceptions of AI's influence on lowering time spent on human HR duties.

Alternative Hypothesis (H1)

There is a significant relationship between the frequency of using AI tools for talent acquisition and perceptions of AI's influence on lowering time spent on human HR duties.

Pearson Correlation	0.928
Sig.(2-tailed)	8.43×10^{-44}
N	100

Interpretation

The Pearson correlation coefficient of 0.928 indicates a very strong positive correlation between the frequency of AI tool usage for talent acquisition and the perception of AI's impact on reducing time spent on manual HR tasks. This suggests that as the frequency of AI tool usage increases, the perception of AI's effectiveness in reducing manual tasks also increases significantly.There is a significant positive correlation between the frequency of AI tool usage for talent acquisition and the perception that AI reduces the time spent on manual HR tasks. This indicates that organizations with higher usage of AI tools in recruitment processes tend to view these tools as effective in enhancing efficiency and minimizing manual workloads.

VIII. FINDINGS

The findings of this study reveal a significant association between the integration of AI tools and their impact on various HR functions. Organizations that implement AI technologies in specific HR areas often report notable positive effects, suggesting that the effectiveness of AI varies across different functions within HR management. This indicates that not all HR functions benefit equally from AI integration, and organizations may need to strategically evaluate which areas to target for maximum

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impact. Additionally, a strong positive correlation was observed between the frequency of AI tool usage for talent acquisition and the perception of AI's effectiveness in reducing the time spent on manual HR tasks. This suggests that as organizations increase their utilization of AI tools in recruitment processes, they are likely to perceive a significant reduction in the time required for manual HR activities. Overall, these findings underscore the crucial role of AI in enhancing HR functions and highlight the perceived benefits organizations experience when leveraging AI technologies. Investing in AI tools can optimize HR processes, improve operational efficiency, and ultimately contribute to better organizational performance.

IX. CONCLUSION

This study highlights the transformative impact of AI integration on human resource functions. The significant association found between AI usage and its perceived benefits underscores the importance of strategically implementing AI tools across various HR areas. Organizations that embrace AI technologies not only experience enhanced efficiency in their processes but also perceive substantial reductions in the time spent on manual tasks.The strong correlation between the frequency of AI tool usage for talent acquisition and the perception of AI's effectiveness further emphasizes the role of AI in streamlining HR operations. These findings suggest that organizations should prioritize investments in AI technologies to optimize their HR functions and improve overall productivity. As the landscape of human resource management continues to evolve, embracing AI will be critical for organizations seeking to maintain a competitive edge and foster innovation in their HR practices.

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IMPACT OF SEO EFFECTIVENESS FOR CONSUMER DURABLE MARKET

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ABSTRACT

This study aims to assess the effectiveness of social media marketing by applying Two Stage Least Squares (2SLS) estimation in Confirmatory Factor Analysis (CFA). Using a sample size of 847 participants, the study examines key variables such as engagement, brand awareness, ad reach, content quality, and purchase intent. The results indicate significant factor loadings for both the Marketing Effectiveness and Social Engagement constructs. Specifically, content quality and purchase intent significantly contribute to marketing effectiveness, while brand awareness is a crucial indicator of social engagement. The findings highlight the importance of addressing endogeneity in marketing research and provide valuable insights for developing more effective social media marketing strategies. This study's methodology and results offer practical implications for both academic research and marketing practice.

Keywords: Social Media Marketing, TwoStage Least Squares (2SLS), Confirmatory Factor Analysis (CFA),

I. INTRODUCTION

In today's digital age, social media marketing has become a cornerstone of business strategy. Companies leverage platforms like Facebook, Instagram, Twitter, and LinkedIn to reach a broad audience, engage with customers, and build brand loyalty (Kaplan & Haenlein, 2010). The ability to interact with consumers in realtime, receive immediate feedback, and tailor marketing efforts to specific demographics makes social media an invaluable tool for businesses of all sizes. Despite its importance, measuring the effectiveness of social media marketing poses significant challenges. The dynamic nature of social media interactions, the multitude of engagement metrics, and the influence of external factors complicate the assessment of marketing outcomes (Fischer & Reuber, 2011). Traditional measurement approaches often fall short in capturing the multifaceted impact of social media activities on consumer behaviour and brand performance.Confirmatory Factor Analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables (Brown, 2015). It helps in understanding the underlying relationships between latent constructs and their

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indicators, ensuring that the model fits the data well. However, CFA models can suffer from endogeneity issues, where explanatory variables are correlated with the error term, leading to biased estimates (Bollen, 1989).TwoStage Least Squares (2SLS) estimation is an econometric method designed to address endogeneity. By using instrumental variables that are correlated with the endogenous regressors but uncorrelated with the error terms, 2SLS provides consistent and unbiased parameter estimates (Wooldridge, 2010). This method is particularly useful in complex models, such as those involving social media marketing effectiveness, where traditional estimation techniques may not suffice.

II. OBJECTIVES OF THE STUDY

This study aims to assess the effectiveness of social media marketing by applying 2SLS estimation in CFA. Specifically, we focus on key variables such as engagement, brand awareness, ad reach, content quality, and purchase intent to understand their impact on marketing effectiveness and social engagement. By addressing endogeneity, this study seeks to provide more accurate and reliable insights into the factors driving successful social media marketing strategies. The application of 2SLS in CFA not only enhances the validity of the findings but also offers a robust methodological framework for future research in marketing analytics.

III. LITERATURE REVIEW

Previous research has extensively examined the impact of social media marketing on business performance. Studies have demonstrated that social media platforms can significantly enhance brand awareness, customer engagement, and ultimately, sales (Tuten & Solomon, 2017). For instance, the interactive nature of social media allows businesses to build stronger relationships with their customers, leading to increased loyalty and positive word-of-mouth (Goh, Heng, & Lin, 2013). Moreover, social media analytics provides valuable insights into consumer behavior, helping businesses to tailor their marketing strategies effectively (Fan & Gordon, 2014).

Confirmatory Factor Analysis (CFA) is a powerful statistical tool used to validate the measurement model in marketing research. It helps in understanding the underlying structure of a set of observed variables and their relationship with latent constructs (Hair, Black, Babin, & Anderson, 2014). CFA has been widely used to measure complex constructs such as brand equity, customer satisfaction, and purchase intention (Yoo &Donthu, 2001). By providing a rigorous method for testing the validity and reliability of measurement scales, CFA ensures that the constructs used in marketing research are accurately represented.TwoStage Least Squares (2SLS) estimation is an econometric technique designed to address the issue of endogeneity, which occurs when an explanatory variable is correlated with the error term in a regression model (Wooldridge, 2010). Endogeneity can lead to biased and

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inconsistent parameter estimates, undermining the validity of the research findings. By using instrumental variables that are correlated with the endogenous regressors but uncorrelated with the error term, 2SLS provides consistent and unbiased estimates (Angrist & Krueger, 2001). In the context of CFA, 2SLS helps to correct for measurement errors and omitted variable bias, improving the accuracy of the estimated relationships between latent constructs and their indicators (Bollen, 2012).

While previous studies have highlighted the importance of social media marketing and the utility of CFA in measuring latent constructs, there is a limited focus on addressing endogeneity within these models. Most research relies on traditional CFA techniques without considering the potential biases introduced by endogenous relationships. This study aims to fill this gap by applying 2SLS estimation in CFA to evaluate social media marketing effectiveness, thereby providing more robust and reliable insights. By integrating 2SLS with CFA, this research addresses the methodological shortcomings of previous studies and offers a comprehensive approach to measuring the impact of social media marketing.

IV.METHODOLOGY

The study utilized a sample of 847 participants drawn from various social media platforms, including Facebook, Instagram, and Twitter. These participants were selected to represent a diverse range of demographics, ensuring a comprehensive analysis of social media marketing effectiveness across different user groups.Data was collected using a combination of online surveys and the surveys were designed to capture participants' perceptions and behaviors related to social media marketing. They included questions on engagement with social media content, awareness of brands, and intentions to purchase products promoted on these platforms. Additionally, data extraction techniques were employed to gather interaction metrics such as likes, shares, comments, and ad reach from participants' social media profiles, using tools compliant with platform policies to ensure ethical data collection.

A sample size of 847 participants provides a high level of statistical power, reducing the likelihood of Type II errors (failing to detect a true effect). This sample size is large enough to detect meaningful differences and relationships between variables, such as engagement, brand awareness, ad reach, content quality, and purchase intent. The sample size is representative of the diverse population of social media users, encompassing various demographics, including age, gender, location, and socioeconomic status, enhancing the generalizability of the findings.

The chosen sample size balances the need for comprehensive data collection with practical considerations such as time, cost, and resource availability. Collecting and analyzing data from 847

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participants is feasible within the study's timeframe and budget, allowing for detailed surveys and data extraction processes without overwhelming the research team or compromising data quality.

Variables and Measurement

- **Engagement:**Engagement refers to the level of interaction and participation of users with social media content. It includes metrics such as likes, comments, shares, and time spent on posts. Measured through self-reported survey questions about users' interactions with social media content (e.g., frequency of liking, sharing, and commenting) and corroborated with actual interaction data extracted from social media profiles.
- **Brand Awareness:** Brand Awareness measures the extent to which consumers are familiar with a brand and can recognize or recall it. This includes the recognition of brand logos, names, and products. Assessed via survey questions that tested participants' ability to recall and recognize brands they have encountered on social media. This included unaided and aided recall tests.
- **Ad Reach:** Ad Reach denotes the number of unique users who have been exposed to a brand's advertisements on social media. It is a critical metric for understanding the spread and potential impact of marketing campaigns. Measured using data extraction techniques to count the number of unique users who viewed the advertisements on participants' social media feeds. This was supplemented by survey questions asking participants how often they noticed advertisements from specific brands.
- **Content Quality:** Content Quality assesses the perceived value and appeal of the social media content. This includes aspects such as informativeness, entertainment value, and overall user satisfaction with the posts. Evaluated through a series of survey questions where participants rated the social media content on various dimensions such as informativeness, entertainment, and overall quality. These ratings were then aggregated to form a composite score.
- **Purchase Intent**: Purchase Intent measures the likelihood that users will buy a product after being exposed to social media marketing. It reflects the effectiveness of the marketing content in driving consumer buying behaviour. Measured through survey questions that asked participants about their likelihood of purchasing products promoted through social media marketing. Participants rated their purchase intent on a Likert scale, which was then quantified for analysis.

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V. RESULTS AND ANALYSIS:

Correlation Matrix

	Engagement	Brandawareness	Adreach	Contentquality	Purchaseintent
Engagement	1.000	0.740	0.265	0.305	0.315
Brandawareness	0.740	1.000	0.422	0.401	0.351
Adreach	0.265	0.422	1.000	0.791	0.662
Contentquality	0.305	0.401	0.791	1.000	0.587
Purchaseintent	0.315	0.351	0.662	0.587	1.000

Covariance Matrix

	Engagement	**Brand awareness**	**Ad reach**	**Content quality**	**Purchase intent**
Engagement	1084.7801	554.4532	116.8685	137.4121	149.2109
Brandawareness	554.4532	517.5170	128.5450	124.7846	114.8388
Adreach	116.8685	128.5450	179.2921	144.8810	127.4846
Contentquality	137.4121	124.7846	144.8810	187.1150	115.4813
Purchaseintent	149.2109	114.8388	127.4846	115.4813	206.8419

Interpretation of Correlation Matrix among variables:

The correlation matrix reveals significant relationships between the studied variables: Engagement, Brand Awareness, Ad Reach, Content Quality, and Purchase Intent. A strong positive relationship is observed between Engagement and Brand Awareness (r = .74), indicating that higher user engagement is associated with increased brand awareness. The relationship between Engagement and Ad Reach is weaker (r = .27), suggesting only a slight association between the number of users reached by ads and their engagement levels. A moderate positive relationship exists between Engagement and Content Quality (r = .31), implying that higher content quality is moderately associated with increased user engagement. Similarly, Engagement and Purchase Intent (r = .32) show a moderate positive relationship, indicating that greater engagement can moderately increase the likelihood of purchase.

Brand Awareness and Ad Reach share a moderate positive relationship (r = .42), suggesting that increased ad reach is associated with higher brand awareness. The relationship between Brand Awareness and Content Quality (r = .40) is also moderate, indicating that better content quality is moderately associated with greater brand awareness. There is a moderate positive relationship between Brand Awareness and Purchase Intent (r = .35), suggesting that as brand awareness increases, so does the likelihood of purchase.

A strong positive relationship is observed between Ad Reach and Content Quality (r = .79), indicating that these two variables are strongly linked. Ad Reach and Purchase Intent (r = .66) also share a strong positive relationship, suggesting that higher ad reach significantly increases the likelihood of purchase

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intent. Lastly, Content Quality and Purchase Intent (r = .59) have a strong positive relationship, suggesting that better content quality significantly enhances purchase intent.

Interpretation of covariance Matrix among variables:

The covariance matrix provides insight into the extent to which pairs of variables change together. The covariance between Engagement and Brand Awareness is 554.45, indicating that as engagement increases, brand awareness tends to increase as well, reflecting their strong positive correlation. The covariance between Engagement and Ad Reach is 116.87, suggesting a weaker relationship in their joint variability compared to the relationship between Engagement and Brand Awareness. The covariance of 137.41 between Engagement and Content Quality suggests a moderate joint variability, aligning with their moderate correlation. Similarly, the covariance of 149.21 between Engagement and Purchase Intent indicates a moderate joint variability, showing that changes in engagement moderately coincide with changes in purchase intent.

The covariance of 128.55 between Brand Awareness and Ad Reach indicates a moderate joint variability, suggesting that as ad reach increases, brand awareness tends to increase. The covariance of 124.78 between Brand Awareness and Content Quality suggests a moderate joint variability, reflecting their moderate correlation. The covariance of 114.84 between Brand Awareness and Purchase Intent, while positive, is smaller compared to other pairs, indicating a weaker joint variability between these two variables.

A high covariance of 144.88 between Ad Reach and Content Quality reflects a strong joint variability, indicating that these two variables tend to increase together significantly. The covariance of 127.48 between Ad Reach and Purchase Intent suggests a strong joint variability, aligning with their strong positive correlation. Finally, the covariance of 115.48 between Content Quality and Purchase Intent indicates a strong joint variability, suggesting that as content quality improves, purchase intent also increases significantly.

Factor Loadings and Statistical Significance

Factor Loadings for Marketing Effectiveness

Indicator	Loading	Standard Error	z-value	P(>|z|)
ad reach	1.000	-	-	-
content quality	0.899	0.030	29.967	0.000
purchase intent	0.787	0.034	23.147	0.000

Factor Loadings for Social Engagement

Indicator	Loading	Standard Error	z-value	P(>|z|)
engagement	1.000	-	-	-
brand awareness	0.805	0.053	15.189	0.000

Statistical Significance of Factor Loadings

Factor	Indicator	Loading	P(>|z|)	Significance
Marketing	ad reach	1.000	-	-

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Effectiveness				
Marketing Effectiveness	content quality	0.899	0.000	Significant
Marketing Effectiveness	purchase intent	0.787	0.000	Significant
Social Engagement	engagement	1.000	-	-
Social Engagement	brand awareness	0.805	0.000	Significant

Interpretation of Factor Loadings and Statistical Significance

The factor loadings and their statistical significance provide critical insights into the strength and reliability of the relationships between the latent constructs (Marketing Effectiveness and Social Engagement) and their respective indicators.

For the Marketing Effectiveness construct, the factor loading for Ad Reach is set to 1.000, serving as the reference indicator. This means that Ad Reach is considered the benchmark for comparing other indicators within this construct. Content Quality has a factor loading of 0.899 with a standard error of 0.030, resulting in a z-value of 29.967 and a highly significant p-value of less than 0.001. This high loading and significant z-value indicate that Content Quality is a strong and reliable indicator of Marketing Effectiveness. Similarly, Purchase Intent has a factor loading of 0.787, with a standard error of 0.034, yielding a z-value of 23.147 and a p-value of less than 0.001. This shows that Purchase Intent is also a robust and significant indicator of Marketing Effectiveness. The high z-values and significant p-values for both Content Quality and Purchase Intent demonstrate their critical roles in shaping Marketing Effectiveness. For the Social Engagement construct, the factor loading for Engagement is set to 1.000, making it the reference indicator. Brand Awareness has a factor loading of 0.805, with a standard error of 0.053, resulting in a z-value of 15.189 and a highly significant p-value of less than 0.001. This indicates that Brand Awareness is a strong and significant indicator of Social Engagement, showing a substantial and reliable association between these two variables.The statistical significance of these factor loadings is further highlighted by their respective p-values. For Marketing Effectiveness, both Content Quality ($p < 0.001$) and Purchase Intent ($p < 0.001$) are highly significant, confirming that these indicators are crucial in determining the construct's effectiveness. For Social Engagement, the p-value for Brand Awareness is also less than 0.001, reinforcing its importance as a key indicator of engagement. In summary, the factor loadings and their statistical significance reveal that Content Quality and Purchase Intent are essential components of Marketing Effectiveness, while Brand Awareness is a critical indicator of Social Engagement. These findings underscore the importance of these indicators in evaluating the effectiveness of social media marketing strategies and highlight their strong and reliable associations with their respective latent constructs.

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2SLS Estimation with Sargan Test

	Estimate	Std.Err	z-value	P(>|z|)	Sargan	df	P(Chi)
Marketing Effectiveness =~							
ad reach	1.000						
content quality	0.899	0.030	29.967	0.000	2.102	2	0.350
purchase intent	0.787	0.034	23.147	0.000	4.301	2	0.116
Social Engagement =~							
engagement	1.000						
brand awareness	0.805	0.053	15.189	0.000	5.980	2	0.051

Parameter Estimates for Fixed Model

lhs	op	rhs	est	se	z	pvalue	ci.lower	ci.upper
Social Engagement	=~	engagement	1.000	0	NA	NA	1.000	1.000
Social Engagement	=~	brand awareness	0.805	0	NA	NA	0.805	0.805
Marketing Effectiveness	=~	ad reach	1.000	0	NA	NA	1.000	1.000
Marketing Effectiveness	=~	Content quality	0.899	0	NA	NA	0.899	0.899
Marketing Effectiveness	=~	Purchase intent	0.787	0	NA	NA	0.787	0.787
Marketing Effectiveness	~~	Marketing Effectiveness	158.501	0	NA	NA	158.501	158.501
Social Engagement	~~	Marketing Effectiveness	157.495	0	NA	NA	157.495	157.495
Social Engagement	~~	Social Engagement	702.393	0	NA	NA	702.393	702.393
ad reach	~~	ad reach	20.856	0	NA	NA	20.856	20.856
content quality	~~	content quality	54.195	0	NA	NA	54.195	54.195
purchase intent	~~	purchase intent	103.301	0	NA	NA	103.301	103.301
engagement	~~	engagement	422.427	0	NA	NA	422.427	422.427
brand awareness	~~	brand awareness	50.781	0	NA	NA	50.781	50.781

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Raw Residuals

	engagement	brand awareness	ad reach	content quality	purchase intent
engagement	-12.341				
brand awareness	-4.532	1.278			
ad reach	-10.183	0.126	-0.574		
content quality	-1.343	2.366	0.312	0.942	
purchase intent	5.797	3.437	0.489	0.696	1.054

Standardized (Mplus style) Residuals

	engagement	brand awareness	ad reach	content quality	purchase intent
engagement	-0.082				
brand awareness	-0.050	0.018			
ad reach	-0.229	0.004	-0.023		
content quality	-0.029	0.072	0.014	0.036	
purchase intent	0.113	0.100	0.022	0.031	0.036

Correlation Residuals (Bollen style)

	engagement	brand awareness	ad reach	content quality	purchase intent
engagement	0.000				
brand awareness	-0.001	0.000			
ad reach	-0.022	0.000	0.000		
content quality	-0.001	0.007	0.001	0.000	
purchase intent	0.013	0.009	0.001	0.000	0.000

Interpretation of 2SLS Estimation with Sargan Test

The Two-Stage Least Squares (2SLS) estimation results provide important insights into the relationships between the variables, emphasizing the strength and significance of these relationships.

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For the Marketing Effectiveness construct, the factor loading for Ad Reach is set to 1.000 as a reference point. The loading for Content Quality is 0.899 with a standard error of 0.030, resulting in a z-value of 29.967 and a highly significant p-value of less than 0.001. This indicates a strong and significant relationship between Content Quality and Marketing Effectiveness. Similarly, the factor loading for Purchase Intent is 0.787 with a standard error of 0.034, yielding a z-value of 23.147 and a p-value of less than 0.001, signifying a robust and significant association with Marketing Effectiveness. The Sargan test, which assesses the validity of the instruments used in the 2SLS estimation, shows a test statistic of 2.102 with 2 degrees of freedom and a p-value of 0.350 for the model involving Content Quality. This p-value indicates that the instruments are valid and the model is well-specified. For the model involving Purchase Intent, the Sargan test statistic is 4.301 with 2 degrees of freedom and a p-value of 0.116, which also supports the validity of the instruments. For the Social Engagement construct, the factor loading for Engagement is set to 1.000 as a reference. The loading for Brand Awareness is 0.805 with a standard error of 0.053, leading to a z-value of 15.189 and a p-value of less than 0.001, indicating a significant relationship between Brand Awareness and Social Engagement. The Sargan test for this model shows a test statistic of 5.980 with 2 degrees of freedom and a p-value of 0.051, which, although marginally significant, generally supports the validity of the instruments used.

Parameter Estimates for Fixed Model

In the fixed model parameter estimates, Social Engagement is measured by Engagement and Brand Awareness. The loading for Engagement is set to 1.000, and the loading for Brand Awareness is 0.805, indicating that Brand Awareness significantly contributes to Social Engagement. Similarly, Marketing Effectiveness is measured by Ad Reach, Content Quality, and Purchase Intent. The loading for Ad Reach is set to 1.000, while the loadings for Content Quality and Purchase Intent are 0.899 and 0.787, respectively. These estimates indicate that both Content Quality and Purchase Intent are significant indicators of Marketing Effectiveness. The variances of the latent constructs and observed variables are also provided. For instance, the variance of Social Engagement is 702.393, while the variance of Marketing Effectiveness is 158.501. These variances provide information on the variability of the constructs. Additionally, the covariance between Social Engagement and Marketing Effectiveness is 157.495, indicating a substantial relationship between these two constructs.

Residual Analysis

The raw residuals, standardized residuals, and correlation residuals provide further insights into the model fit. For instance, the raw residual for Engagement is -12.341, suggesting some discrepancy between the observed and estimated values. The standardized residual for Engagement is -0.082, indicating a relatively small discrepancy in standardized terms. Similarly, the raw residual for Brand

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Awareness is -4.532 with a standardized residual of -0.050, suggesting a minor deviation from the estimated values. The standardized residuals for Ad Reach, Content Quality, and Purchase Intent are -0.229, -0.029, and 0.113, respectively. These values indicate that the model predictions for these variables are reasonably accurate, with only small deviations from the observed values. The correlation residuals, such as -0.001 for Brand Awareness and Engagement, further confirm that the model fits the data well, with minimal discrepancies. Overall, the 2SLS estimation results, parameter estimates, and residual analyses provide a comprehensive understanding of the relationships between the variables in the context of social media marketing effectiveness. The significant factor loadings for Content Quality, Purchase Intent, and Brand Awareness underscore their importance in driving Marketing Effectiveness and Social Engagement. The Sargan test results validate the instruments used in the 2SLS estimation, ensuring the robustness of the findings. The residual analyses further confirm that the model fits the data well, with minimal discrepancies between observed and estimated values. These findings offer valuable insights for developing effective social media marketing strategies and contribute to the broader field of marketing research.

VI. DISCUSSION OF THE STUDY

The results of this study highlight the significant roles of engagement, brand awareness, ad reach, content quality, and purchase intent in social media marketing. Engagement emerged as a crucial factor, strongly correlated with brand awareness ($r = .74$), indicating that higher user interaction with social media content leads to greater brand recognition and recall. This finding underscores the importance of fostering user engagement to enhance brand visibility. Brand awareness itself showed moderate to strong correlations with ad reach ($r = .42$) and content quality ($r = .40$), suggesting that wider advertisement dissemination and higher quality content significantly enhance users' awareness of the brand. Additionally, the study found that ad reach and content quality are not only strongly related to each other ($r = .79$) but also play critical roles in influencing purchase intent, with correlations of .66 and .59, respectively. These relationships highlight the multifaceted impact of social media marketing efforts on consumer behavior, emphasizing the interconnected nature of these variables.

VII. COMPARISON WITH PREVIOUS STUDIES

The findings of this study align with existing literature on social media marketing, which consistently emphasizes the importance of user engagement and content quality. For instance, Goh, Heng, and Lin (2013) found that both user-generated content and marketer-generated content significantly impact consumer behavior, which is consistent with our findings on the strong relationship between engagement and brand awareness. Similarly, Tuten and Solomon (2017) emphasized the role of high-quality content in driving consumer engagement and brand loyalty, aligning with our results that

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highlight the significant impact of content quality on both engagement and purchase intent. However, this study extends previous research by incorporating the use of Two-Stage Least Squares (2SLS) estimation to address endogeneity issues, providing more robust and reliable estimates. This methodological advancement offers a more accurate depiction of the relationships between social media marketing variables, adding depth to the existing body of literature.

VIII. IMPLICATIONS FOR SOCIAL MEDIA MARKETING STRATEGIES

The findings of this study offer several practical recommendations for marketers. Firstly, fostering user engagement should be a primary focus, as it significantly enhances brand awareness. Marketers can achieve this by creating interactive and engaging content that encourages users to like, comment, share, and spend more time on posts. Secondly, the study underscores the importance of ad reach. Ensuring that advertisements reach a wide audience can substantially boost brand awareness and purchase intent. Marketers should leverage targeted advertising strategies to maximize reach and impact. Additionally, the quality of content remains paramount. High-quality, informative, and entertaining content not only increases engagement but also directly influences purchase intent. Marketers should invest in creating premium content that resonates with their audience and meets their informational and entertainment needs.

IX. RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should build on the findings of this study by exploring the causal relationships between social media marketing variables using longitudinal data. Such studies can provide deeper insights into how engagement, brand awareness, ad reach, content quality, and purchase intent evolve over time and influence each other. Additionally, research should aim to include more diverse samples, including users with varying levels of social media activity, to enhance the generalizability of the results. Further exploration of different social media platforms and their unique impacts on marketing effectiveness can also provide valuable insights. Finally, future studies should continue to refine and validate the use of instrumental variables in 2SLS estimation to ensure the robustness of the findings. Investigating alternative methods to address endogeneity, such as structural equation modeling (SEM) with instrumental variables, can also contribute to the methodological advancements in this field. This study provides valuable insights into the effectiveness of social media marketing, highlighting the critical roles of engagement, brand awareness, ad reach, content quality, and purchase intent. The findings offer practical implications for marketers and pave the way for future research to further explore and refine these relationships.

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X. CONCLUSION

This study has highlighted the significant roles of engagement, brand awareness, ad reach, content quality, and purchase intent in social media marketing effectiveness. Using Two-Stage Least Squares (2SLS) estimation in Confirmatory Factor Analysis (CFA), we addressed endogeneity issues, providing robust and reliable insights.Key findings show that user engagement significantly enhances brand awareness, while ad reach and content quality are critical in driving purchase intent. These results align with existing literature and underscore the importance of interactive content and strategic ad dissemination for marketers.Despite its contributions, the study's cross-sectional design and potential selection bias are limitations. Future research should employ longitudinal designs and more diverse samples to build on these findings.In summary, understanding and leveraging the key drivers identified in this research can help marketers develop more effective social media strategies to engage consumers, build brand awareness, and drive purchase intent.

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FINANCIAL LITERACY – A PILLAR OF MODERN ECONOMIC DEVELOPMENT

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ABSTRACT

Financial literacy is an essential life skill that equips individuals with the knowledge and ability to make informed and effective financial decisions. In the context of today's rapidly evolving economic landscape, characterized by technological innovations and complex financial products, financial literacy has become indispensable for ensuring personal financial well-being and broader economic stability. The chapter explores the current global and Indian financial literacy scenarios, highlighting key facts, figures, and disparities in financial knowledge across gender, age, and geographic lines. Drawing attention to the low financial literacy rates in India, it underscores the challenges faced by marginalized communities and emphasizes the necessity of targeted educational initiatives. Detailed attention is given to the core components of financial literacy, including budgeting, saving and investing, debt management, risk management, tax literacy, credit management, and financial planning. Additionally, the chapter delves into emerging areas such as digital financial literacy, which is critical in navigating digital banking platforms, online payments, cryptocurrency, and cybersecurity. The chapter concludes by advocating for a multi-stakeholder approach—incorporating educational institutions, government bodies, private sectors, and communities—to bridge the financial literacy gap and foster a financially resilient and inclusive society.

Keywords: Digital Financial Literacy, Financial Education, Financial Planning, Risk Management

I. INTRODUCTION

In today's fast-paced economic environment, financial literacy is no longer a luxury but a necessity. Financial literacy refers to the ability to comprehend and effectively use financial skills such as budgeting, investing, borrowing, taxation, and personal financial management. Despite its critical role, financial literacy has often been neglected in traditional educational frameworks. This chapter explores the significance of financial literacy, delves into facts and figures that reflect the current global and Indian landscape, dissects its components, and emphasizes the role of digital financial literacy in shaping the economic future. The absence of financial education affects individuals across

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all socio-economic backgrounds. Financially illiterate individuals often find themselves trapped in cycles of debt, unable to plan for retirement, or falling prey to predatory financial schemes. This perpetuates economic inequality, leading to wider societal and economic challenges (Lusardi & Mitchell, 2014). Conversely, financially literate individuals are empowered to make informed decisions, build assets, and contribute to economic growth. The ability to effectively manage personal finances has become one of the most vital skills in the 21st century. In a world characterized by increasing economic complexities, a proliferation of financial products, and rapid technological advancements, financial literacy plays a crucial role in ensuring individual financial well-being, societal equality, and national economic stability.

Defining Financial Literacy

Financial literacy refers to the knowledge, skills, and attitudes necessary to make informed and effective financial decisions. It encompasses understanding various financial components such as budgeting, saving, investing, credit management, debt handling, tax planning, and risk management. More importantly, financial literacy empowers individuals to apply this knowledge in real-life scenarios to build sustainable wealth, avoid financial pitfalls, and contribute positively to economic growth.

The Need for Financial Literacy in the Modern World

Historically, education systems across the globe have emphasized literacy in reading, writing, mathematics, and science. While these subjects form the cornerstone of intellectual development, financial education - the practical ability to navigate the financial aspects of life—has often been overlooked. In contrast, financial responsibilities in modern society have grown exponentially. From managing credit cards, home loans, and insurance policies to planning for retirement, taxation, and investments, individuals face an increasing number of financial decisions from an early age. This oversight has had tangible consequences. Many individuals, regardless of their socio-economic backgrounds, struggle with basic financial tasks such as budgeting monthly expenses, planning for retirement, or managing debts. A lack of financial literacy leaves people vulnerable to financial fraud, predatory lending, poor investment decisions, and long-term financial instability. Studies have consistently shown that financially illiterate individuals are more likely to carry unmanageable debt, live paycheck to paycheck, and have insufficient savings for emergencies or retirement (Lusardi & Mitchell, 2014).

Financial Illiteracy: A Widespread Problem

One common misconception is that financial illiteracy is a problem restricted to marginalized, low-income populations. However, research reveals that financial illiteracy affects individuals across

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socio-economic, demographic, and geographic divides. Even well-educated professionals and middle-class families often lack the essential financial knowledge needed to make sound financial decisions. In countries like India, where economic development has rapidly expanded access to financial services, the problem is particularly pronounced. Data from the National Institute of Securities Markets (NISM) indicates that only 24% of Indians are financially literate, with even lower rates among rural populations and women (NISM, 2020). This gap in financial knowledge is exacerbating income inequality and limiting upward mobility, making it an urgent policy issue.

Societal Impacts of Financial Illiteracy

Financial illiteracy does not only have consequences for individuals—it also has ripple effects throughout society. When large sections of a population lack the ability to manage their money effectively, it leads to higher levels of debt, increased reliance on social welfare programs, and greater financial vulnerability during economic downturns. Moreover, poor financial decisions made by individuals can translate to systemic risks within the broader economy, such as housing market collapses, banking crises, and pension fund shortfalls. For instance, the global financial crisis of 2008 illustrated how widespread financial mismanagement, fueled by poor understanding of credit products and risk, can trigger devastating economic consequences. Thus, financial literacy is not just an individual necessity but a cornerstone of economic stability and national prosperity.

Financial Literacy and Technological Change

In addition to the traditional financial landscape, today's world introduces a new layer of complexity with the rise of digital financial platforms. Online banking, digital wallets, cryptocurrency, robo-advisors, and mobile payment systems are reshaping how financial services are accessed and used. While these innovations offer convenience and efficiency, they also present new challenges, such as cybersecurity risks, digital fraud, and information overload. This makes digital financial literacy—the ability to safely and effectively use digital financial tools—an essential subdomain of financial education. Without proper guidance, individuals may struggle to distinguish between legitimate financial products and scams, or fail to understand the risks involved in digital investments like cryptocurrencies.

Why Financial Literacy Should Begin Early

Several studies highlight the importance of introducing financial education early in life. Research shows that financial habits are often formed during adolescence and early adulthood (Lusardi et al., 2010). Integrating financial literacy into school curricula ensures that young people acquire the necessary knowledge and skills to navigate their financial futures confidently. Early education in

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personal finance also instills positive financial behaviors such as budgeting, saving, investing, and responsible borrowing.

Bridging the Financial Literacy Gap

To address the pervasive gap in financial literacy, both governments and private institutions have started implementing educational initiatives. Programs run by central banks, financial institutions, and educational bodies aim to increase awareness, particularly among women, youth, and rural populations. In India, the Reserve Bank of India (RBI) and National Centre for Financial Education (NCFE) have launched targeted campaigns and workshops to promote financial inclusion and empower individuals with financial skills. However, efforts need to be more widespread and consistent, integrating financial education into mainstream school curricula and community outreach programs.

II. FINANCIAL LITERACY: GLOBAL & INDIAN PERSPECTIVE

Global Trends: According to the Standard & Poor's Ratings Services Global Financial Literacy Survey, global financial literacy rates hover around 33% (Klapper et al., 2015). Countries like Sweden (71%), Norway (71%), Germany (60%), and the UK (67%) lead globally due to robust financial education programs integrated into their educational systems. Conversely, emerging economies like India (27%), China (28%), and Brazil (35%) lag behind.

Indian Scenario: The National Institute of Securities Markets (NISM) revealed that only 24% of Indians are financially literate (NISM, 2020). Gender disparities are evident, with women exhibiting lower financial literacy rates than men. Financial inclusion remains moderate, as reflected in the RBI's Financial Inclusion Index score of 60.1 for 2023 (RBI, 2023). States like Goa, Delhi, and Chandigarh have higher literacy levels, while Bihar, Jharkhand, and Rajasthan struggle. Youth financial literacy remains a concern, with only 16.7% of students having basic financial knowledge (Global FinLit Center, 2021).

III. COMPONENTS OF FINANCIAL LITERACY

Budgeting: Budgeting involves understanding income, tracking expenses, and planning for financial stability. It enables mindful spending, helps avoid debt, and facilitates the achievement of financial goals (OECD, 2016).

Saving and Investing: Saving is crucial for emergencies and future goals. Investment literacy involves understanding risk-return trade-offs in instruments like stocks, bonds, mutual funds, real estate, and commodities (S&P, 2015).

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Debt Management: Effective debt management includes understanding credit types, interest rates, and repayment strategies. This avoids debt traps and improves creditworthiness (Lusardi, 2019).

Risk Management: Risk management entails insuring against health risks, life uncertainties, and income disruptions. Proper strategies include health insurance, life insurance, and maintaining emergency funds (OECD, 2020).

Financial Planning: Strategic financial planning aligns income, savings, investments, and expenses to achieve short- and long-term financial objectives (Lusardi & Mitchell, 2014).

Tax Literacy: Understanding tax systems, exemptions, and deductions empowers individuals to minimize liabilities legally (Thaler & Sunstein, 2008).

Credit Management: Credit score awareness and responsible borrowing ensure long-term financial stability (Atkinson & Messy, 2012).

Inflation Awareness: Recognizing how inflation erodes purchasing power helps in choosing suitable financial instruments (RBI, 2023).

Tools to Enhance Digital Financial Literacy: Popular tools include Google Pay, Paytm, Upstox, Credit Karma, and Robo-advisors like Betterment and Wealthfront (G20 OECD, 2019). Workshops, government initiatives like RBI's programs, and educational modules in schools further promote digital literacy.

India's Efforts Towards Financial Literacy

Initiatives include:

- RBI's financial literacy programs targeting rural populations
- National Centre for Financial Education's (NCFE) campaigns
- Pradhan Mantri Jan Dhan Yojana (PMJDY) promoting financial inclusion (RBI, 2023)

IV. CONCLUSION

One of the key takeaways is that financial literacy is not a privilege limited to a particular socio-economic class—it is a universal necessity. Whether it is a daily wage worker budgeting monthly expenses or a corporate executive planning complex investments, the importance of sound financial knowledge remains constant. Moreover, financial literacy equips individuals to navigate life's financial risks—whether related to market volatility, unexpected health expenses, inflation, or economic downturns. It reduces the chances of financial distress and promotes long-term security and financial independence. Financial literacy is not merely an academic or technical skill—it is a life skill essential for personal freedom, security, and prosperity. As financial products and technologies

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continue to evolve, so too must our efforts to equip individuals with the knowledge and confidence to make informed financial decisions. By fostering a culture of financial literacy, we can pave the way for a more resilient, equitable, and inclusive economy—one where every individual has the ability to secure their financial future and contribute meaningfully to societal progress.

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A STUDY ON MODELLING ONLINE SOCIAL AND ECONOMIC FACTOR IN FINANCE

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I. INTRODUCTION

This study estimates the gender-wise analysis of behavioural factors, socio-economic factors and financial literacy influencing retail investors' investment decisions. The study designs a model separately for men and for women to highlight the differential. Investment decisions are well grounded in economic theory. Investment decisions are treated as a macroeconomic aggregate. Individuals maximise their utility by choosing consumption or investment across time **(Merikas et al., 2004)**. The critical process of investment decisions depends upon many factors that may vary from individual to individual. None of the fewer decisions of the investors are linked to investment factors such as risk, ambiguity and product preference. Increased levels of financial literacy help to make good investment decisions with high confidence to manage risk **(Awais et al., 2016, Charness & Gneezy 2007).** Investment decisions can be measured by the (a) rate of return, (b) risk level and (c) prior information **(Marsis, 2013; Vuthalova, 2015).** The present study also uses this for investment decisions' construct, which is the dependent variable. The predictors used in the model are behavioural factors, financial literacy and socio-economic factors.

The following relevant study draws on the work of gender-wise analysis of behavioural factors, socio-economic factors, financial literacy and their influence on investment decisions. Whereas investors agree on the same basic modules of investment decision approach, a lot of behavioural finance researchers also accept that there is dissimilarity in the perception of men and women **(Beckmann & Menkhoff (2008).** Investment objectives, risk tendency and investment return prospects of both the genders are not similar **(Jianakoplos & Bernasek 1998; Nataliya et al., 2009; Tahira & Cazilia, 2008).**

Martenson (2008) opined that men are fascinated to invest for a long duration and women desire quick returns in short term. But **Burton (1995)** found that women tend to differentiate more in comparison to men vis-à-vis investment instruments. Both genders have different perceptions of investment. Men harvest more time for investment decisions **(Charness & Gneezy, 2007).**

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II. OBJECTIVE OF THE STUDY:

The current study is performed in an effort to examine how investor's decisions are influenced by Behavioural factors, socio-economic factors and financial literacy.

- To examine the impact of behavioural factors on investment decisions;
- To examine the impact of financial literacy on investment decisions;
- To examine the impact of socio-economic factors on investment decisions; and
- To design a model relating behavioural factors, financial literacy and socio-economic factors

  With investment decisions separately for men and women.

III. LITERATURE REVIEW

New technology (for example, e-banking systems). While, with respect to studies done on information technology, several external and internal factors; such facilitating condition, perceived ease of Use, perceived usefulness, perceived credibility, Social influence, among other things, have been Regarded as positive socio-economic factors that Trigger people's intention to accept/engage in theNew system (see Ajzen, 1991; Venkatesh & Davis,2000; Venkatesh et al., 2003). On the other hand,This study examines the conflicting issues of these Aforementioned factors that persistently inhibit The engagement in e-banking transactions in the Context of a developing country: a lack of support Infrastructure, price of digital devices, perceivedKnowledge gap, perceived financial cost, andCustomer experience as the underlying researchConstructs.

Facilitating condition, such as investment of infrastructure, is commonly noted as an important key driver of socio-economic development Of every nation (Shankar & Meyer, 2009), while Studies have shown that the "quality, quantity,And accessibility of economic infrastructure in Developing countries lag considerably behind"(Boateng et al., 2008) as compared to the developed world (see Jibril et al., 2020; Nwaiwu et al., 2020). In light of this, scaling up infrastructure Investment or support systems is largely described as a key driver to speed up socio-economic growth and development, especially in the undeveloped economies (Awh & Waters, 1974). In Fact, many developing countries have been scaling up an infrastructure support system, mostly through public spending, as well as growing Participation of the private sector (NabaresehEt al., 2014). Therefore, infrastructure gaps are Still large in pursuing sustainable technological Development, such as smart cities, e-payment,e-revenue mobilization, among others, and filling these gaps would help in the medium to longterm sustainability of innovation diffusion andsuccessful technology adoption by the citizenry.

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This refers to the unit price of the digital device in the electronic market. In other words2020) consist of distinct variables that include: income, education, employment, community safety, and social supports, among other things, that can significantly affect a person's life in a given geographical area. However, within the framework of the online banking system, this concept refers to factors, either tangible or intangible, that support people in accepting/adopting the use of ameans the value of the amount paid to acquire any electronic device (Esteve & Machin, means the value of the amount paid to acquire any electronic device (Esteve & Machin, 2007) in order to have access to online transactions. In the developing world, since many citizens are leaving below the poverty line (Ali, 2016) or within the low-income bracket (Ali & Langendoen, 2007), buying sophisticated devices (such as smartphones, tablets, notebook, etc.) at higher prices makes it difficult to access such income brackets. It is also important to acknowledge the concept of 'consumer rationality' in the field of consumer behavior. This concept reiterates the principle of demand, which suggests that low-income earners demand less of a product (good) when the price is high, and vice versa. . Perceived financial cost Financial cost towards the adoption/engagement in online transactions refers to expenses associated with the online transaction. Thus, these are expenses incurred in buying or selling a good or service or even using an online platform for other intended purpose (Stein et al., 2005; Wu et al., 2014) such as money transfer and interbank transfer/deposit.

Yu (2012), in his work, argued that potential users of electronic banking systems/transactions are quite skeptical with regard to the potential charges that may be attached due to services rendered by a bank. Nonetheless, since first-timers anticipate that they would be deducted from their deposit or whichever possible, this perceived transaction cost deters potential users from engaging in 'loos game transaction', especially in a low-income bracket group (Amegbe & Osakwe, 2018). As a matter of fact, bank customers (both online and off-line) are mostly not satisfied when it comes to a levy on transaction-related activities, especially when the perceived cost does not correspond to the expected service provided. However, as the new technology (e-banking transaction) comes with an associated cost, hence, they (banks) transfer the service charge/ cost on to the users (Sathye, 1999; Yiu et al., 2007), since the cost is a shared responsibility to both a bank and a customer in question (Thambiah et al., 2010). This suggests that a shift in charges to bank clients can potential.

IV. RESEARCH METHODOLOGY

A research design is purely and simply the framework plan for a study that guides the collection and analysis of a data. In this study the researcher has adopted descriptive research design

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Descriptive Research Design

The research is descriptive-in nature hence it includes-descriptive research design. The examination is enlightening in nature henceforth it incorporates unmistakable research plan. Elucidating examination configuration is utilized to think about the qualities of a populace that is being contemplated. This plan goes for receding tide besidesstream matters or issues complete a process of info gathering and authorises the specialist to show the situation completely.

Data Collection

Data collected is one of the most important aspects of research. For the success of any project accurate data is very important and necessary. The information collection through research methodology must be accurate and relevant.

Primary Data :

Data that has been collected from first-hand-experience is known as primary data. Primary data has not been published yet and is more reliable, authentic and objective. Primary data has not been changed or altered by human beings; therefore its validity is greater than secondary data. Importance of Primary Data: In statistical surveys it is necessary to get information from primary sources and work on primary data.

Interview: interview has been made with office staff, where several random of questions have been asked related to digital marketing and the repose has been recorded

Observation: observation has been made on digital marketing tools and techniques and strategies that they use to promote their business. Questionnaire, Personal Interview, Interview with Marketing Professional

V. DATA ANALYSIS AND FINDINGS

Behavioural factors covered in the study comprise personal factors (PF), herding factors (HF), overconfidence (O), ability bias (AB), loss aversion (LA), regret bias (RB) and mental accounting (MA), respectively. Socio-economic factors are (a) Market (M), (b) Firm (F) and (c) social (S). After applying factor analysis two factors that emerge for financial literacy are FLA and FLB. The investment decision is the dependent factor and comprises (a) prior information (PI), (b) risk (RI) and (c) returns (RE). The proposed model is depicted in Figure 1.

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VI. TRAINING AND TEST DATA

Before engaging in data analysis, it is necessary to test data with Pareto's 80–20 rule. This rule or principle was observed by Italian economist Vilfredo Pareto in 1906. The 80–20 rule or Pareto's principle says that roughly 80% of results come from 20% of the data (Flegl & Vydrova, 2014). It is also called 'law of the vital few'. In this study, total data that included 514 respondents were further classified into 347 men and 167 women. The data have been categorised as per the 80–20 percentage, with the Training group comprising 411 respondents and the Test group comprising 103 respondents chosen randomly.

PLS-SEM) was used for all four models, viz. model 1 consisting of 411 respondents for training, and model 2 consisting of 103 respondents for testing. After analysing results for the Test group from the total sample, two models were created—model 3 for male respondents and model 4 for female respondents. The basic idea was to test the model and then apply it to males and females for investigating the relation among behavioural factors, socio-economic factors, financial literacy and investment decisions. This comprehensive data analysis helped in understanded the relation in greater depth. Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE) have been computed for all constructs for checking reliability and validity. This is presented in Table 6. Cronbach's alpha measures the internal consistency of the survey instrument (Hair et al., 1995; Nunnally, 1978)

	Cronbach's Alpha		CR		AVE		Square Root of AVE	
	80	20	80	20	80	20	80	20
BF	0.845	0.869	0.883	0.900	0.521	0.565	0.722	0.752
FL	0.631	0.573	0.842	0.817	0.728	0.692	0.853	0.832
ID	0.860	0.894	0.915	0.934	0.782	0.825	0.884	0.908
SEF	0.696	0.728	0.832	0.846	0.624	0.648	0.790	0.805

Reliability and validity of all exogenous and endogenous variables are checked, viz.

behaviourfactors (BF), financial literacy (FL), socio-economic factors (SEF) and investment decisions (ID). In the present study, all internal consistencies are greater than 0.70, it meaning all values are in an acceptable range, except the internal consistency of financial literacy (20%), which is less than 0.70, and hence lies in an unacceptable range. According to Hamid et al. (2017), the CR value should be in the threshold limit of 0.70, and the threshold limit for AVE is 0.50. In Table 6, all latent variables have CR and AVE values that are beyond the acceptable level. In the current study, two criteria have been used to check the discriminant validity recommended by Fornell and Larcker

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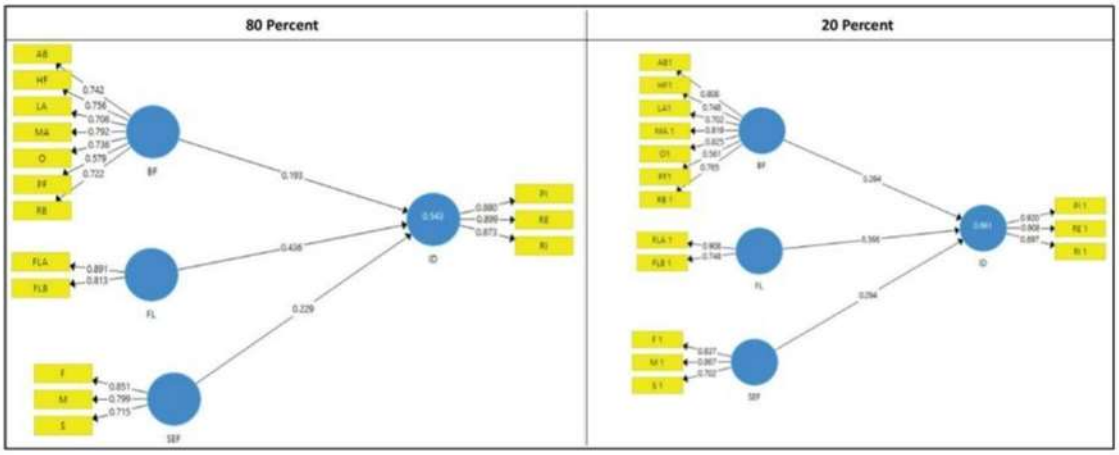
(1981) and by Heterotrait–Monotrait (HTMT). The square root of AVE has been used to check the discriminant validity using Fornell and Larcker (1981) criteria. The square root of AVE should be greater than correlation coefficients for the constructs. In the present model, the square root of AVE is greater than the correlation of the constructs. The results reflect the unrelatedness of constructs. Table 7 depicts discriminant validity acceding to the Fornell–Larcker criterion. HTMT values close to 1 signify the absence of discriminant validity. Kline (2011) suggests a threshold of 0.85, and Gold et al. (2001) proposed 0.90. According to the HTMT ratio, the condition of discriminant validity is satisfied as only four values are greater than 0.90

	Original Sample (O)		Sample Mean (M)		Standard Error (STERR)		*T*-statistics (|O/STERR|)		*p*-Values	
	80	20	80	20	80	20	80	20	80	20
BF → ID	0.193	0.264	0.194	0.266	0.048	0.066	3.991	3.986	0.000*	0.000*
FL → ID	0.436	0.366	0.436	0.364	0.050	0.083	8.748	4.437	0.000*	0.000*
SEF → ID	0.229	0.294	0.230	0.299	0.053	0.075	4.343	3.926	0.000*	0.000*

	R^2		Adjusted R^2	
	80	20	80	20
ID	0.543	0.661	0.540	0.651

Source: The authors.

Note: *$p < 0.01$.



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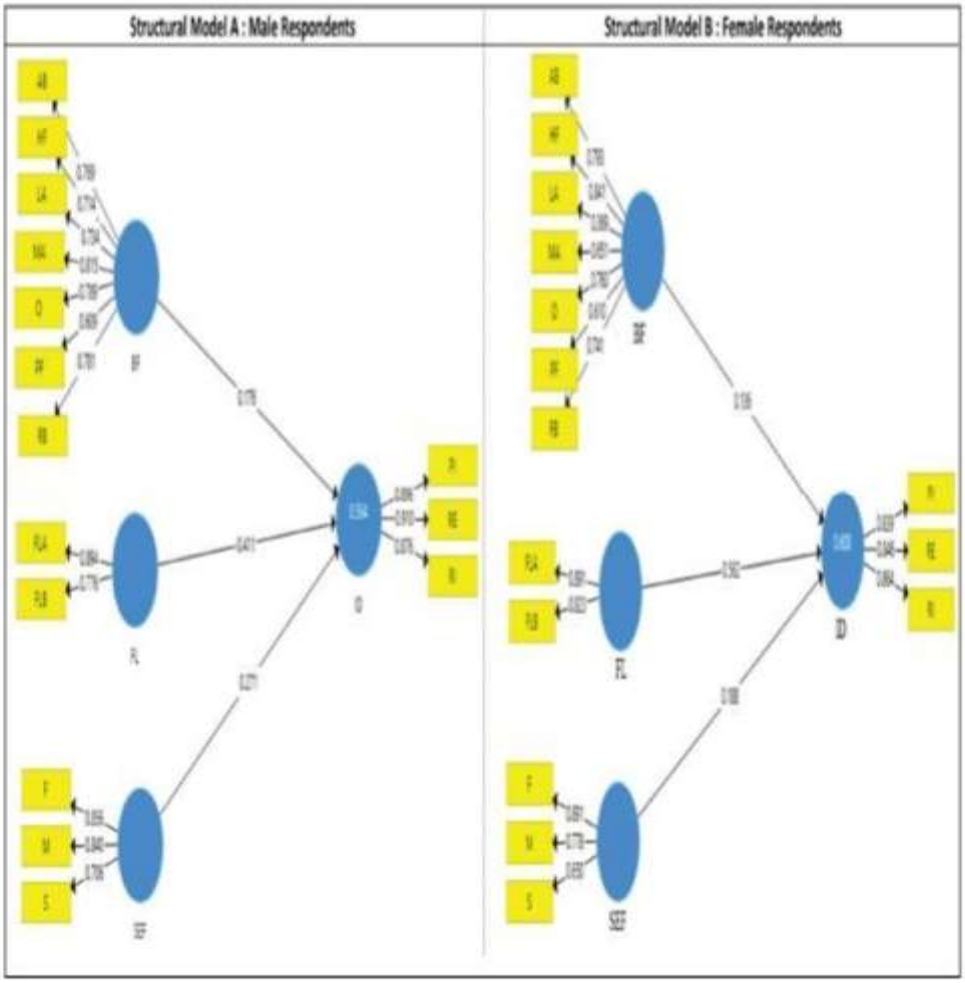

Financial literacy is also an important factor influencing investment decisions for both men and women. The t-statistics of these factors for men and women are 7.526 & 6.945, respectively, and p-value < 0.01. Thus, hypothesis H2 (Table 2 and 4): Financial literacy influences investment decisions is empirically proved. Hypotheses H2a: Financial literacy has a stronger influence on investment decisions in the case of men than in the case of women is empirically proved as β-value for men is higher than that of the fairer sex. As opined by Caroline et al. (2017), men have higher levels of financial literacy. Socio-economic factors emerged as an important factor influencing investment decisions for both men and women. The t-statistics of these factors of men and women are 3.537and 1.984respectively, and p-value < 0.01. Thus, hypothesis H3 (Table 3 and 4): Socio-economic factors that influence investment decisions are empirically proved. However, socio-economic factors emerged to have a stronger influence on men than women as the β-value for women is 0.143 and that of men is 0.198. Earlier research suggests that men are more than women. The status of the acceptance empirically proved (Table 14). In the present model, the value of R-squared for men is

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0.489 and 0.503 for women. It means that behavioural factors, financial literacy and socio-economic factors explain 61.4% of the variation of investment decisions for men. Model 2 results highlight that behavioural factors, financial literacy and socio-economic factors explain 57.8% of the variation of investment decisions for women. The adjusted R-squared for women (0.518) is again higher than men (0.490). Thus, explanatory power is higher for women when compared to men.

VII. CONCLUSION AND DISCUSSION

The present study has been carried out on Indian investors. The questionnaire deals with various aspects related to investment decisions, viz. behavioural factors, socio-economic factors and financial literacy. The study tries to investigate gender-wise relation of how behavioural factors, financial literacy and socio-economic factors influence investment decisions. The behavioural factors include personal factors, herding factors, overconfidence, ability bias, loss aversion, regret bias and mental accounting. The socio- economic factors include market, firm and social factors influencing retail investors. Returns, risk and prior information are the main constituents of investment decisions, while financial literacy includes FLB and FLA. Financial literacy, behavioural factors and socio-economic factors show a significant positive impact on investment decisions as revealed from their associated t-statistics in the PLS-SEM model for both the genders. Gender-wise associated R-squared and adjusted R-squared for investment decisions is good at 0.564 and 0.608, 0.561 and 0.601, respectively. It shows that gender-wise behavioural factors, socio-economic factors and financial literacy directly explain 56.4% and 60.8% of the variance, respectively. The value of R2 and adjusted R2 of investment decisions is greater for men in comparison to women.

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BEHAVIOURAL FINANCE AND INVESTMENT DECISIONS: AN OVERVIEW STUDY ON RETAIL INVESTORS

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ABSTRACT:

The field of behavioural finance has transformed our understanding of how psychological influences and cognitive biases affect the financial decisions of retail investors. Traditional finance theories, like the Efficient Market Hypothesis, are challenged by behavioural finance, which integrates psychology, sociology, and neuroscience to explain real-world investment behaviours. Retail investors are prone to emotional and cognitive biases such as overconfidence, loss aversion, herding behaviour, mental accounting, and anchoring, which significantly impact their investment decisions. This study provides a thorough examination of behavioural finance, focusing on the decision-making patterns of retail investors and highlighting the irrationality and inconsistency in their investment strategies. Herding behaviour, common among retail investors, can lead to asset bubbles and market downturns, driven by the fear of missing out. Mental accounting, where individuals categorize money based on subjective criteria, and anchoring, where investors rely too heavily on specific information or historical prices, also play significant roles in investment decisions. Emotional aspects such as fear and greed further impact retail investors' decisions, as do social and cultural factors like peer pressure and media influence. Overall, behavioural finance provides crucial insights into the complexities of retail investor decisionmaking and highlights the importance of integrating psychological factors into financial analysis and advice.

Keywords: Behaviour finance, Retail investors, Investment psychology, Decision making patterns, Investor education, Cognitive biases.

I. INTRODUCTION

People in standard finance are rational. People in behavioural finance are normal.

— Meir Statman, Ph.D., Santa Clara University.

Behavioural finance is a relatively new field that seeks to combine behavioural and cognitive psychological theory with conventional economics and finance to provide explanations for why people make irrational financial decisions. It is very popular in stock markets around the world for investment decisions. According to economic theorists, investors think and behave "rationally" when buying and selling stocks. In particular, investors are supposed to use all available information to form

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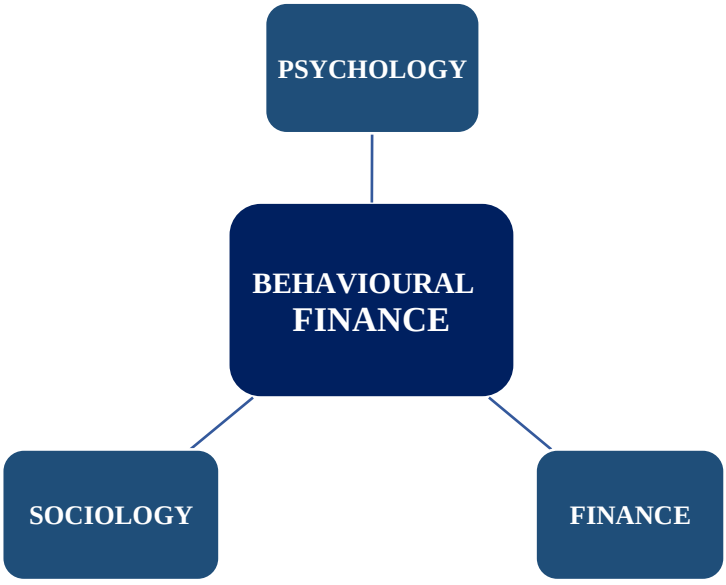
"rational expectations" about the future to determine the value of companies and the general health of the economy. Thus, economists have concluded that financial markets are stable and efficient, that stock prices follow a "random path," and that the overall economy tends toward "general equilibrium. " However, in reality, according to Shiller (1999), investors do not think or behave rationally. Rather, driven by greed and fear, investors speculate on stocks between unrealistic highs and lows.



Human herd behaviour results from impulsive mental activity in individuals responding to behavioural cues from others (Prechter, 1999). This requires a better understanding of human nature in today's global perspective, as well as the development of excellent skills and the ability to get the most out of investments. Each investor differs from others in any way due to many factors, such as demographic factors, which include their socio-economic background, level of education, age, race and gender. In the current scenario, behavioural finance has become an integral part of the decision-making process, as it greatly influences the performance of investors. They can improve their performance by recognizing the biases and errors of judgement to which we are all subject. Understanding behavioural finance will help investors choose a better investment and avoid making mistakes in the future. The relevant questions of this analytical study are how to minimize or eliminate psychological biases in the investment decision process. Although many studies have discovered the behavioural dimensions of retail investors, many of these dimensions remain unexplored or have been studied with little effort to improve the performance of retail investors in the stock market. Therefore, this study aims to examine all the major cognitive biases associated with the heuristic, prospective and herd theories of behavioural finance in order to better understand the psychology of investors and improve the investment performance of individuals and of the stock market.

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II. REVIEW OF LITERATURE:

Tversky and Kahneman who were recognized as the father of behavioural finance can be best explained in different phases by their works. In 1979, they presented a paper. The book presented insights into how understanding these behavioural tendencies could help investors make more informed and balanced decisions.

R. Raut (2020) stated that this study aims to explore the importance of past behaviour and financial literacy in the investment decision-making of individual investors and examines the validity of the theory of planned behaviour in this context. The study used a self-administered questionnaire and adopted the convenience sampling technique followed by a snowball sampling method for the survey to collect data from the individual investors covering the four distinct states of India. Results indicated a significant effect of all the predictive variables. Past behaviour showed no significant direct impact on investor's intention; however, it had an indirect significant relationship while mediated by the attitude of investors.

Renu Jonwall et al (2022) stated and identifies the SRI awareness level, attitude towards the importance of environmental, social, and governance (ESG) issues, willingness to invest in SRI avenues and obstacles in SRI investment decision-making by Indian retail investors. Indian retail investors show a willingness to invest in socially responsible investments, but face obstacles such as lower returns, lack of information, and low liquidity.

Girish & Vidya (2023) identifies that how investment biases significantly impact the decisionmaking processes of Gen Y (Millennials) and Gen Z retail investors in the Indian capital market, highlighting the need for tailored investor education programs to enhance financial literacy and mitigate risks. Overall, this study highlights the shed light on the implications of investment biases on the financial well-being of Gen Y and Gen Z investors, offering valuable recommendations for financial institutions, regulators, and educators to empower these cohorts in navigating the complex Indian capital market landscape.

Ghazani et al (2024) investigates the relationships between investors behavioural biases and compares their relative importance. For this purpose, a survey is conducted, and analytical methods are used. The respondents replied about their behaviour in different situations to analyze the prevalence of asymmetric discounting, mental accounting, shifting risk preference, loss aversion, regret aversion, overconfidence, proxy decision making, ambiguity aversion bias, anchoring, and herd behaviour as significant fields of behavioural biases in their investment decisions. The data is analyzed using two different analytical techniques.

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III. OBJECTIVES OF THE STUDY:

- To identify Behavioural biases influencing retail investors.
- To analyze the savings and investment decision
- To detect the factors which have an impact on the investor's decision.

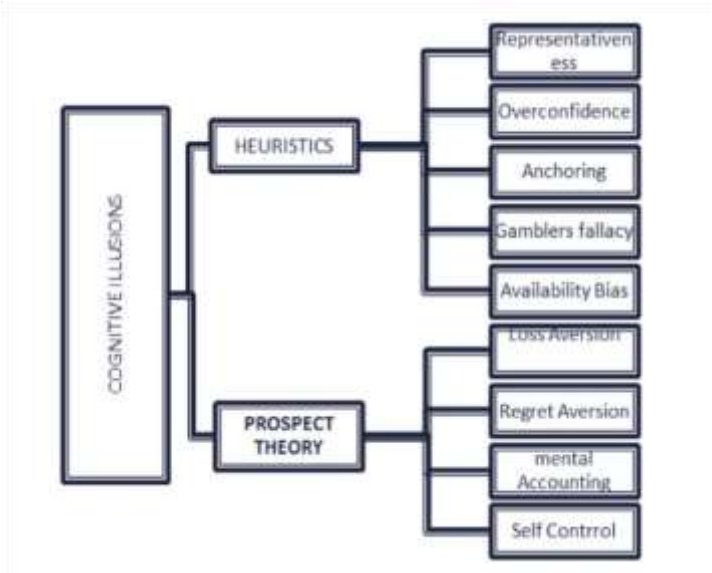
IV. RESEARCH METHODOLOGY:

This theoretical research model aims to evaluate how behavioural biases affect investor behaviour. Sources of data: The current research project is a secondary research project only. The data for this research study was gathered from a variety of sources, including books, journals, papers, and websites.

V HEURISTIC DECISION PROCESS:

The decision-making process allows investors to decide things for themselves, often through trial and error, leading to the development of rules of thumb. In other words, it refers to the rules of thumb that people use to make decisions in difficult and uncertain environments. The reality is that investors' decision-making processes are not always accurate. Investors are expected to gather relevant information and evaluate relevant information, including psychological and emotional factors. It is very difficult to distinguish Sometimes that works, but often the decision is flawed.

This includes:



Source- Manoharan Kannadhasan, BIM, Trichy, Jun 2022. (PDF) ROLE OF BEHAVIOURAL FINANCE IN INVESTMENT DECISIONS (researchgate.net)

- Evidence: current success for investors. It will continue in the future. The tendency of investors to make decisions based on past experiences is known as stereotyping. Debont

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(1998) concluded that analysts are biased towards recent success or failure in their revenue forecasts, which is a characteristic of decision making.

- Self-Confidence: Self-confidence comes in many forms. It increases confidence and is considered the key to success. Although confidence is often encouraged and praised, it is not the only reason for success. Careful and analytical investors can succeed while others are forced to retreat. However, self-esteem, especially self-confidence, can be seen as a positive trait. Sometimes investors overestimate their forecasting skills or have more knowledge than they realize. It often leads to great sales.
- Anchoring: This refers to a person's tendency to rely heavily or "anchor" on a particular piece of information when making a decision. When new information is released, investors change, and the value scale is determined or determined by the current findings. Hopefully earnings will continue with the previous trend and this will happen.
- Gambler's fallacy: Occurs when investors wrongly predict that the trend will change. It can indicate a good or bad ending.
- Lack of Availability: Investors place undue weight on the information available to make decisions. This is very common and this leads to lower returns and sometimes negative results.

VI. BEHAVIOURAL FINANCE AND INVESTMENT DECISIONS:

Behavioural finance investigates how emotions and psychology influence investment decisions, focusing on common mistakes made by investors due to emotional factors. Decision making is complex and difficult, with factors like demographics, socio-economic background, education, gender, age, and race affecting each investor. Festinger's cognitive dissonance theory suggests that individuals try to reduce internal conflict by changing their past values or choices, or rationalizing their choices. Financial cognitive dissonance can be seen in investors changing investment styles or beliefs to support their financial decisions. For example, traditional investors may rationalize their change by believing in a "new economy" where traditional financial rules are no longer applicable, or by buying Internet retail companies based on price momentum. The theory of regret suggests that individuals evaluate their expected reactions to future events or situations, leading to more regret when making less conventional decisions. Behavioural finance explores how emotions and psychology influence investment decisions, focusing on why sane people make stupid decisions. They may also buy the "hot or popular store of the week" to follow the crowd and rationalize their investment choices. Fear of regret can prevent or motivate investors to take greater risks in the stock market.

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PROSPECT THEORY:

This theory was proposed by Kahneman and Tversky. A second group of illusions that can influence the decision-making process is grouped into perspective theory. He discussed some psychological factors that can influence the decision making of investors. The main points he discussed are as follows:

- Loss aversion: It is an important psychological concept that focuses on financial analysis. Entrepreneurship is risky when it comes to the nature of the disease, but it is risky when it comes to profit. This condition is called non-destructive. Ulrich Schmidt and Horst Zankeb proposed the theory of death aversion and risk aversion, and he agreed with the ideas of Kahneman and Tversky.
- Frustration: It stems from investors desire to avoid the regret of a bad investment decision. Investors are encouraged to hold stocks that are underperforming because avoiding sales can lead to unrealized losses and poor investment decisions. Depression creates a tax-free investment strategy because investors can reduce their taxable income by realizing capital losses.
- Mental Accounting: It is a set of mental processes that investors use to plan, evaluate and track investments. There are three areas of mental accounting that focus on. First it shows how to understand and experience the results and how to make decisions and then evaluate. The second part of mental accounting is the allocation of tasks to separate accounts. The sources and uses of money are indicated in accounting systems and psychology. The third part of the mental account is about the frequency of the evaluation of the account and the "choice points". Accounts can be balanced daily, weekly, yearly, etc., and defined as small or global.
- Self-control: This is what all investors should have to avoid losses and protect investments. As Thaler and Shefrin point out, investors tend to experiment and find tools to improve control. Business owners can control their spending needs by mentally dividing their financial resources into capital and "free to spend" sources.

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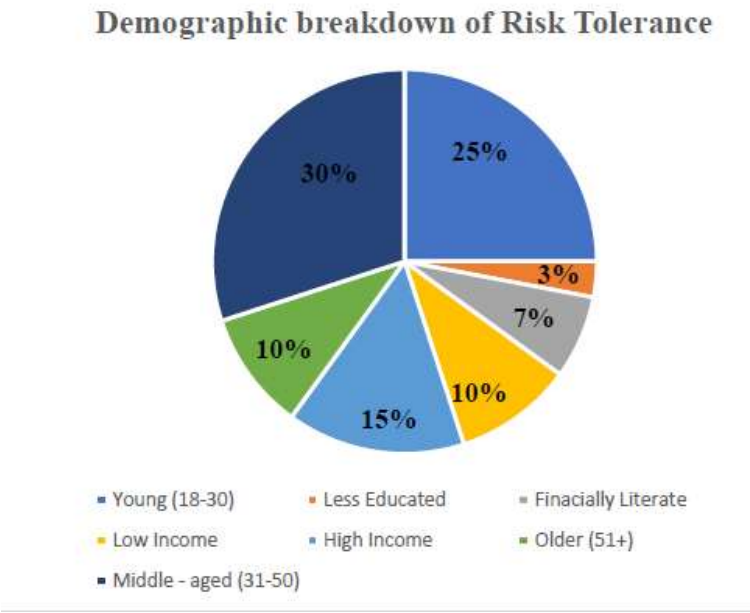
DECISION MAKING UNDER UNCERTAINTY:

Every day, people have little difficulty in making hundreds of decisions. Indeed, the best course of action is often obvious, and many decisions do not determine outcomes important enough to merit close attention. Sometimes our decisions have important consequences. These situations require a lot of time and effort to create a systematic approach to analyze different courses of action. Even in a perfect world, when a decision maker must choose between several possible actions, the ultimate consequences of each or all of them will depend on uncertainties that will be resolved in the future. According to Michael M. Pompian, when faced with making a decision in the face of uncertainty, there are generally accepted guidelines that a decision maker must follow:

1. Take an inventory of all viable options available for obtaining information, for experimentation, and for action.
2. List the events that may occur.
3. Arrange pertinent information and choices / assumptions.
4. Rank the consequences resulting from the various courses of action.
5. Determine the probability of an uncertain event occurring.

VII. ANALYSIS:

1. Demographic influence on investment behaviour:



The first important observation is the influence of demographic factors on the decisions of individual investors. The chart shows that a large part of the investors is between the ages of 25 and 45, showing that the young and middle-aged are the players of the market. This group is more tech oriented,

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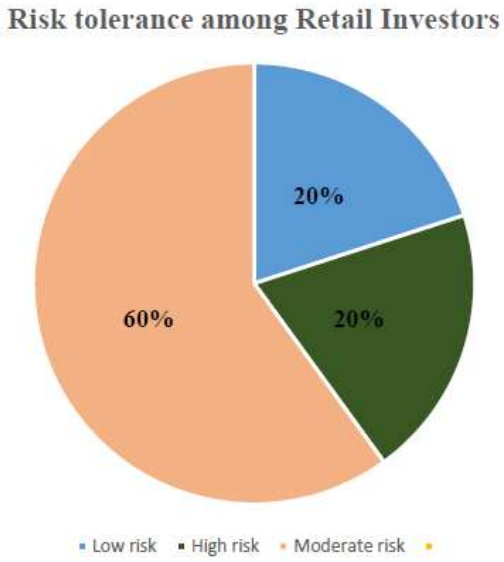
smarter and willing to take risks. Educational background also plays a role in shaping their decisions, with investors with higher levels of education showing a greater interest in systematic and data-driven approaches to investing. This demographic data suggests that financial institutions and market analysts need to cater their strategies to younger and educated investors, offering digital tools, advanced market insights, and tailored financial products. Additionally, income levels are strongly tied to the type of assets chosen, with higher-income groups more likely to diversify across multiple asset classes like stocks, mutual funds, and real estate.

2. Risk Appetite and Investment Preferences:



Another critical aspect displayed in the charts is the risk tolerance level among different segments of retail investors. A large portion of the respondents fall into the category of “moderate risktakers,” suggesting a balanced approach where investors seek returns but are cautious about potential losses. However, a small segment is classified as "high risk takers", which represents a group of investors who want to engage in strategic investments, often in large stocks or in new sections. This suggests that behavioural constructs such as overconfidence or affect may be stronger among risk takers. It is important for financial advisors to address these issues by providing behavioural training, encouraging diversity and reducing herd mentality. On the other hand, overconfidence, shown as the second common bias, often results in investors being more knowledgeable and reducing risk, resulting in poor investment choices.

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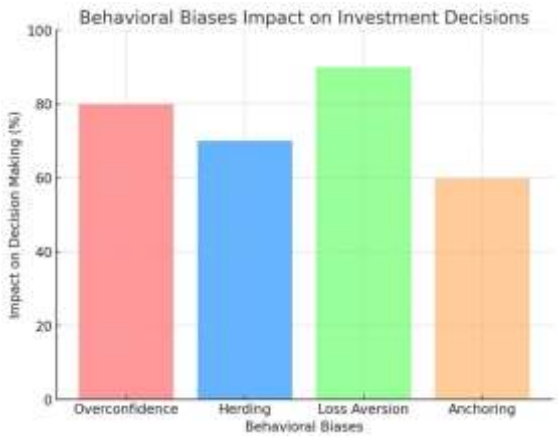
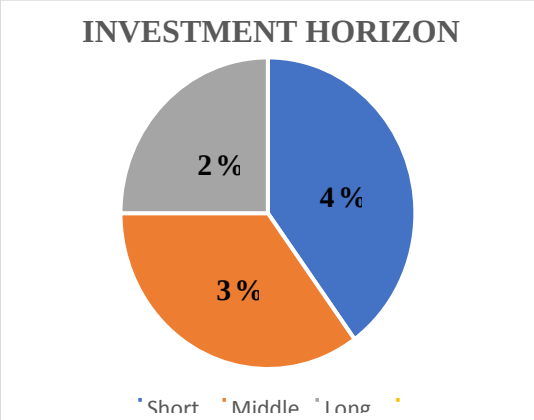
3. The impact of behavioural factors:



Behavioural factors such as resistance, herd behaviour, and overconfidence are important factors in consumer decision making. The chart shows that most investors follow herd behaviour, meaning that they are more influenced by market conditions, news and the actions of peers than their own analysis. This can have a big impact on market bubbles or crashes, as wrong decisions based on emotion rather than principle can lead to poor results. To avoid these pitfalls, this study points to the need for increased financial education programs and access to reliable and objective market information. Encouraging real-time goal setting strategies can also help reduce the impact of these biases. The chart illustrates the fluctuation in retail investor participation in the stock market during key economic events, such as changes in interest rates by the Reserve Bank of India (RBI) and international trade agreements. During times of economic uncertainty, the volume of trades typically decreases as investors move towards safe-haven assets. Conversely, when there are signs of economic recovery, retail participation rises, reflecting positive market sentiment and an increased appetite for riskier investments.

4. Area of investment and decision making:



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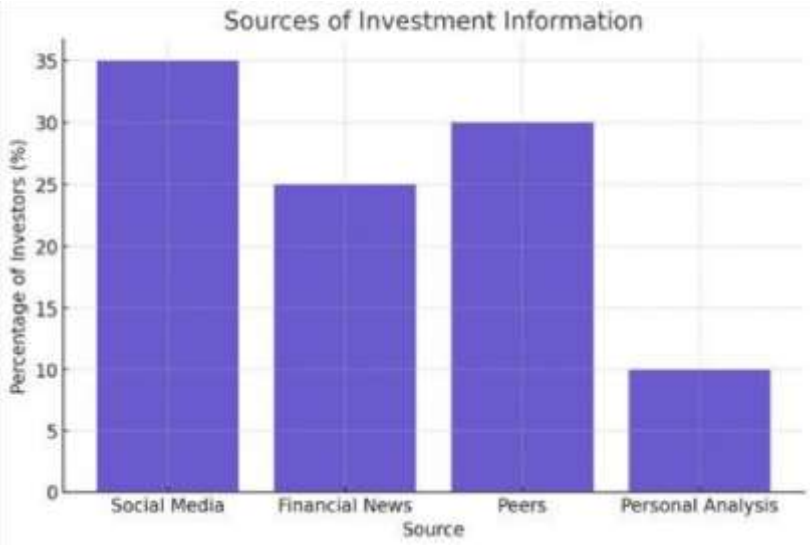
Further analysis shows that investors in India have different investment areas and most of them prefer short term investment and for the medium term. This is closely related to their behavioural characteristics, such as patience and the ability to react to short-term market movements. However, there are few long-term investors, indicating the need to maximize the benefits of long-term investments, such as consolidation and reduced trading costs. These data point to the importance of educating retail investors about the benefits of long-term holding strategies, aligning their investment decisions with financial goals and reducing the impact of volatility market to their accounts. This chart illustrates the breakdown of investments between equity and debt instruments. Equity investments (stocks) are favored by younger, more aggressive investors looking for capital appreciation over a longer time frame, while debt instruments (bonds, fixed deposits) attract conservative investors seeking steady returns with lower risk. Demand for funds increases during bull market periods, as debt securities become more popular during market downturns as investors seek to reduce at risk.

5. The role of external information:



Finally, the chart shows the important role of external information sources such as social media, financial reports and peer recommendations in creating the investment decisions. Investors often rely on these external indicators, which may not always reflect the intrinsic value of a property or company. This trust shows vulnerability to market volatility and popularity-related investment behaviour, which makes investors vulnerable to herding-like behaviour. Financial institutions and regulatory bodies must ensure that market investors have access to verified, accurate and timely information to support decision-making. As shown in the last pie chart, investors with financial literacy are more likely to make decisions by relying on technical analysis and data-driven strategies. On the other hand, investors with limited knowledge rely on financial advisors, friends or social media

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for investment guidance. This reliance on external sources leads to foolish investment decisions driven by noise rather than fundamentals.

VIII. CONCLUSION:

Behavioural finance studies how psychological biases influence retail investors decision-making processes. Unlike traditional finance theories, behavioural finance recognizes the impact of emotions, biases, and heuristics on investment behaviour. Retail investors are especially susceptible to biases due to a lack of resources, education, and exposure to external influences like media and social pressures. Loss aversion, overconfidence, herding behaviour, framing effects, and mental accounting all shape how retail investors make investment decisions. These biases lead to irrational strategies, excessive trading, and poor risk management. Social influences, media, and emotional responses like fear, greed, regret, and hope further complicate decision-making. Financial literacy is crucial for promoting rational decision-making and mitigating impulsive actions among retail investors. Higher levels of financial literacy led to better decision-making and reduced susceptibility to biases. However, many retail investors lack the necessary education to make informed decisions, leading to suboptimal investment performance. Educational programs, accessible tools, and advisor guidance can help improve financial literacy and empower retail investors to navigate financial markets effectively. The advent of technology and digital investment platforms has both positive and negative implications for retail investors. While these platforms democratize access to financial markets, they can also encourage impulsive trading and speculative behaviour due to ease of use and gamification elements. Stakeholders must design platforms that incorporate behavioural finance insights, provide tools to help investors recognize and mitigate biases, and promote educational resources for thoughtful investment strategies over speculative trading. Policymakers, financial institutions, and advisors have a crucial role in addressing behavioural biases among retail investors. By promoting financial literacy, creating informative tools, and regulating the financial environment, stakeholders can cultivate a rational and efficient investment ecosystem. Financial advisors can leverage their understanding of behavioural finance to guide investors away from biased decision-making and towards objective, data-driven strategies. Integrating behavioural finance principles can help advisors manage client expectations, reduce impulsive decisions, and promote sustainable investment behaviour.

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CONSUMER AWARENESS AND PERCEPTION TOWARDS ARTIFICIAL INTELLIGENCE

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ABSTRACT:

Early men to civilised men is a journey that showcases a historic transformations, scientific advancements and developing ideas. In the same context the transition from reality to virtual reality can be witnessed. There have been times when the method adopted to work by industries were categorised into labour intensive and capital intensive, now it is not at all wrong to say that a new dimension has also been evolved and created which is AI intensive.The main aim of this study is to find out consumer awareness towards artificial intelligence and its Scope.The study was undertaken amongst 51 respondents,which reveals the acceptance and liking rate of consumers towards artificial intelligence in present context.

Keywords: AI, Virtual Reality,AI intensive

I. INTRODUCTION:

Human intelligence has alawys created some or the other unique equipments and platforms. The latest example is blend of human intelligence and information technology that has itself paved a long way for its utilisation.The discusiion is for none other that the artificial intelligence.We are living in world of very responsive chatbots who always satisfies our queries, our friend of loneliness and most trusted Alexa,our true navigator, which never misleads, dear googlemaps and many more. In the world full of human beings which are able enough to handle everything, has created a super power to facilitate all dimensions of life and i.e. artificial intelligence. None of the life is untouched with the use of AI and maximum relish their experience.the trend of working women has somewhere led to maximum of AI aida at households.mechanisation has alawys been the key of any industry but now digitalisation cum mechanisation is the foundation at every individuals life. households, business etc.

The Artificial Intelligence technology function is no longer an emerging technology segment – AI as a function has pervaded almost all industries and functions – from eCommerce to BFSI and from Manufacturing to Agriculture – Data Science and Deep Learning are increasingly utilised to solve complex business challenges. AI is increasingly utilised across several B2B, B2C, and, even, C2C (Consumer-to-Consumer) channels.

- AI is increasingly adopted across Contact Center Customer Services (RPA-driven Chat Bots), Media Delivery (ML and AI-driven Social Media, Streaming content, and eCommerce recommendations), and Intelligent Networks / Telecom Services, to name a few.

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- AI adoption is no longer restricted to financial enterprises or large technology implementations or organizations. AI adoption in increasingly becoming democratized with personnel from non-technological backgrounds adopting AI processes in their functional roles.
- Machine Learning and AI technologies are central to the functioning of Smartphones, Smart TVs, Household Appliances, and Automobiles.

As revealed in the AI and Analytics start-up investment study for 2020 – 2021, the Data Science space in India, specifically the AI function, is evolving into an innovative enterprise segment. MNC Technology, Domestic, Advanced Engineering, Healthcare, and Semiconductor firms, to name a few, are now developing advanced Artificial Intelligence capabilities in India and providing top-notch AI services to firms across various industries and geographies – they are being rewarded with substantial investments by foreign and domestic funds.

Key Highlights:

- The Indian Artificial Intelligence market is valued at $7.8 Bn as of July – August 2021. This represents a 22% increase in size of market over 2020.
- After the adoption of AI services in 2020 to ensure contactless payments and virtual banking services, the BFSI sector's contribution to the AI industry has remained more or less constant.
- The market size covers revenues from all AI operations originating from India regardless of stakeholder or client type, type of firm providing AI services, and geography of client.
- The AI market share and size in relation to the Types of Companies is the highest across the broad MNC IT / Technology / Electronic category, which includes Highend Software and Hardware technology, IT Services, Semi-conductor, and Electronics firms. The combined market share is 32%, down from a market size of 36.2% in 2020.
- The market size by Industries or Sectors is the highest across the IT Services sector, followed by the Technology sector (including Software and Hardware firms), with a market share of 35% and 23.3% respectively.
- Apart from the IT and Technology sectors, the BFSI sector has a market share of AI services at 9.6%.
- There are close to 109000 Artificial Intelligence personnel working in India across enterprises and sectors – this represents a 20% jump in personnel from last year (91000 Artificial Intelligence personnel) – the median salary of the AI personnel is INR 14.3 Lakhs.
- The highest median salaries are drawn by AI professionals in Mumbai, at INR 17.3 Lakhs.

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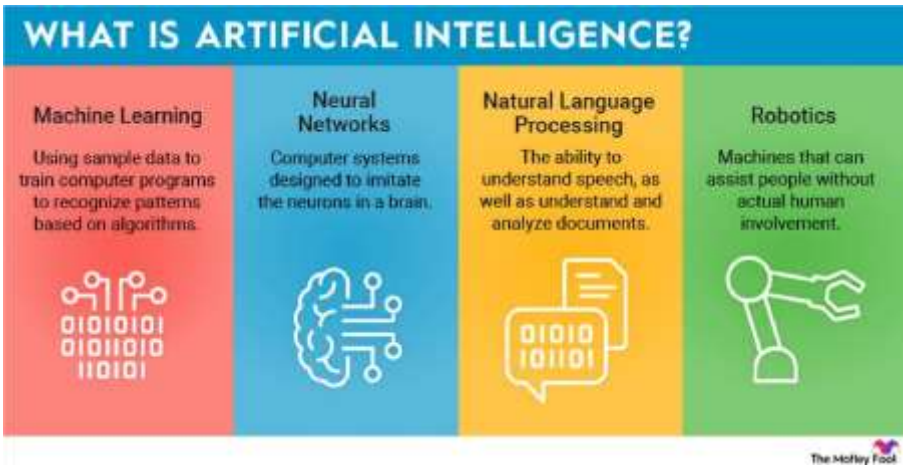
- Close to 14500 open positions related to AI are currently available to be filled in India, as of July – August 2021. Bengaluru, just as it does for other Data Science and IT services roles, tops the location for the highest proportion of open jobs.
- The 2nd wave of the devastating pandemic has affected the AI sector overall – while contactless services are driving the need for AI services in sectors such as eCommerce and Healthcare, the effect of the pandemic continues to pull down the AI services in the Travel & Hospitality.



II. REVIEW OF LITERATURE:

Vincent Conitzer (2019) has conducted a study on "Designing Preferences, Beliefs, and

Identities for Artificial Intelligence" has identified the well found theories of, and methodologies and algorithms for, how to design preferences, identities, and beliefs. This paper lays out an approach to address these problems from a rigorous foundation in decision theory, game theory, social choice theory, and the algorithmic and computational aspects of these fields. Vanessa Putnam, Cristina Conati (2019) in their study "Exploring the Need for Explainable Artificial Intelligence (XAI) In Intelligent Tutoring Systems (ITS)" has identified student attitudes towards incorporating explanations to an ITS, by asking participants for suggestions on the type of explanations, if any, that they would like to see. Their results indicate an overall positive sentiment towards wanting explanation and suggest a few design directions for incorporating explanation into an existing IT.

Amisha Gupta, Deepti Sharma This research investigates the customer's attitude towards the chatbots in Banking Industry of India. The author used correlation analysis to determine and understand the attitude of customer for acceptance and adoption of chatbots in banking industry. Data is collected through Primary survey. 100 people were targeted, out of which 72 responded. The study concludes a positive correlation between the attitude and the adoption of chatbots. As part of the conclusion author made some suggestions and recommendations discussing the implementation of chatbots in the Shyna

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K and Vishal M (2017) in their study "A Study on Artificial Intelligence in E-Commerce" has identified the applications in the e-commerce sector such as real time product targeting, visual search, AI based hiring process, voice powered search, assortment intelligence tool, conversational commerce, customer service, virtual personal shoppers, virtual assistance, AI fake reviews detection, AI based sales process, customer centric advertisements.

III. RESEARCH GAP:

There are many researches that showcases the difference between artificial intelligence and human intelligence, many studies the perception towards the same. But there are none that defines the awareness level of consumers towards artificial intelligence and also shows the preferences towards it.This study tries to fulfill the gap by surveying users on their basic knowledge and preference.

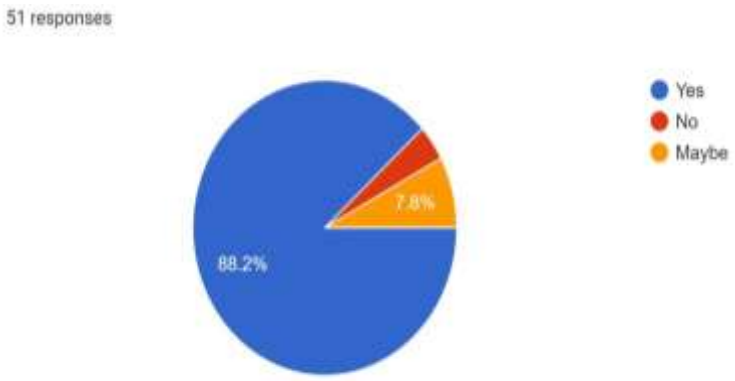
III. OBJECTIVES OF THE STUDY:

- The main objective of this study is to understand the consumers awareness and liking towards artificial intelligence.
- This study tries to focus on the basic need of the users and the influence of artificial intelligence in it.

IV. RESEARCH METHODOLOGY:

51 respondents were interviewed on various aspects dealing with their awareness towards artificial intelligence and preferences towards the scope of artificial intelligence.

V. DATA INTERPRETATION:



Interpretations: 88.2% of people gave their opinion as they have heard about artificial intelligence while other 7.8% of people said they are not sure about the artificial intelligence, and 3.9% of people said they have not heard about artificial intelligence.

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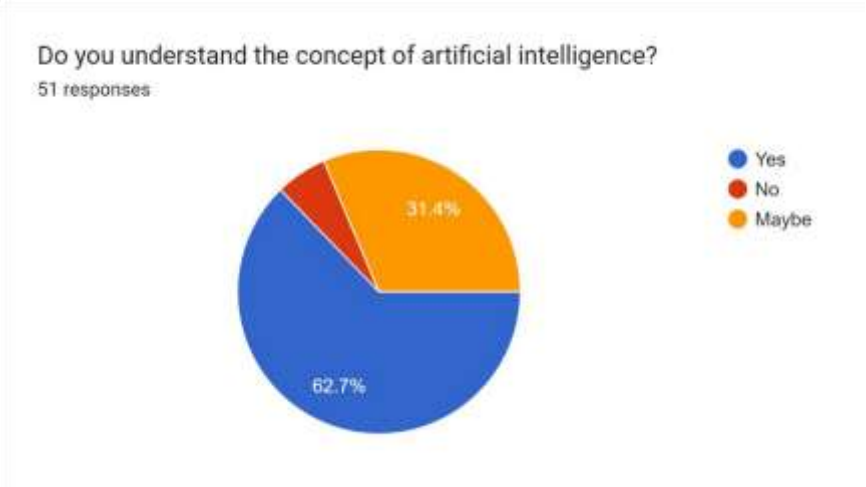
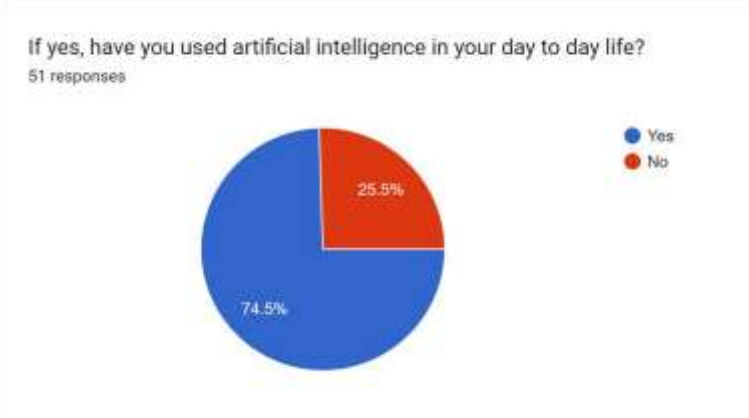
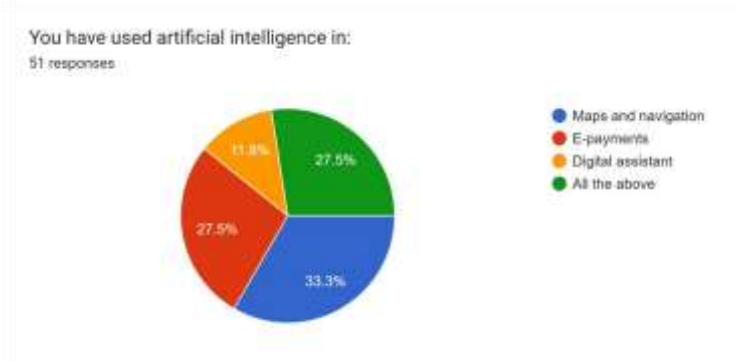


Interpretations: 62.7% gave their opinion as they understand its concept and 31.4% of people were not sure about its concept while other 5.9% of people were not at all aware about the concept of artificial intelligence.



Interpretations:

About 74.5% of people gave their opinion as they use artificial intelligence in their day to day life. While 25.5% of people gave their opinion as they are not using artificial intelligence in their day to day life.



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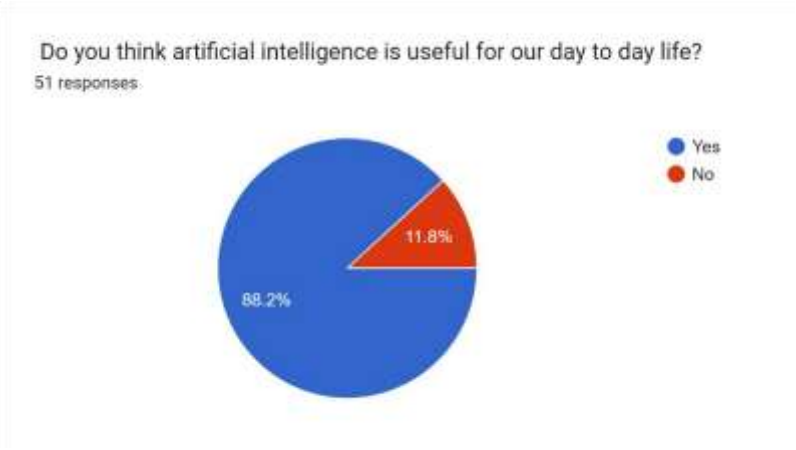
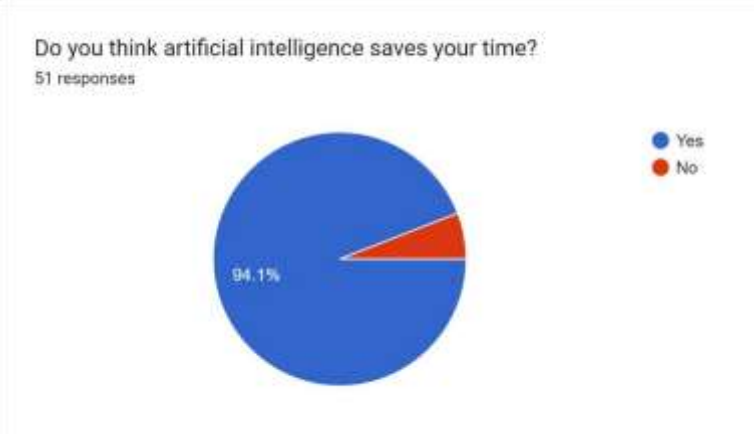
Interpretations:

33.3% people gave opinion as they use artificial intelligence in maps and navigation, 27.5% epayments, 11.8% in digital assistant and other 27.5% of people use all of these in their day to day activities.



Interpretations:

88.2% people gave their opinion as artificial intelligence is useful in day to day life whereas other 11.8% of people say artificial intelligence is not useful in daily life.



Interpretation: 94.1% of people gave their opinion as artificial intelligence saves time while

5.9% people gave their opinion as 5.9% of people says artificial intelligence does not save time.

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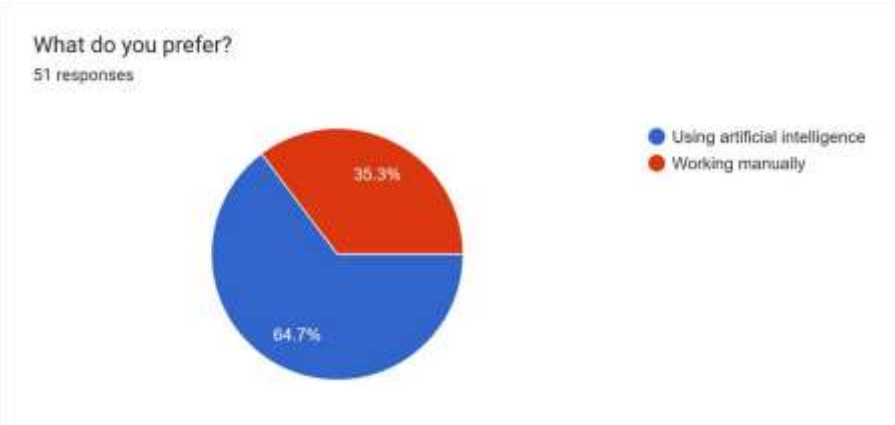
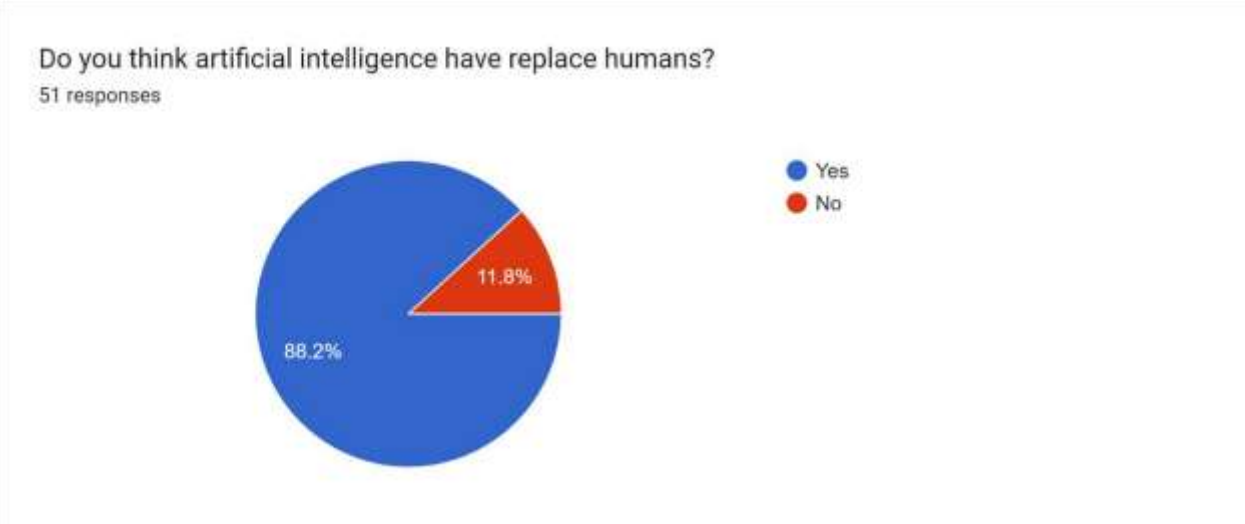


Interpretations:

64.5% of people gave their opinion as they prefer artificial intelligence while other 35.5% of people gave their opinion as they prefer working manually.

Questions:



Interpretation:

88.2% of people gave their opinion as artificial intelligence have replace as humans while other

11.8% of people say artificial intelligence as not replace human.

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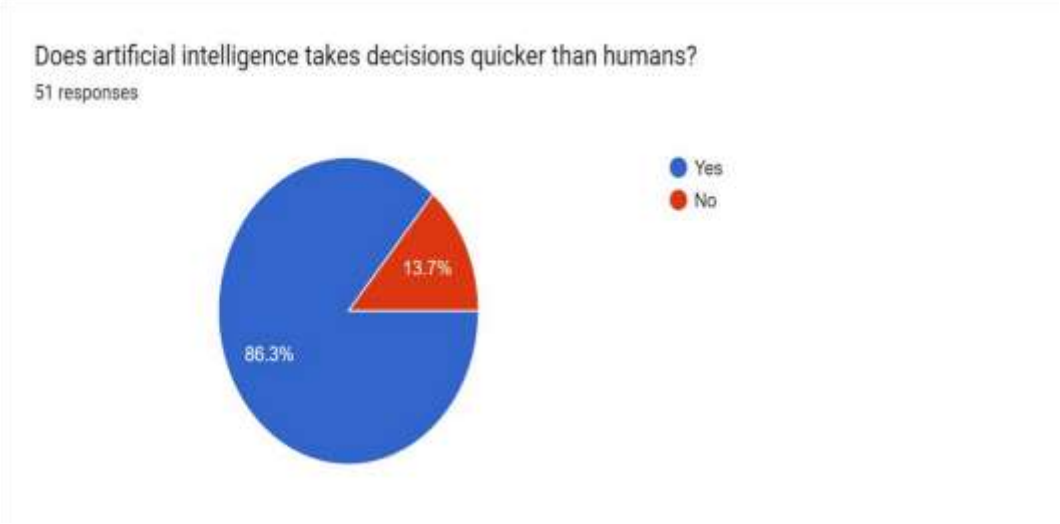
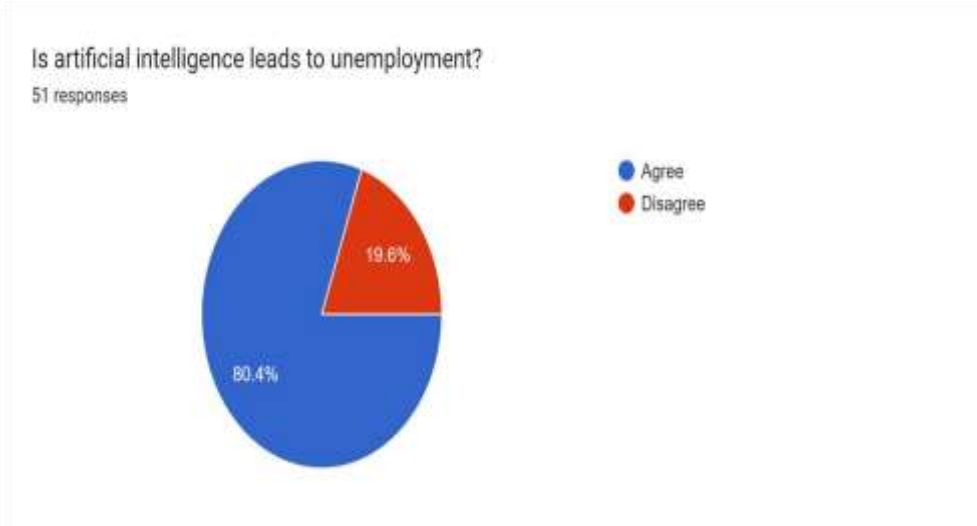


Interpretations:

86.3% of people gave their opinion as artificial intelligence makes decisions quicker than humans. While other 13.7% gave their opinion as artificial intelligence refuses for the same.



Interpretation:

80.4% people gave their opinion as artificial intelligence leads to unemployment as robots and computers are introduced while 19.6% of people say that artificial intelligence does not lead to unemployment as humans are required to operate them.

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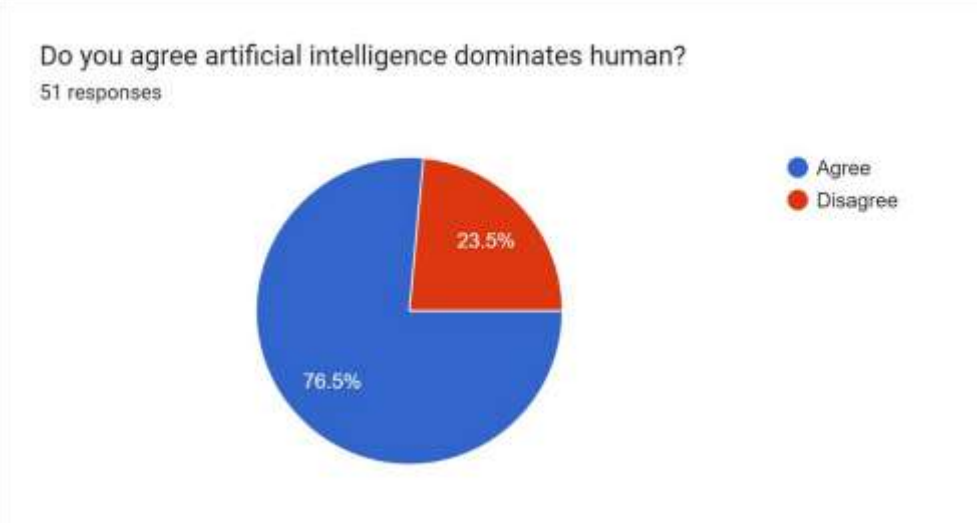
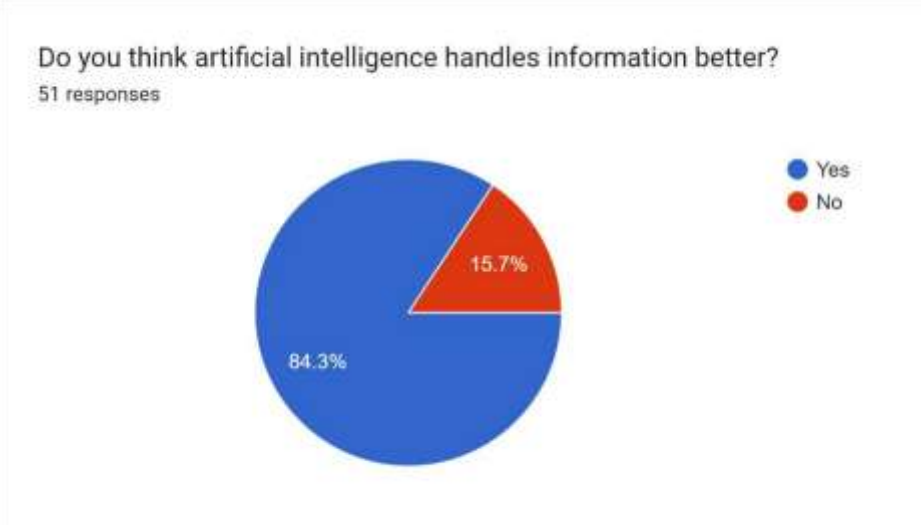


Interpretations:

76.5% of people gave their opinion as artificial intelligence dominates human while other 23.5 % of people say artificial intelligence does not dominates human.



Interpretation:

84.3% people say artificial intelligence handles information better than humans while 15.7% of people gave their opinion as humans handle information better than artificial intelligence.

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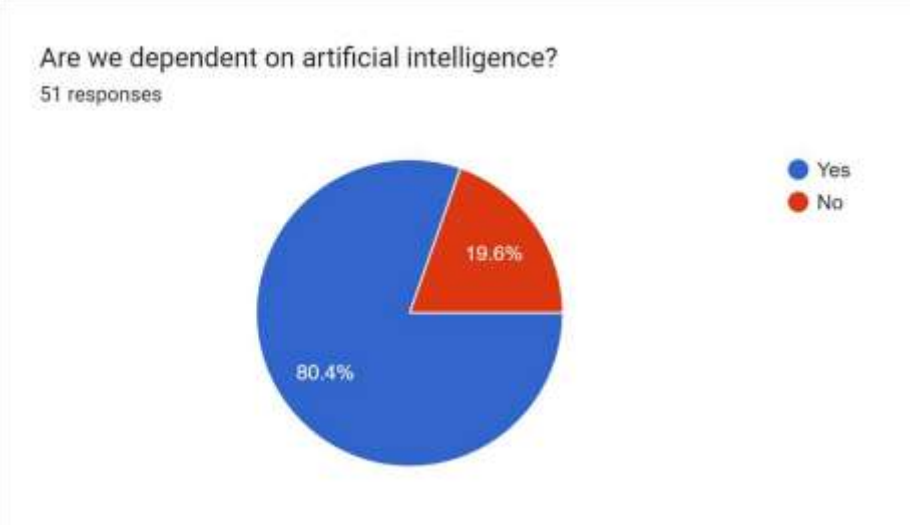
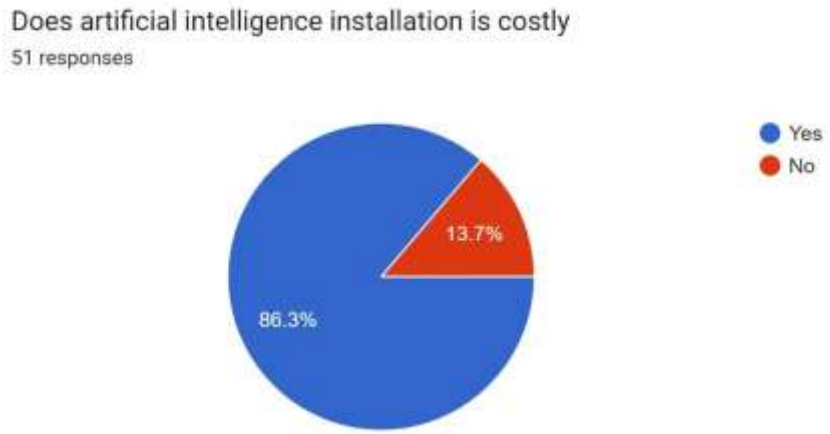


Interpretation:

80.4% of people gave their opinion as they are dependent of artificial intelligence as they perform the task better while other 19.6% of people gave opinion as they prefer working independently.



Interpretation:

86.3% of the consumers says installation of artificial intelligence is high while other 13.7% of Suggestions

VI. FINDINGS:

The outcome of study reveals that:

- Many consumers are aware of AI and making best use of it.
- Many prefer AI to quickly complete their work.
- Ease and security aspect of digital payments, make it amongst the favorite of all other dimensions of AI.

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 While travelling to a new place, maps and navigation are helpful and easier to find destination.

 Digital assistant is also becoming very popular.

VII. SUGGESTIONS:

- Artificial Intelligence will have a significant effect on the consumer retention and satisfaction so must be designed accordingly.
- Handle with care feature or handle will human intelligence instruction will always help in upgrading human intelligence and keeping it superior of all **Scope for further research:**

In future researchers can widen their research on many other factors such as:

- The risk and the challenges.
- The disadvantages faced by the users.
- Screen time.
- Scope of AI tools in daily life.

The research can also be widened on the employees associated with the particular organization and their perception towards the artificial intelligence.

VIII. CONCLUSION:

This study reveals the awareness level of daily users towards artificial intelligence. 88.2% of people gave their opinion as they have heard about artificial intelligence while other 7.8% of people said they are not sure about the artificial intelligence, and 3.9% of people said they have not heard about artificial intelligence. Depending upon the gender, age the differences have been found but the result shows that majority people know about artificial intelligence and tools..The scope of artificial intelligence is so wide and broad that none can be untouched with the use of AI tools. The demand for AI tools will be more rising, people prefer the digital payment system, navigation, chatbots, google assistant the most. Looking at the increasing trend for AI, it paves for higher growth in this market and also evolution of new tools.

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A STUDY ON EMPLOYEE SATISFACTION AMONG THE EMPLOYEES OF THAI HOUSING, CHENNAI

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I. INTRODUCTION

Job satisfaction happens when employees feel like they have a stable job, room to grow in their career, and a good mix between work and personal life. This means that the employee is happy at work because the work meets the person's standards. Job satisfaction is the result of various attitude possessed by an employee in a narrow sense, these attitudes are related to the job under condition with such specific factor such as wages. Job satisfaction is favorable or unfavorable with which the employee view his/her work. It expresses the amount of agreement between one's expectation of the job and the rewards that the job provides. Job satisfaction is a part of life satisfaction. the nature of one's environment of job is an important part of life as job satisfaction influence one's general life satisfaction. The most common way of measurement is the use of rating scales were employees report their reaction to their jobs. Questions relate to rate of pay, Work responsibilities, variety of tasks, promotional opportunities, the work itself and co-workers. This study was conducted to determine the level of job satisfaction among the employees of Thai Housing. This study included a sample of 50 respondents. The primary objective of the project was to study the job satisfaction of employees in Thai Housing. In addition, the secondary objective was to find the opinion on the factors influencing job satisfaction such as working environment and the nature of work, relationship with supervisor and colleagues, welfare facility and pay and promotion

II. OBJECTIVES OF THE STUDY

Primary Objective

To find out the overall job satisfaction levels of employees in Thai Housing.

Secondary Objectives

- To find out opinion of employees on the work.
- To find out the relationship between a employer and the employee.
- To find out the pay and promotion of the employees in the organisation.
- To study the welfare facilities provided by the organisation.
- To give suggestion to improve the job satisfaction levels.

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III. SCOPE OF THE STUDY

This project is done to analyse the job satisfaction level among the employees at Thai Housing. Job satisfaction is an index of the effectiveness of the employees, so employees view about work environment, relationship with supervisors and colleagues, welfare facility, pay and promotion etc. can be know from this survey. It would be useful for the company to know the employees perception. Recommendation that contribute to improvement of above factor will be given Job satisfaction has impact on effective and efficient functioning of organization. Therefore, researcher has formulated problem of findings of job satisfaction

IV. REVIEW OF LITERATURE

DEFINITIONS

According to Edwin A. Locke (1976), who defines job satisfaction as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" others have defined it as simply how content an individual is with their job; Whether they like the job.

IN JOB SATISFACTION

- JURGENSEN (1949) has 3700 applicants for to rate jobs characteristics. He found that security advancement and type of work to be of most importance, supervision, co-workers pay and compare pride, next in importance and hours, working condition and benefits were to least importance.
- HERSON (1952,1954 and 1955) suggested that job satisfaction might be a result rather than a cause of effective job-performance.
- MALSOW (1943) VROOM (1964) and HERZBERG (1959) focused on different aspects of work motivation and job satisfaction. VITLES (1953) has identified the "will to work "as industries core problem in the utilization of its man power resources MAIER (1955)emphasized the need for deeper attention in exploring motivations for better satisfaction an industrial firm.
- KATZ, MACCOBY and MORSE (1950), and Kats, MACCOBY, BURN and FLOOR (1951) did not found and difference between high and low productivity groups regarding satisfactions with wages and job status

REASON FOR LOOSING JOB SATISFACTION

Job dissatisfaction is when employees' expectations for their job are not met. This leaves them with negative perception and lack of motivation and commitment to their work and the organization. This, in turn, affects the performance of the organization and ultimately, its bottom line.

Reason why you may have lost job satisfaction may include:

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- Lack of opportunities for promotion
- Underpaid
- Negative work atmosphere
- Conflict with your supervisor
- Bickering co-workers
- Lack of appreciation

More job Satisfaction can mean less stress

Whether your work is a job, a career or a calling, you can take steps to restore meaning to your job. Make the best of difficult work situation by being positive. Doing so will help you manage your stress and experience the rewards of your profession.

JOB SATISFACTION AS AN INDICATOR OF JOB QUALITY

Although job satisfaction emerged as an indicator of the job quality, proposed by European council in 2001, as was outline at the start of this report, a Spanish research paper (Llorente and macias, 2003) concluded that there is a little or no correlation between job satisfaction and job quality. Two approaches were followed in this paper in order to access the adequacy of using job satisfaction as an indicator of the quality of work. First, using the ISSP of 1997, the author explored whether difference between the countries in terms of job satisfaction can be explained by job quality- related variables, such as working time, wages, etc. Secondly using the Spanish SQLW 2000 as a case study, the authors studied the relationship between certain objective measures of job quality and job satisfaction. In both cases job satisfaction is not related to other objective indicators of job quality, which make this indicator of little adequacy for evaluating job quality. Paradoxically, in a context of pronounced objective in quality among jobs the author found a co- existence of high level of jobs satisfaction, with only a small range of variation between the maximum and minimum level of job satisfaction.

V. RESEARCH METHODOLOGY

It is the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.

Statement of problem

Job satisfaction is the most concerned field of analysis, which has been done by research. Job satisfaction has impact on effective and efficient functioning of organization

Source of Data Collection

The information required for the study was collected from primary and secondary sources

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Pre-testing-initially a questionnaire was prepared comprising of open ended and close- ended questions of study the problem. The questionnaire was distributed. That is the effectiveness and understandability of phrases, sequences of questions, any inclusion of jargons, and the time factor for respondents.

Primary Data

Primary data was collected from the employees of Thai Housing, a questionnaire was used for this purpose, which was administered by the supervisor.

Secondary Data

Secondary source can be found more quickly and cheaply than primary data. Secondary Data needed for conducting this research was collected from various sources such as books, magazines, company record's and other electronic sources.

Percentage method

Percentage method refers to a special kind of ratio. Percentages are used in comparison between two or more series and to describe the relationship. Percentage reduces everything to a common base and thereby allowing meaningful comparison to be made.

Research design sampling

Sampling Method

The sampling method used in the research is a non-probability sampling under which the sampling units are chosen primarily based on the convenience of the research.

Sampling size Based on the convenience sampling the sample size was determined. A sample of 100 employees of Thai Housing was chosen for administering the questionnaire.

VI. DATA ANALYZE AND INTERPRETATION

Opinion on Working Hours

Opinion	Number of respondents	Percentage %
Strongly agree	90	90%
Agree	10	10%
Disagree	0	0
Total	100	100%

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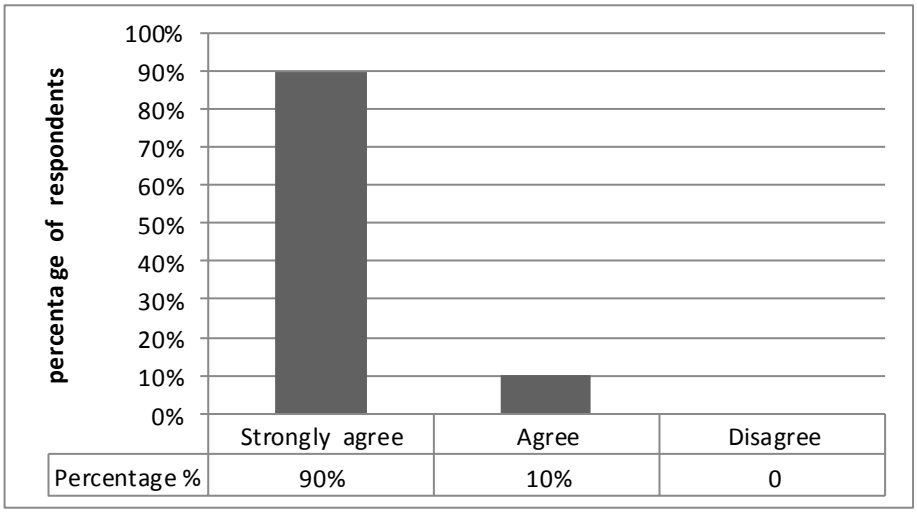
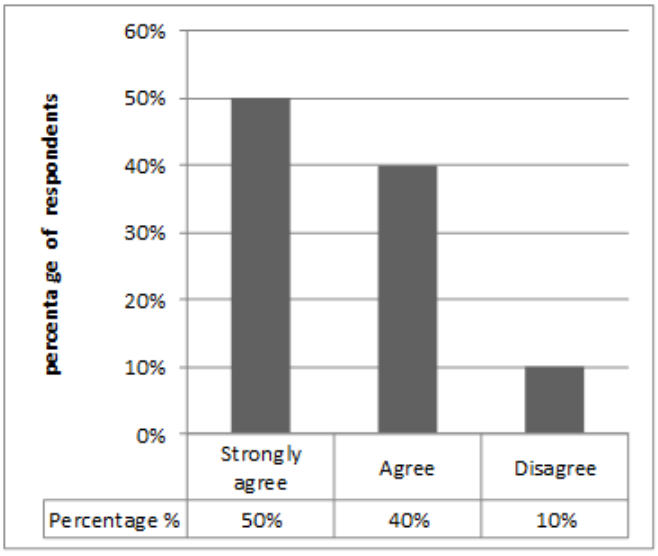


Inference:

From the above table, it shows that 90% of the respondent's strongly agree and 10% of the respondent's agree that they are convenient with the working hours of the company and none of them are inconvenient with the working hours.

Opinion on lighting and ventilation arrangements

Opinion	Number of respondents	Percentage %
Strongly agree	**50**	**50%**
Agree	**40**	**40%**
Disagree	**10**	**10%**
Total	**100**	**100%**



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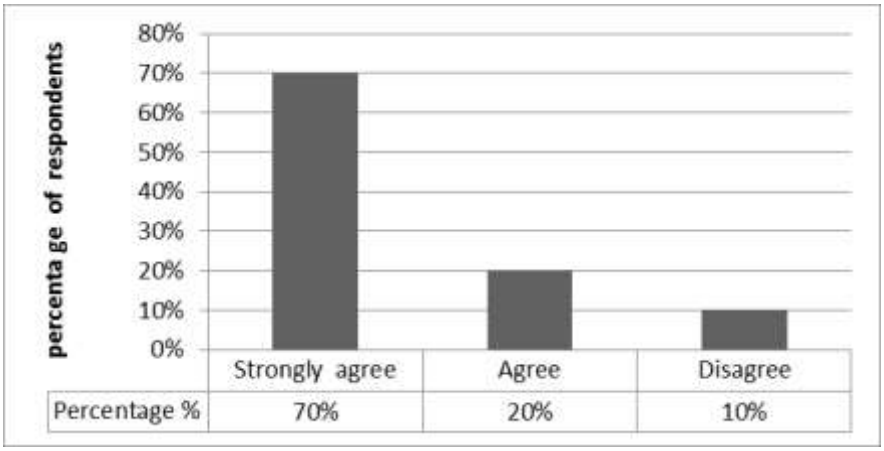
Inference:

From the above, it shows that 50% of the respondent's strongly agree and 40% of the respondent's agree that there are convenient with the lighting and ventilation arrangements of the company.

Opinion on safety measures

Opinion	Number of respondents	Percentage %
Strongly agree	**70**	**70%**
Agree	**20**	**20%**
Disagree	**10**	**10%**
Total	**100**	**100%**



Inference:

From the above table, It shows that 70% the respondents feel that they strongly agree, 20% of the respondent's agree that they are convenient with the safety measures of the company and rest 10% of the respondents feel that they are inconvenient with the safety measures of the company.

Opinion on Relationship with supervisor

Opinion	Number of respondents	Percentage %
Strongly agree	**62**	**62%**
Agree	**30**	**30%**
Disagree	**8**	**8%**
Total	**100**	**100%**

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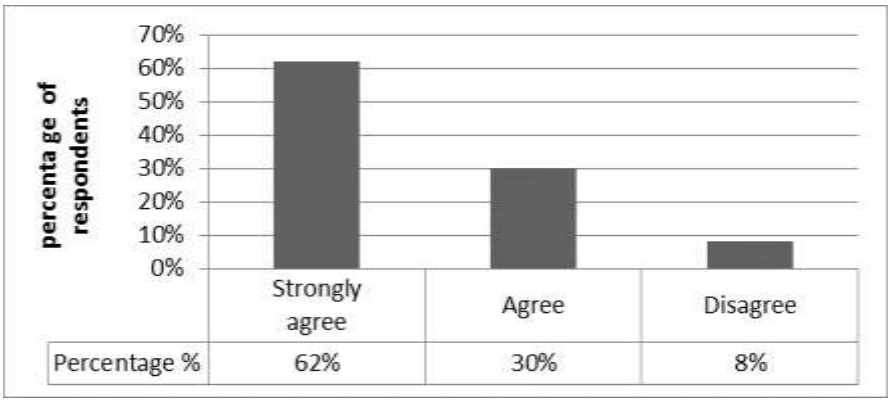
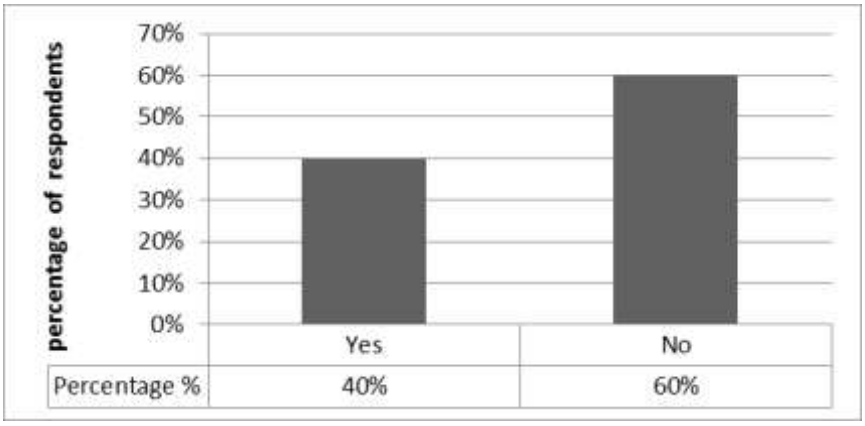


Inference:

From the above table, it shows that 62% of the respondents strongly agree, 30% of the respondents agree that the relationship with the supervisor is cordial and rest 8% of the respondents feel that the relationship with the supervisor of the company is not cordial.

Do you have career conversations with your manager?

Opinion	Number of respondents	Percentage %
YES	**40**	**40%**
NO	**60**	**60%**
Total	**100**	**100%**



Inference:

From the above table it is clear that 60% of the employees doesn't have a career conversations with their manager and only 40% have such conversation.

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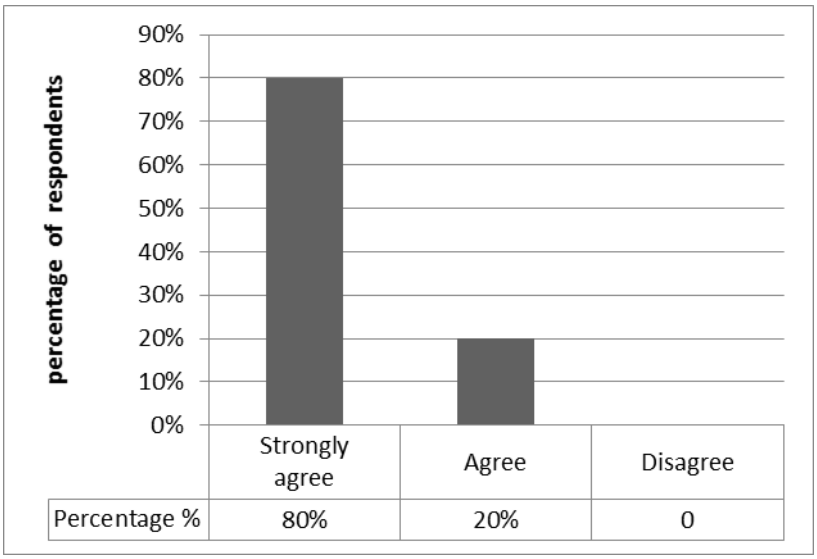
Workplace is distraction free

Opinion	Number of respondents	Percentage %
Strongly agree	**80**	**80%**
Agree	**20**	**20%**
Disagree	**0**	**0%**
Total	**100**	**100%**



Inference:

80% of the respondents have responded that the work place is distraction-free and 20% agreed to it.

VII. FINDINGS OF THE STUDY

- As per the survey, employees feel that they are convenient with the lighting and ventilation arrangements.
- It is found from the research that employees that they are satisfied with the safety measures of the company.
- As per the survey, employees feel that the relationship with the supervisor is been good.
- It is found from the research that, employees feel that the supervisor supports them.

VIII. RECOMMENDATION OF THE STUDY

- Job enrichment and promotion can make the employee to stay in the organization.
- A good salary & better allowance or incentives can make the employee to stay in the job fo a long period.
- More man power is to be recruited.
- The incentives given towards the employee can be developed.

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- The ideas given by the subordinates can be taken in to consideration

IX. CONCLUSION

Employee Welfare measures prove to be an important factor when compared to the other factors in the organization. When these measures are not provided to the fullest extent the worker's self-interest and motivation decreases and their dedication to the work may declines. So, the task of the Personnel Manager becomes challenging and it imposes him to introduce the various employee welfare measures in the organization. This research work tries to bring out various suggestions on how to enhance the welfare measures in Thai Housing , so as to increase the satisfaction level of employees. Promotion and nature of the job are so interesting, challenging and easy that makes the employees to stay in the organization. Employees in the organization are satisfied with their job and environment and culture of the organization will. Therefore, if there is increment in the salary the employees will also be satisfied. Whereas the organization will also be satisfied with the employee's job. Finally, the conclusion is all employees working in the Thai Housing have been satisfied with the job they are doing. This will help the worker to achieve their work targets easily. "IF the job satisfaction is good in the company it will result in the unexpected growth of the organization.

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EMPLOYEE ENGAGEMENT

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I. INTRODUCTION

The individual's involvement and satisfaction with as well as enthusiasm for work. A heightened emotional connection that an employee feels for his or her organization, that influences him or her to exert greater discretionary effort to his or her work.

OPERATIONAL DEFINITIONS

The extent that an employee believes in the mission, purpose and values of an organization and demonstrates that commitment through their actions as an employee and their attitude towards the employer and customers. Employee engagement is high when the statements and conversations held reflect a natural enthusiasm for the company, its employees and the products or services provided. An organization's productivity is measured not in terms of employee satisfaction but by employee engagement. Employees are said to be engaged when they show a positive attitude toward the organization and express a commitment to remain with the organization.

ELEMENT OF ENGAGEMENT

Some researchers conclude that personal impact, focused work, and interpersonal harmony comprise engagement. Each of these three components has sub-components that further define the meaning of engagement.

Personal Impact

Employees feel more engaged when they are able to make a unique contribution, experience empowerment, and have opportunities for personal growth. Past research concurs that issues such as the ability to impact the work environment and making meaningful choices in the workplace are critical components of employee empowerment. Development Dimensions International's (DDI) research on retaining talent found that the perception of meaningful work is one of the most influential factors determining employees' willingness to stay with the organization.

Focused Work

Employees feel more engaged when they have clear direction, performance accountability, and an efficient work environment. Aside from the personal drive and motivation to make a contribution,

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employees need to understand where to focus their efforts. Without a clear strategy and direction from senior leadership, employees will waste their time on the activities that do not make a difference for the organization's success. Additionally, even when direction is in place, employees must receive feedback to ensure that they are on track and being held accountable for their progress. In particular, employees need to feel that low performance is not acceptable and that there are consequences for poor performance. Finally, employees want to work in an environment that is efficient in terms of its time, resources, and budget. Employees lose faith in the organization when they see excessive waste. For example, employees become frustrated when they are asked to operate without the necessary resources or waste time in unnecessary meetings.

II SCOPE OF THE STUDY

- This study will help the organization to keep the employees engaged by conducting other activities apart from their regular work.
- This will also give the organization few important inputs in order to improve their stands on current employee engagement activities.
- The project allows for increased engagement of employees, and loyalty by identifying the root causes of employee engagement and targeting those areas.
- Listening to employees' insights and suggestions for improvement provides the organization with valuable information that can be acted upon to increase satisfaction in the workplace.

III. OBJECTIVE

- To find out the Nature of employee engagement programs.
- To find out how far the employees are satisfied with such programmes.
- To find out the extent to which the employees are committed to the organization.
- To Study about the level of employee engagement in the company in Chennai Zon

IV. RESEARCH METHODOLOGY

The research design is the basic framework or a plan for a study that guides the collection of data and analysis of data. In this survey and the design used is ***Descriptive Research Design***. It includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of state of affairs, as it exists at present.

Data Collection: comprehensive questionnaire was prepared to meet out the needs of the objective.

SOURCES OF DATA: Data collection method is the backbone of the research design. The source of data utilized for analysis and report preparation is both primary and secondary.

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Primary data : Primary data was collected through the interview and getting the questionnaires filled. The interview was made only to the employees who were willing to share their views.

Secondary data: The main source of secondary data was internet.

SAMPLING TECHNIQUE

The Convenience Sampling Method is used for the survey. Convenience or opportunistic sampling is the crudest type of non-random sampling. This involves selecting the most convenient group available.

Sampling Unit: The employees who are working in Vistonsoft Technologies were met and the survey was made based on their response.

Sampling Area: The sampling area considered for the current research was Vistonsoft Technologies in Chennai.

Sample Size: 110 employees were surveyed during the study period.

Questionnaire Design: The questionnaire design is basically closed ended questions. As multi- option are given to the employees for their convenience. 5 point rating scale is used in the study.

Statistical tools: Simple percentage analysis and tabulation is used to analysis the data. Pie chart and bar diagram is used to give pictorial representation to the analysis.

V. DATA ANALYSIS AND INTERPRETATION

Rewards after the engagement activity

REWARDS AFTER THE ENGAGEMENT ACTIVITY	FREQUENCY	PERCENT
STRONGLY DISAGREE	2	1.8
DISAGREE	2	1.8
AGREE	34	30.9
STRONGLY AGREE	72	65.5
Total	110	100.0

INTERPRETATION

It is found from the Table - 21 that 65.5 per cent of the employees strongly agree, 30.9 per cent of the employees agree, 1.8 per cent of the employees strongly disagree and 1.8 per cent of the employees disagree that they have been rewarded at the end of employee engagement activities.

These details reveals the fact that the employees have to be rewarded at the end of employee engagement activities in order to make the actively participate in the engagement activities and it also

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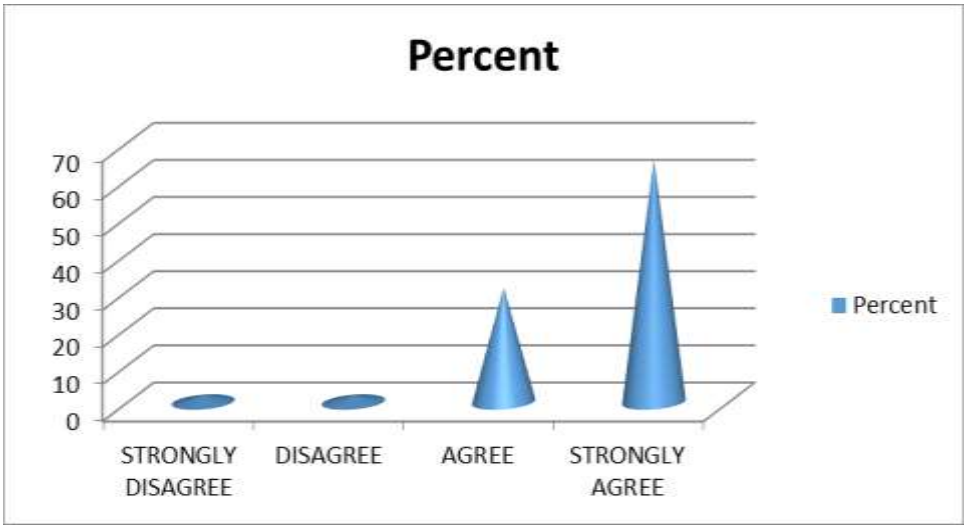
gives recognition to the employees. About 96 per cent of the respondents agree that they have been rewarded after every activity

Rewards after the engagement activity



RESPONDENTS LEVEL OF SATISFATION TOWARD THE REWARD GIVEN AT THE TIME OF EMPLOYEE ENGAGEMENT ACTIVITY

This variable has been studied to determine whether the employees are satisfied with the rewards given after the employee engagement activities.

Satisfaction about the rewards given

SATISFACTION ABOUT REWARDS GIVEN	FREQUENCY	PERCENT
STRONGLY DISAGREE	4	3.6
DISAGREE	6	5.5
AGREE	29	26.4
STRONGLY AGREE	71	64.5

INTERPRETATION

It is found from the Table - 22 that 64.5 per cent of the employees strongly agree, 26.4 per cent of the employees agree whereas 5.5 per cent and 3.6 per cent of the employees disagree and

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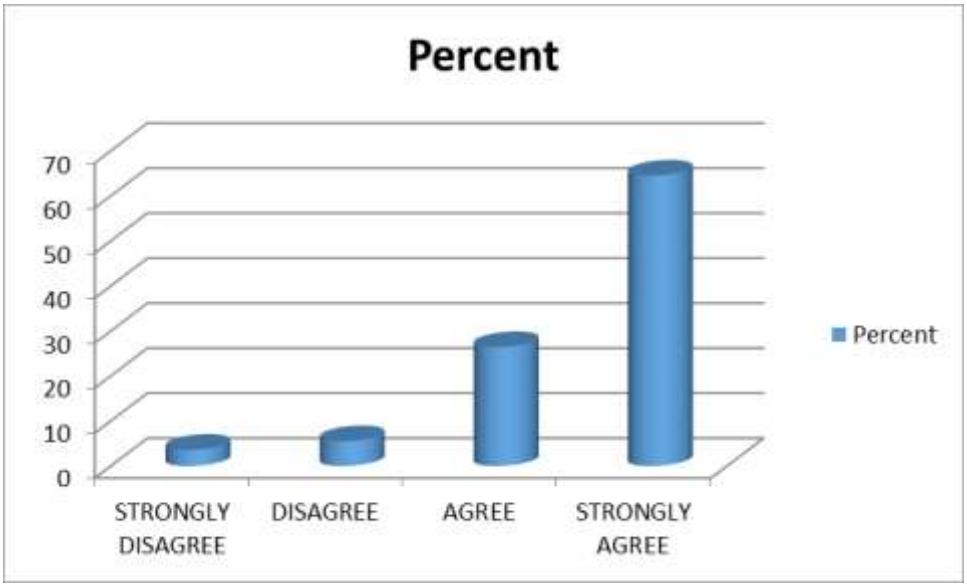
Satisfaction about the rewards given



RESPONDENTS OPINION ON THE TYPES OF REWARD GIVEN BY THE ORGANIZATION AT THE TIME OF EMPLOYEE ENGAGEMENT ACTIVITY

This variable has been studied to determine what type of reward schemes are in place at the company for the employees after the engagement activities.

Type of Reward schemes at the company

TYPE OF REWARD SCHEMES AT THE COMPANY	FREQUENCY	PERCENT
COMPENSATION & BENEFIT PROGRAMMES	14	12.7
RECOGNITION PROGRAMMES	77	70
COMP AND BEN.PROG & RECOGNITION PROG	18	17.3
Total	110	100.0

INTERPRETATION

It is found from the Table – 23 that 70 per cent of the employees say recognition programs, 17.3 per cent of the employees say both compensation and benefit programs and recognition programs are at place, 12.7 per cent of the employees say compensation and benefit programs, are the type of reward schemes are in place at the company for the employees after the engagement activities.

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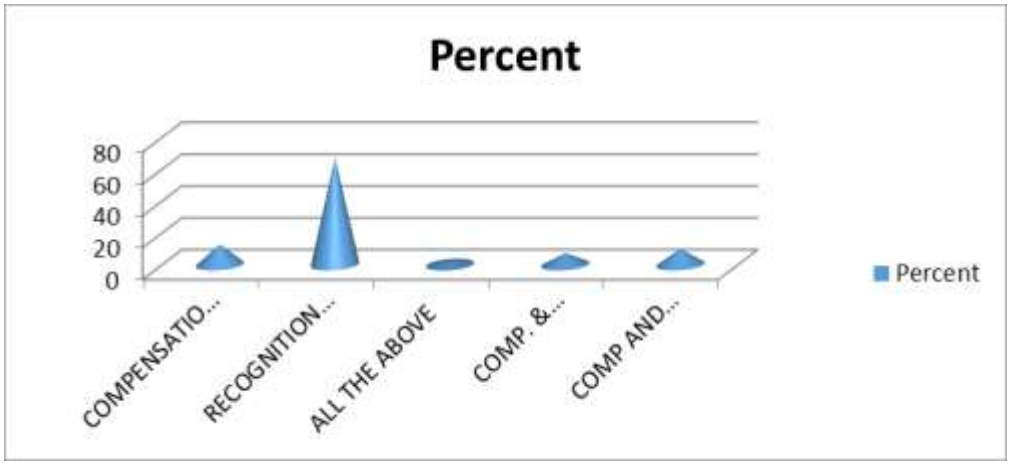
Type of Reward schemes at the company



RESPONDENTS OPINION TOWARDS THE ORGANIZATION STEPS TAKEN TO ENGAGE THEM DURING THE LOCAL FESTIVAL & CELEBERATIONS

This variable has been studied to determine whether the organization conducts Local Festivals & Birthday celebration

Special day celebrations

SPECIAL DAY CELEBRATIONS	FREQUENCY	PERCENT
STRONGLY DISAGREE	4	3.6
DISAGREE	6	5.5
AGREE	30	27.3
STRONGLY AGREE	70	63.6
Total	110	100.0

INTERPRETATION

It is found from the Table - 24 that 63.6 per cent of the employees strongly agree, 27.3 per cent of the employees agree whereas 5.5 per cent and 3.6 per cent of the employees disagree and strongly disagree that their organization conducts (local festivals) special day celebrations like Birthday, Independence Day and Republic day.

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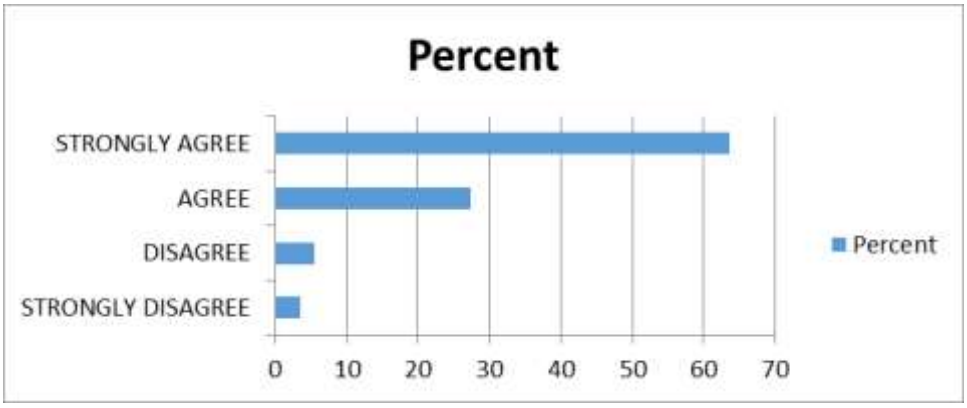
CHART

Special day celebrations



RESPONDENTS OPINION TOWARDS THE ORGANIZATION STEPS TAKEN TO ENGAGE THEM DURING THE FESTIVAL CELEBRATIONS OF ALL RELEGIONS

This variable has been studied to determine whether the organization conducts festival celebrations of all religions.

Festival Celebrations of all religions

FESTIVAL CELEBRATIONS OF ALL RELIGIONS	FREQUENCY	PERCENT
STRONGLY DISAGREE	6	5.5
DISAGREE	13	11.8
AGREE	48	43.6
STRONGLY AGREE	43	39.1
Total	110	100.0

INTERPRETATION

It is found from the Table - 25 that 39 per cent of the employees strongly agree, 43.6 per cent of the employees agree, 11.8 per cent of the employees disagree and 5.5 per cent of the employees disagree that their organization conducts festival celebrations of all religions.

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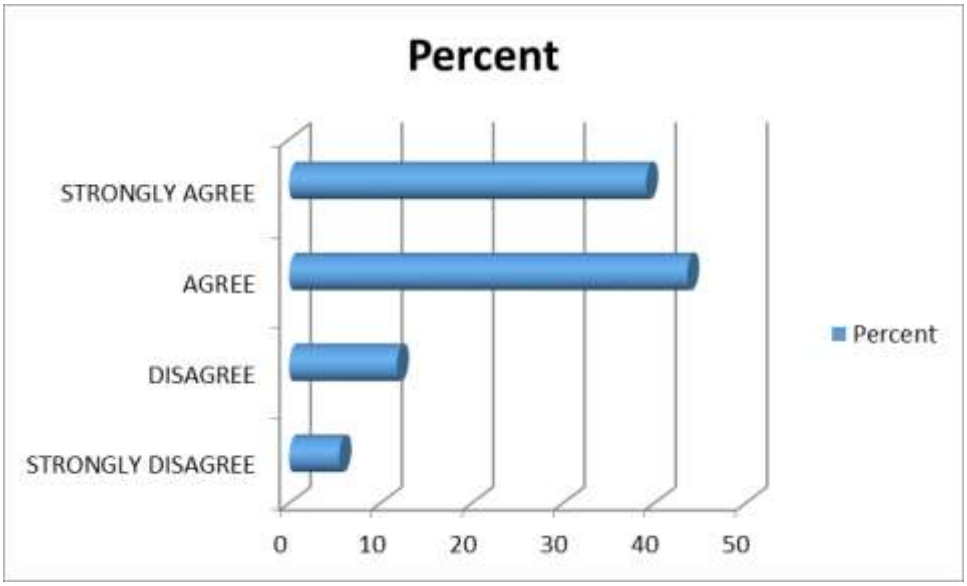
CHART

Festival Celebrations of all religions



RESPONDENTS OVERALL SUGGESTIONS ON THE EMPLOYEE ENGAGEMENT ACTIVITIES CONDUCTED BY THE ORGANIZATION

This variable has been studied to determine the employee's suggestions about the engagement activities.

Suggestions about engagement activities

SUGGESTIONS ABOUT ENGAGEMENT ACTIVITIES	FREQUENCY	PERCENT
YES	24	21.6
NO	86	78.4
Total	110	100.0

INTERPRETATION

It is found from the Table - 26 that 77.5 per cent of the employees are No suggestions about the engagement activities, whereas 21.6 per cent of the employees are gave the suggestions about the engagement activities.

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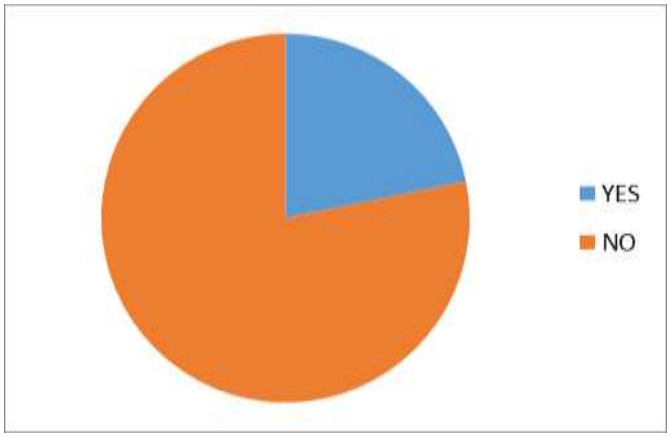
Suggestions about engagement activities



VII. MAIN FINDINGS

- Sixty six per cent of the employees strongly agree that they are rewarded at the end of the employee engagement activities.
- Sixty five per cent of the employees agree that they are satisfied with the rewards given by the company after the employee engagement activity.
- Seventy per cent of the employees say that Recognition programmes are in place at their company after the employee engagement activity has been conducted.
- Sixty four per cent of the employees agree that their company conducts (local festivals) special day celebrations like Birthday, Independence Day and Republic day.
- Forty five per cent of the employee in the company agrees that their company conducts festival celebrations of all religions.
- Seventy eight per cent of the employees are not given any suggestions about the engagement activities.

VIII. SUGGESTIONS

- Employees have diverse needs so this diversity requires flexible and individually directed support. The priority must be to offer a customizable program that can be tailored to the specific needs of each individual.
- Health savings plan, HSAs paired with high deductible health plans, HDHPs help employers cope with rising health care premiums can be implemented.
- Incentive awards must be designed to reward employees ideas, suggestions and solutions that results in cost savings and generate revenue.
- Cash awards or gift certificates can be awarded as per the policy and procedures governing recognition/incentive programs.
- On the spot citation awards may be granted for specific behaviours.

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IX. CONCLUSION

Every individual organization growth is not a real growth.

Every organization as well as employee growth is a real growth.

The study on Employee engagement activities at Vistonsoft Technologies reveals that the engagement level of employees is at a moderate level. But, there are certain areas that need to be improved in order to make the employees feel engaged as far as their jobs are concerned. Several job elements contribute to employee engagement. It has also been found that the employees have considered certain factors which influence and affect employee engagement, i.e., recognition of suggestions given by employees, reward systems or policies, Initiatives taken by the management, Work allocation with respect to the capabilities and limitations of the employees, and timely improvements on the basis of feedback of the employees, most importantly the type of activities conducted. Serious consideration and review of these factors by the management may help in making certain improvements in these areas. Actions taken on the same could lead to an increased level of morale, loyalty, productivity and engagement among employees in the organization. By doing so employees turn out to more committed and satisfied human resources.

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OPEN BANKING WORKING GROUP

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I. INTRODUCTION

Since the inception of the "Open Banking Working Group" in the United Kingdom in 2015, open banking has generally been considered as the platformization of the retail banking industry To date, it has spread worldwide from the UK to Continental Europe, America, and Asia, constituting one of the retail banking industry's shaping forces of the future Thus, on top of the open banking initiative in the UK and PSD2 (Payment Services Directive) in the European Union, there are open banking regulations in Australia, India, Mexico, and Brazil, and forthcoming regulations in Russia and Canada. The essence of open banking regulations is to recognize the banking clients' right to share their transactional data with authorized third parties and detailed provisions on how to materialize this right Despite its apparent simplicity, this data-sharing right constitutes the primary vector for fostering the transformation of the retail banking sector from a closed business model to an open platform, similar to what occurred in telecommunications, power, and gas industries Open banking originated from practitioners and was inspired by the open data, open-APIs (Application Programming Interfaces), and open innovation philosophies applied to the retail banking business.

The business community is analyzing this phenomenon extensively, understanding it as a "collaborative model in which banking data is shared through APIs between two or more unaffiliated parties to deliver enhanced capabilities to the marketplace" . Its first implementation worldwide materialized in the UK. It was requested by the Competition and Markets Authority as a foundational strategy to ascertain that personal current accounts, as well as small and medium-sized enterprises' banking markets, serve customers better. This issue emanated from a retail banking market investigation concluded in 2016/ It also inspired the European Commission to publish the PSD2 . Although open banking is still in its initial stages of development, the concept has been embraced by practitioners and regulators, being regarded as one of the shaping forces of the financial industry worldwide. Nevertheless, despite existing literature acknowledging the importance of open banking as a critical retail banking industry's transformational lever open banking as a research object still lacks conceptualization both theoretically and empirically. Academic literature on the subject is still in its early stages of development. Out of 990 documents registered in the Google Scholar database (Aug 6,

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2021) containing the term "open banking," only 57 were published in Scopus-rated peer-reviewed academic journals

II. OBJECTIVES OF THE STUDY

- Open Bank also provides users with access to a range of third-party financial services, such as credit cards, investment products, and tax services.
- Open Bank also allows users to link their accounts to other third-party services, such as PayPal, Amazon, and Apple Pay.
- Additionally, Open Bank offers a secure environment for users to store and access their financial data.

III. REVIEW OF LITERATURE

"Open Banking could be all kinds of things, from a remedy to an ecosystem, or most often: a (business) model of some sort. Its purposes are considered to be providing new ('better', 'customer-centric') services to customers and improving competition in the banking market by letting 'third parties' in."

O'Leary et al. (2021), building on an open data lenses approach, propose the following definition: "An initiative which facilitates the secure sharing of account data with licensed third parties through Application Programming Interfaces (APIs), empowering customers with ownership of their own data. The initiative aims to increase competition in retail banking by developing innovative products and services which will bring increased value to customers."

Laplante and Kshetri (2021) approach the need for a definition of open banking, but do not provide a generalized definition other than describing the phenomenon as: "Open banking describes a special kind of financial ecosystem. The ecosystem provides thirdparty financial service providers open access to consumer banking, transaction, and other financial data from banks and nonbank financial institutions through the use of application programming interfaces (APIs)."

The existing definitions of open banking present three types of problems fundamentally: perspective bias, discipline bias, and purpose bias. Starting with the perspective bias problem, open banking is a tripartite scheme between the owner of the data, custodian, and third party who accesses it. Any general definition must consider the three agents to avoid partial or incomplete analysis of the phenomenon. Regarding the discipline bias problem, researchers tend to confuse the context in which open banking is used in their discipline with a generally applicable definition. Thus, technical literature focuses exclusively on the technological support of the phenomenon, the regulatory literature on its legal support, and the management literature on the possible implications for the

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business model. However, a generalized concept of open banking must be able to encompass all its contexts of use and not just one of the meanings. Finally, the purpose bias problem consists of giving open banking a specific purpose other than the one for which it was formulated: to increase competition in retail banking by facilitating the entry of new competitors. Considering the combined effect of the three biases

IV. RESEARCH METHODOLOGY

In this chapter is introduced research methodology and factors how it has been synthesized with research process, data collection methods and analysis methods. In addition, the actual data collection is walked through following with the data analysis and presenting the results. This chapter is concluded with the evaluation of research validity and reliability.

Research Descriptive : This study made use of a descriptive research design in exploring deeply into the course of this study. This study adopted a survey research method to generate the necessary information that was needed for the research work.

Data Source: There were many sources available for the researcher to adopt in order to gather information concerning the topic at hand, but due to non-existence of solid and accurate data from a modified or secondary source, the researcher was hereby restricted to making use of primary sources of generating information which is abetted via a well-structured and organized questionnaire comprising meaningful questions relating to the topic at hand.

Data Collection : Data collected is one of the most important aspects of research. For the success of any project accurate data is very important and necessary. The information collection through research methodology must be accurate and relevant.

Primary Data: Data that has been collected from first-hand-experience is known as primary data. Primary data has not been published yet and is more reliable, authentic and objective. Primary data has not been changed or altered by human beings; therefore its validity is greater than secondary data. Importance of Primary Data:

Secondary Data: Secondary data is the data that is collected from the primary sources which can be used in the current research study. Collecting secondary data often takes considerably less time than collecting primary data where you would have to gather every information from scratch.

Sampling Technique: Sampling techniques can be broadly classified in to two types: Probability Sampling and Non Probability Sampling.

Sample Size : Around 100 people were given the surveys to find out the examination.

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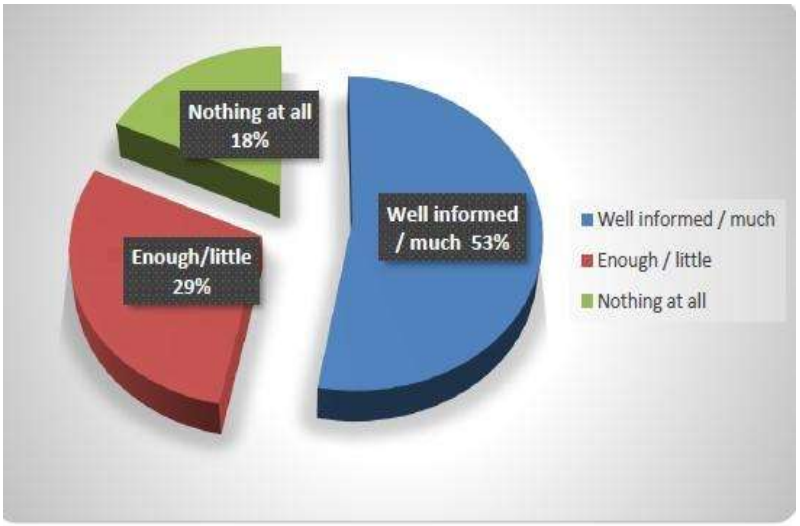
V. DATA ANALYSIS AND INTERPRETATION

How much you are aware of the products of open-Banking?

Particulars	**No. of Respondents**	**Percentage**
Well informed / much	53	53%
Enough / little	29	29%
Nothing at all	18	18%



INTERPRETATION:

We had surveyed 100 people. Out of them 53% people are well informed about open-banking, 29% people are having little knowledge about E-banking, 18% people do not know about the open banking.,

How often you avail of the service of open banking?

Particulars	**No. Of Respondents**	**Percentage**
never	18	18%
1-time	21	21%
2-3 times	43	43%
4-6 times	10	10%
Everyday	8	8%

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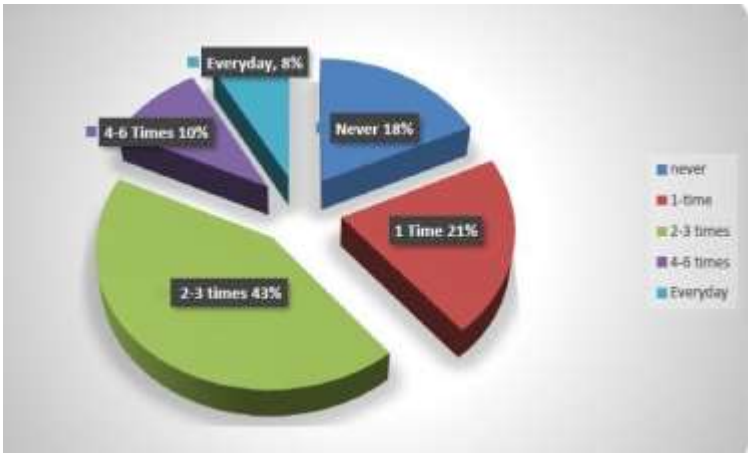
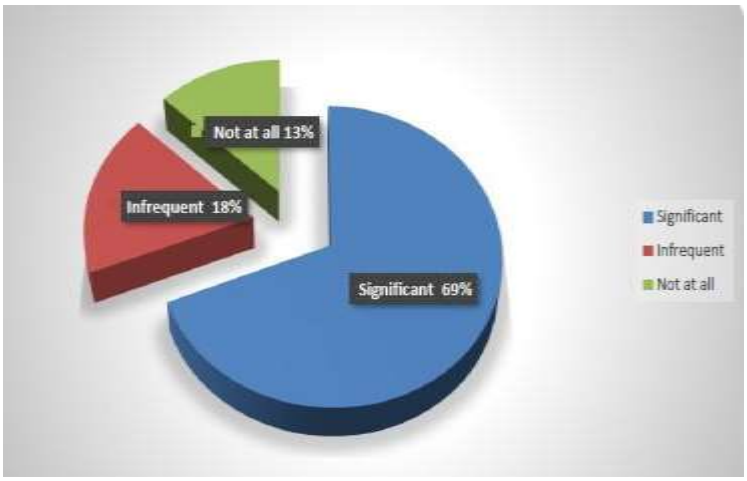


INTERPRETATION:

We had surveyed 100 people. Out of them 18% people never use E-banking, 21% people are using 1-time, 43% are using 2-3 times, 10% are using 4-6 times, 8% people are using E-banking on everyday basis.

How important would be the open Banking for your day-to-day activities

Particulars	**No. Of Respondents**	**Percentage**
Significant	69	69%
Infrequent	18	18%
Not at all	13	13%



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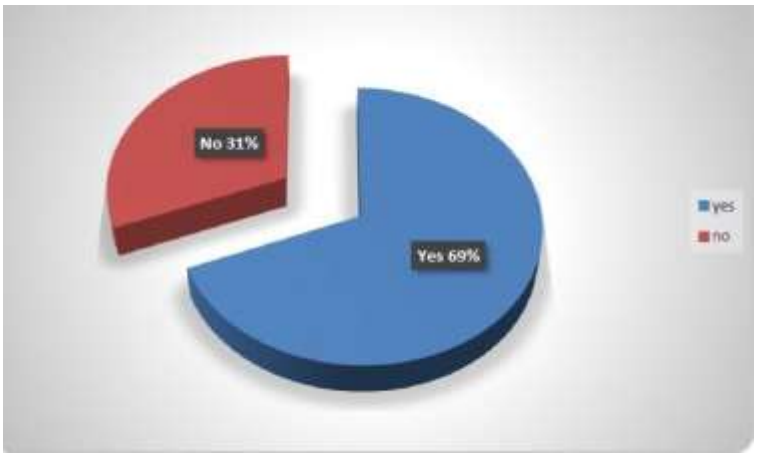
INTERPRETATION:

According to survey, 69% people find that E-banking is having significant importance in their daily banking activities, 18% people find that E-banking is having infrequent importance in their daily banking activities 13% people find that E-banking is not at all important in their daily banking activities.

Are the services being offered adequate?

Particulars	**No. Of Respondents**	**Percentage**
YES	69	69%
NO	31	31%



INTERPRETATION:

According to survey, 69% people find that the services being offered to them are adequate but 31% people that the services being offered to them are not adequate This shows what people feel about banking services and this may also be one of the reason for the dissatisfaction of the people

What kind of banking transactions you normally do use the Internet?

Particulars	**No. Of Respondents**	**Percentage**
Personal banking	48	48%
Business Transaction	39	39%
Both	13	13%

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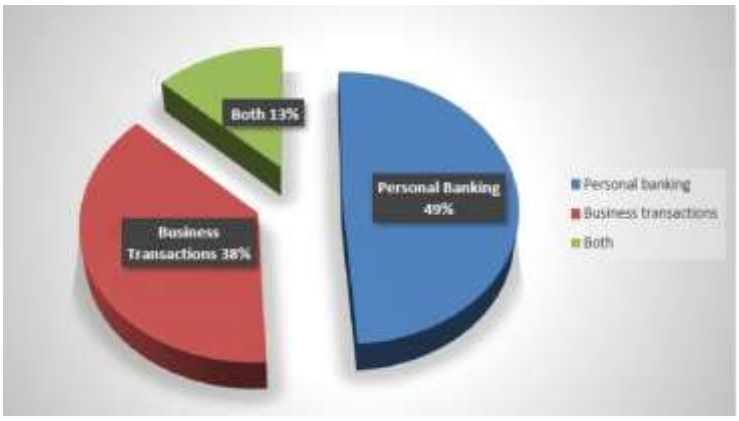

INTERPRETATION:

According to survey, 48% people do personal banking over the internet, 39% people do business transactions over the internet and 13% people do personal banking as well as business transactions over the internet.

VI. DISCUSSION AND CONCLUSION

Customer expectations in financial services are increasingly being conditioned by their experiences in other industries that are further along the digital curve. In retailing, for example, customers have overcome their early inhibitions about buying fashion online driven by styling and fit concerns (and indeed industry scepticism). This has been aided in no small part by flexible return policies, pioneered by new market entrants rather than incumbents, which have gradually become the industry norm. We believe the emergence of marketplace banking and the ensuing fight to capture the customer interface between incumbents and new entrants alike will drive similar pressures for change. Even in the context of baking's currently low switching rates and the need for greater customer reassurance in money matters, we believe that banks will need to use customer data to: •improve the user experience, •tailor services and offers to customers , •anticipate their future needs.

This will necessitate a shift in focus away from individual product profitability. Instead, it will move to identifying gaps in the bank's offering based on customer needs and determining whether these can be filled internally or via partnerships with TPPs. Potential new entrants, ranging from relatively traditional players like PCWs to non-traditional players such as Fin Techs and technology giants, are likely to adopt this customer-centric approach, forcing a shift in industry mindset and practices. This is likely to lead to a blurring of industry boundaries, with non-traditional players moving into banking and banks potentially moving into non-traditional services. Incumbent banks have much to consider if they are to thrive in this future landscape. However, they cannot afford to stand still. By addressing their leadership and culture, improving their ability to optimize their use of data and embracing opportunities to automate, incumbent banks will be well positioned to maintain the customer relationship and, ultimately, to win in an 'open banking' world.

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A STUDY ON EMPLOYEE'S ATTRITION

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I. INTRODUCTION

Attrition rate is defined as the number of employees who leave a company during a specified time period divided by the average total number of employees over that same time period. It's expensive, non-productive and frustrating.

*Attrition brings decreased productivity.

*People leave causing others to work harder.

*This contributes to more attrition, which contributes to increased costs and lower revenue.

*These forces additional cost reduction and austerity measures.

Attrition, as such, is not a bad phenomenon. It has been known to exist all along.

However, when jobs were scarce, the technology change was less rapid, voluntary attrition was small and companies managed it. However, with technology changing rapidly and manpower costs increasing, attrition is high and hurts badly.

Fresh graduates joining an organization make it a point to leave within the first year, they equip themselves not for performing their current job but for attracting a new one. Many a time, there is migration from bigger companies to smaller companies too, mainly because of the prestige associated with a certain project or a particular client. In some cases, smaller companies are even better paymasters than larger brands.

II. NEED FOR THE STUDY

1. To know about the low, pay and recognition.
2. To study about the demotivated employees.
3. To define about the lack of career growth.
4. To analysis about the poor working condition.

III. PROBLEM OF THE STUDY

1. The job satisfactory level of the employees is dis–satisfied.
2. The employees are not satisfied with their salaries.
3. Low salary is one of the factor that leads to attrition.
4. The organizational culture and working environment are not satisfied among the employees.

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IV. OBJECTIVES OF THE STUDY

I. To find out the specific reasons why the attrition occurs and the possible way to reduce it.

II. To analyses the attrition rate in different departments.

III. To suggest the area of improvement.

IV. To study how efficiently management, settle a grievance in an organization.

V.SCOPE OF THE STUDY

- **To know the satisfactory level of employees towards their job and working conditions.**
- To identify the factors which makes employees dis-satisfy.
- To know the reasons, why attrition occurs.

1. **Brayfield and Crockett, (1955)[1]** have highlighted the positive relationship between attitudinal variables and voluntary turnover. It is seen that attitude-based turnover models have a direct link between employee attitudes and the act of leaving the organization.

2. **Arthur, (1994)[2]** the key employees, who have done amazing in their education and are hardworking, always feel the need to be rewarded and recognized for their performance in the organization. Their enthusiasm to work and perform better depends a lot on the organizations‟ way of rewarding and recognizing them. So, if an organization has an environment that provides prospects for further development and self-actualization, this would reduce the chances of an employee leaving the organization.

3. **Magner etal., (1996)[3]** emphasized that the employees stay longer in the same organization where they feel they are involved in the decision making process. This involvement gives them the satisfaction to be part of something really important.

4. **Herman, (1999)[4]** has highlighted five main reasons because of which employees leave their current organization. Insufficient support, incompatible corporate culture, unsatisfactory relationships with coworkers, dissatisfaction with compensation offered, and inadequate opportunities for growth are the reasons because of which employees leave.

5. **Sahu and Gupta, (1999)[5]** Length of service, expectation reality match, turnover perception and outside career opportunities are also responsible for deciding to quit or to stay with the company.

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6.**Abbasi and Hollman, (2000**) talked about five reasons that facilitates employee turnover. Toxic workplace environment, hiring practices, lack of recognition, managerial style, and lack of competitive compensation systems are the reasons which results in employee turnover

7.**Walker, (2001)** has identified seven factors which boosts retention. These factors are compensation and appreciation of the work performed, recognition of capabilities and performance contributions, challenging work, good communication, opportunities to learn, positive relationships with colleagues, and good work-life balance.

8.**Arora et al., (2001)** in their study observed that virtually it is becoming difficu lt for all firms to retain the talented pool of professionals. Even the compensation given to them (which is ideally above Indian standards) is not reducing their turnover.

9.**Ramlall, (2003)** accentuated that inadequate compensation, payment below prevailing market rate and inadequacy in the internal and external equity was the common reason because of which employees leave an organization.

10.**Mano-Negrin and Tzafrir, (2004)** claim that employees leave their organization because of the economic reasons, and one can use these reasons to understand and further envisage the employee turnover in the market.

VI. RESEARCH METHODOLOGY

Descriptive research: it provides an accurate position of a particular aspect of the market environment. The purpose of descriptive research together is quantified measurement of a specific research. It is structured. Most of the data that we needed where gathered in some form of direct or indirect questions which future will depend upon.

- ➢ Nature of question
- ➢ Time frame of study
- ➢ Funds available
- ➢ Kinds of respondents

The project is totally based on survey of the market i.e., people and a lot of research on the web, so for that DECRIPTIVE type of research design was used. Descriptive research provides an accurate position of particular aspects of the market condition. The purpose of this research is together quantified measurement of a specific type of reaction. It is a structure most of the data we collected from the field are gathered in some form of direct or indirect questions.

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SAMPLE AND SAMPLING METHOD

A small part or quantity intended to show what the whole is like. In **research** terms a **sample** is a group of people, objects, or items that are taken from a larger population for measurement. The **sample** should be representative of the population to ensure that we can generalize the findings from the **research sample** to the population as a whole.

RANDOM SAMPLING was used in this project. It is a procedure from a population in which (a) the selection of a sample unit is based on chance and (b) every element of the population has a known, non-zero probability of being selected.

A method of selecting a sample (random sample) from a statistical population in such a way that every possible sample that could be selected has a predetermined probability of being selected. "A random sample will be representative of the population" …. A slightly better explanation that is partly true but partly urban legend: "RANDOM SAMPLING eliminates bias by giving all individuals an equal chance to be chosen." It is true that sampling randomly will eliminate systematic bias.

VII. STATISTICAL ANALYSIS

1. U-TEST:

H_0: There is no difference between gender and satisfaction of job.

H_1: There is difference between gender and satisfaction of job.

STATUS OF GENDER AND SATISFACTION OF JOB:

Marital Status	Extremely Disagree	Dis-Agree	Neutral	Agree	Extremely Agree	Total
Male	27	14	1	1	16	**59**
Female	-	-	-	-	1	**1**

MALE	RANK	FEMALE	RANK
27	**4**	**-**	**-**
14	**2**	**-**	**-**
1	**1**	**-**	**-**
1	**1**	**-**	**-**
16	**3**	**1**	**1**
59	**R_1=11**	**1**	**R_2=1**

$$U_1 = n_1 n_2 + \frac{n_1 (n_1+1)}{2} - R_1$$

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n_1=5 n_2=1

$U_1 = (5 \times 1) + \frac{5(5+1)}{2} - 11$

$= 5 + 5(6)/2 - 11$

$= 5+30/2-11$

$= 5+15-11$

$=20-11$

$U= 9$

$Z = \frac{U - n_1 n_2 /2}{\sqrt{n_1 n_2 (n_1 + n_2 -1)/12}}$

$= \frac{9 - 5\times 1 /2}{\sqrt{(5\times 1)(5+1-1)/12}}$

1.44

$Z= 1.38$

Degree of freedom at 5% level of significance is 1.96

C.V > T.V 1.38<1.96

2. CHI- SQUARE TEST

H_0: There is no relationship between promotion and salary structure.

H_1: There is relationship between promotion and salary structure.

PROMOTION AND SALARY STRUCTURE

Promotion	Higly dis-satisfied	Dis satisfied	Neutral	Satified	Highly satisfied	Total
NONE	2	3	2	3	2	**12**
1	3	4	3	4	3	**17**
2	4	4	2	3	3	**16**
3	**3**	**2**	**5**	**3**	**2**	**15**
TOTAL	**12**	**13**	**12**	**13**	**10**	**60**

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O	E	O-E	$(O-E)^2$	$\frac{(O-E)_2}{E}$
2	12×12÷60= 2.4	-0.4	0.16	0.07
3	13×12÷60= 2.6	0.4	0.16	0.06
2	12×12÷60= 2.4	-0.4	0.16	0.07
3	13×12÷60= 2.6	0.4	0.16	0.06
2	10×12÷60=2	0	0	0
3	12×17÷60= 3.4	-0.4	0.16	0.05
4	13×17÷60= 3.7	0.3	0.09	0.02
3	12×17÷60= 3.4	-0.4	0.16	0.05
4	13×17÷60= 3.7	0.3	0.09	0.02
3	10×17÷60= 2.9	0.1	0.01	0.003
4	12×16÷60= 3.2	0.8	0.64	0.2
4	13×16÷60= 3.5	0.5	0.25	0.07
2	12×16÷60= 3.2	-1.2	1.44	0.45
3	13×16÷60= 3.5	-0.5	0.25	0.07
3	10×60÷60= 2.7	0.3	0.09	0.03
3	12×15÷60= 3	0	0	0
2	13×15÷60= 3.3	-1.3	1.69	0.5
5	12×15÷60= 3	2	4	1.3
3	13×15÷60= 3.3	-0.3	0.09	0.03
2	10×15÷60= 2.5	-0.5	0.25	0.1
				$\sum = 3.153$

TABLE VALUE= 3.153

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

χ^2 = the test statistic $\sum$ = the sum of

O = Observed frequencies E = Expected frequencies

$\sum$ **= 3.153**

POOLING=2

Degrees of freedom (df) = (c-1) (r-1) -2

= 4×3-2

= 12-2

=10

CHI SQUARE TEST=18.307

LEVEL OF SIGNIFICANCE = 5% T.V is **18.307**

C.V< T.V

3.153<18.30

INTERPRETATION: since, the calculated value is lower than the table value; the null hypothesis has been accepted. There is no relationship between experience and incentives.

VIII STATISTICAL FINDINGS:

- There is difference between gender and satisfaction of job.
- There is no relationship between promotion and salary structure.

IX SUGGESTIONS:

- Management should help the employees to overcome their personal barriers helping him to perform well in his work and in his personal life.
- Reduces their work pressure and provide flexible working time to some department in which it possible.
- Management can organize many more recreational facilities and employee engagement activities so that employee can enjoy their work place.
- Management should consider employee's valuable suggestions and should be able to implement it.
- Management should increase the number of female employee to promote female worker.
- Management should organize a general health checkup camp in a month for betterment of employee's health because many employees responded the health or family reason to resign

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the job.

X. CONCLUSION:

The study helped in understanding the relative important factors responsible for employee attrition. My study helped in finding out the most critical reason of attrition that is salary is better opportunity. I also learned that through the salary might be high employee would be willing to change their job for better development and opportunity as the second most critical reason is low growth and advancement opportunity. It can retain employee by dealing with the most tow critical factor behind attrition. Apart from project there was also lot of things I learned at Chennai .which enhance our HR skills and gain a better understanding of functioning of HR (like using the job portals like mat ha.com, times job.com for job searching, job posting, mass mailing, taking interviews, how to evaluate the candidates, orientation, making offers, letters etc.)

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RECENT ADVANCEMENT IN WASTEWATER TREATMENT

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1. INTRODUCTION

The aesthetic value of our environment is affected by the discharge of effluents from these industries without treatment. Dyes have been used in many dyeing industries such as textiles, plastics, cosmetics, pulp, paper and food industries. It adversely affects the aquatic life as well as humans by its hazardous nature. it may cause severe damage to human beings, such as reproductive system, dysfunction of the kidneys, brain, liver and central nervous system (Shen et al., 2009) due to their toxic, mutagenic and carcinogenic in nature.

Dyes are capable of reacting chemically with cotton fiber to form a strong covalent bond. The first fibre reactive dyes were designed for cellulose fibres, which are in use till date. Also, commercially available fibre reactive dyes for protein and polyamide fibres are available. Fiber reactive dyes are permanent by the formation of a covalent bond with cellulose materials unlike other dyes.

Considerable works have been done on wastewater treatment for the removal of reactive dyes. It is mainly due to three reasons, i) reactive dyes contributes 20–30% of the total dye market (Orfao et al., 2006); ii) nearly, 10–50% of reactive dyes are sent to environment as wastewater constituents during dyeing process i.e., dyestuff effluent contains 0.6–0.8 g dye/L approximately; iii) conventional wastewater treatment methods were found inefficient for complete elimination of many reactive dyes (Robinson et al., 2001).

Adsorption is being the effective method for the removal of these reactive dyes with activated carbon. However, the activated carbon is an expensive adsorbent and it is difficult to regenerate after use. Hence, it is necessary to find cheap adsorbent for the wastewater treatment. Therefore, many researchers have been focusing on the low-cost adsorbent in recent years as best alternative for activated carbon.

A wide variety of low cost materials, such as clay minerals, bagasse fly ash, wood, maize cob and peat are being evaluated as viable substitutes for activated carbon to remove dyes from colored effluents. Different physical, chemical and biological methods have been investigated to remove the dyes from wastewater (Ebrahimi et al., 2013).

The dye removal from wastewater have been done by many treatment process such as: photocatalytic degradation, sonochemical degradation, micellar enhanced ultrafiltration,

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electrochemical degradation, cation exchange membranes, integrated iron(III) photo assisted-biological treatment, adsorption / precipitation processe, integrated chemical–biological degradation (Sudarjanto et al., 2006), solar photo-Fenton and biological processes (Garcia-Montano et al., 2008), Fenton-biological treatment scheme (Lodha and Chaudhari, 2007).

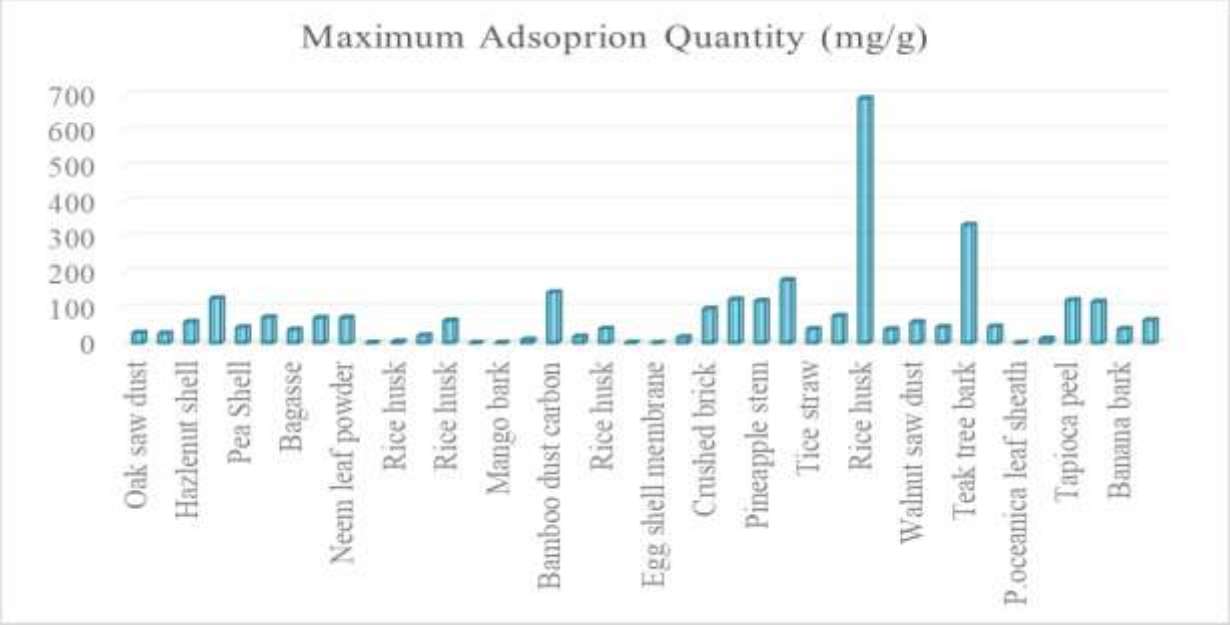
Removal of Textile dyes from wastewater

Many physical and chemical methods, like chemical coagulation, flocculation, photo degradation, Electrolysis, ozonation, precipitation, filtration, ion-exchange and adsorption have been employed for the treatment of wastewater containing dyestuffs.

ADSORPTION

Adsorption is a phenomenon of retaining the adsorbate molecule on the solid adsorbent. The substance which held on the solid surface is called adsorbate (usually gas or liquid) and the substance which attracts the adsorbate molecule is called adsorbent (solid). The reverse process is called desorption. Adsorption takes place due to the difference in the properties of bulk and solid surfaces. The free valencies and a force of attraction on the adsorbent is the cause for retaining the adsorbate molecule which is in contact (Jiuhui, 2008).

An adsorption technique is suitable for removal of dyes as a mixture and even it is applicable to remove a particular dye in specifically. It was proven here that the adsorption was both size-selective as well as charge-selective. The maximum adsorption capacity of some of the adsorbent is presented in the following figure.



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II. MATERIALS AND METHODS

All experiments were carried out for maximum removal of textile waste water with suitable conditions. The methodology followed, chemical and apparatus used for the removal of dye from aqueous textile effluents are described below.

- Adsorbent material
- Adsorbate Dyes
- Chemicals (NaOH, HCl etc.)

2.1 APPARATUS and INSTRUMENTS

- Glassware (Conical flasks, Beakers, Test tubes, Measuring cylinders etc.)
- Mortar with pestle
- pH meter (Pen Type) – PH-009(I)
- China dish
- Centrifuger (Remi 6x15 mL capacity Laboratary Centrifuge C-854/6)
- Muffle furnace (Bio Technics 2000W 9x4x4 Inch BTI-36)
- Orbital shaking incubator (Remi Elektrotechnik Limited)
- UV spectrophotometer (Shanghai mapada Instruments Co. Ltd., Model: UV 1100)
- FT-IR spectral analysis was carried out using Thermo Scientific NICOLET, (model iS5) using iD1 transmission with KBr pellets.
- SEM

2.2 PREPATION OF DYES SOLUTIONS

A stock solutions of 500 mgL^{-1} or 500 ppm were prepared by weighed accurately, 0.5 g of the dye sample and dissolved in 1000 mL of the double distilled water. These stock solutions were suitably diluted to the required concentration for 50 mL using dilution formula.

$$\mathbf{C_1V_1 = C_2V_2} \qquad \textbf{---------- (2.1)}$$

C_1 = Concentration required (mgL^{-1})

C_2 = Concentration of Stock solution (500 mgL^{-1})

V_1 = Volume required (50 mL)

V_2 = Volume of stock solution required (mL)

2.3 PREPARATION OF ADSORBENTS

The adsorbent material used is washed with double distilled water and kept to dry in sun light. The dried sample is undergone for various preparation methods. The resulting product was dried at 250 ^oC then activated in muffle furnace at required temperature for required time; cooled in the

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furnace overnight. The Activated Carbons were ground and the portion between 0 and 150 µm carbon particles were used in all experiments.

2.4 Method of Equilibrium Studies

The constant volume of dyes of different concentration was shaken at the constant agitation speed with required adsorbent dosage was carried out at the optimum temperature using Batch adsorption technique for a specific period of contact time in an shaker; the initial pH of the solution have been noted. The supernatant liquid was collected by filtering out the solid phase using 0.45µm filter paper and the residual concentration of dye present in the supernatant was determined by UV spectrophotometer.

III. RESULTS AND DISCUSSION

3.1 Effect of pH

It has been done by taking 50 mL of various dyes of fixed initial concentration (ppm) by adjusting the pH of dye solution between 1-7, with constant adsorbent dose (g L^{-1}).

3.2 Effect of Adsorbent Dose

It has been done by changing the adsorbent dose between 0.4-2.0 (g L^{-1}) with constant 50 mL of initial dye concentration (ppm) of constant desired pH.

3.3 Effect of Dye concentration

A constant pH of various initial dye concentrations between 10-150 mg L^{-1} was prepared with constant desired adsorbent dose.

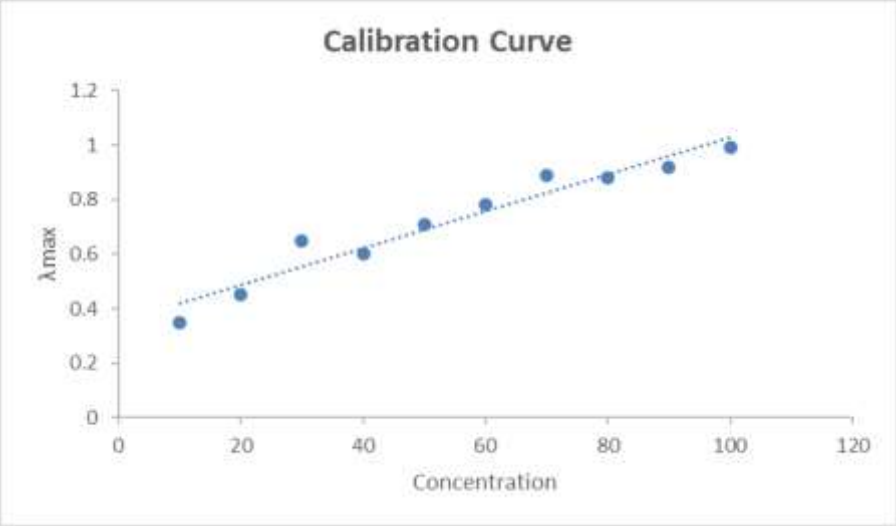

Figure: Calibration curve for the Dyes

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3.4 Effect of contact time

It has been done by keeping the adsorbent dose, initial dye concentration and pH of dye solutions were constant and noting the equilibrium adsorption at various time intervals.

3.5 Effect of Temperature

It has been done by noting the adsorption equilibrium at fixed initial dye concentration, adsorbent dose, pH of solution and contact time at different temperature from 298 K to 313K.

3.6 Adsorption Isotherm Models

- Freundlich Adsorption Isotherm : $$log Q_e = log K_F + \frac{1}{n} log C_e$$
- Langmuir Adsorption Isotherm : $$\frac{C_e}{Q_e} = \frac{1}{Q_m K_L} + \frac{C_e}{Q_m}$$
- Tempkin Adsorption Isotherm : $$Q_e = \beta ln K_T + \beta \, ln C_e$$
- Redlich-Peterson Adsorption Isotherm : $$log \frac{C_e}{Q_e} = log K_R + \beta_R log C_e$$

3.7 Adsorption Kinetics Models

- Lagergren first order Kinetics : $$log(Q_e - Q_t) = log Q_e - \frac{k_1}{2.303} t$$
- Pseudo Second order Kinetics : $$\frac{t}{Q_t} = \frac{1}{k_2 Q_e^2} + \frac{t}{Q_e}$$
- Elovich Kinetics : $$Q_t = \frac{1}{\beta} ln \alpha\beta + \frac{1}{\beta} ln t$$
- Intra-particle diffusion kinetics : $$Q_t = k_{id} t^{0.5} + C_i$$

3.8 Thermodynamic studies

Thermodynamic parameters such as change in enthalpy (ΔH°), change in entropy (ΔS°) and Gibbs free energy (ΔG°) for the system were determined using following equations:

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

where, ΔH°, ΔS° and ΔG° are change in enthalpy (kJ/mol), change in entropy (J/mol/K) and change in free energy (kJ/mol) respectively.

In general as the temperature increases ΔG° value becomes more positive and hence the adsorption process becomes thermodynamically not feasible at high temperature.

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These findings indicated that, the decreasing feasibility of adsorption may due to increasing kinetic energy of the dye molecule as the temperature increases, causes the dye molecule to transfer from the solid into the solution. The decrease in randomness at the adsorbent-solution interface was described by negative value of ΔS° during adsorption.

3.9 Analysis of SEM and FT-IR spectra before and after adsorption for Dyes on Adsorbents

The surface morphology of the activated carbon was examined using scanning electron micrography (SEM), the corresponding micrographs being obtained at an accelerating voltage of 5kV at 1500 x magnification.

The adsorption capacity increases when the adsorbent has the (i) rough surface area (ii) free spaces between the adsorbent particles (iii) high porosity (indicated by arrow mark).

Fourier transform infrared spectroscopy (FTIR) was used to determine the functional groups on the carbon surface. The spectra were measured within the range of 400-4000 cm^{-1}. There will be a considerable change in the fundamental FTIR frequencies of the adsorbent before and after adsorption of dyes.

IV. **CONCLUSIONS**

- The natural materials have potential as low cost adsorbents.
- The maximum adsorption takes place at lower pH and higher adsorbent dose, low initial dye concentration and at low temperature.
- For all the experiments, 50 % of the adsorption takes place within 5 minute of contact time. The equilibrium is reached in one hour of contact time. Therefore, the adsorption is very fast initially as the available surface area is higher initially.
- Pseudo second order kinetics was followed by all the experiments carried out in this study. Therefore, the adsorption is dependent on both adsorbate dye molecule and adsorbent carbon.
- From the calculated correlation coefficient values, it can be concluded that the isothermal studies follow the Langmuir and Redlich-Peterson isotherms. Hence, the adsorption process is physisorption at low temperature and it is chemisorptions at high temperature.
- The thermodynamic parameter such as, change in enthalpy (ΔH^{o}), change in entropy (ΔS^{o}) and change in free energy (ΔG^{o}) were negative at low temperature.
- Therefore the adsorbents used were easily available in low cost, which may be useful for local textile dyeing industries.

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SYNTHESIS, BIOLOGICAL EVALUATION AND DOCKING STUDIES OF NOVEL CHALCONE DERIVATIVES AS ANTIMICROBIAL AGENTS

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ABSTRACT

This work identified a summary of new chalcone derivatives (E)-2-(4-acetamidophenoxy)-N-(3-(3-(4-sub stitutedphenyl) acryloyl) phenyl) acetamide by the condensation of 2-(4-acetamidophenoxy)-N-(3-acetyl phenyl) acetamide with various aromatic aldehydes. Synthesized compounds were characterized by IR and 1H NMR spectroscopy. Several bacterial species and also candida albicans were tested for the antimicrobial activity. Compared to the standard drug streptomycin and clotrimazole against bacterial and fun- gal species, 5e, 5c and 5d have shown strong antibacterial and moderate antifungal activity. The aim of the anti - microbial agent enzyme was to investigate and describe the interactions of the identified hits within the target enzyme binding pocket using the synthesized composite against glucosamine-6 phosphorus synthase. The docking results enhanced the behaviour of new derivatives as promising antimicrobials. The simulation of (E)-2-(4-acetamidophenoxy)-N-(3-(3-(2-chlorophenyl) acryloyl) phenyl acetamide (5a) in BRCA1 resulted in the creation of two hydrogen bond interactions with bond distance (2.13 Å) and it was observed that the best binding energy value for —9.07Kcal / mol.

I. INTRODUCTION

In the last few years, millions of people worldwide have been anxious about either gram positive or gram - negative bacterial strains. Such micro - organisms will cause food toxicity, diarrhoea, salmonella, rheumatic [1], etc. Antibiotics are therefore the major treatments for these microbial diseases. However, continuous and overused antibiotics have resulted in a variety of microorganism classes ' multi drug resistance [2]. Moreover, the current medication is either too expensive or ineffective or has undesirable side effects [3].Consequently, in recent years , new antibiotic agents with different targets to disperse bacterial aggressions have been established urgently. The clinical importance of fungal illnesses grew dramatically during the second half of the 20th century, mainly due to the growing number of immune hosts including HIV - infected individuals, transplants and cancer patients. There- fore, the investigation of fungi is a priority of research. Because fungal pathogens are eukaryotes which share with humans a lot of their biological processes, many antifungal drugs may cause toxicity when they are used therapeutically.

Chalcones are well known intermediates used to synthesize specific heterocycles. Anti-protozoal [4], anti-inflammatory [5–6], antiviral(AIDS) [7–8], antioxidant [8–9], and a-gulcosidase inhibi- tor activity [10–11] are reported to possess Chalcone. Only Chalcones and flavanoids were found to be effective against

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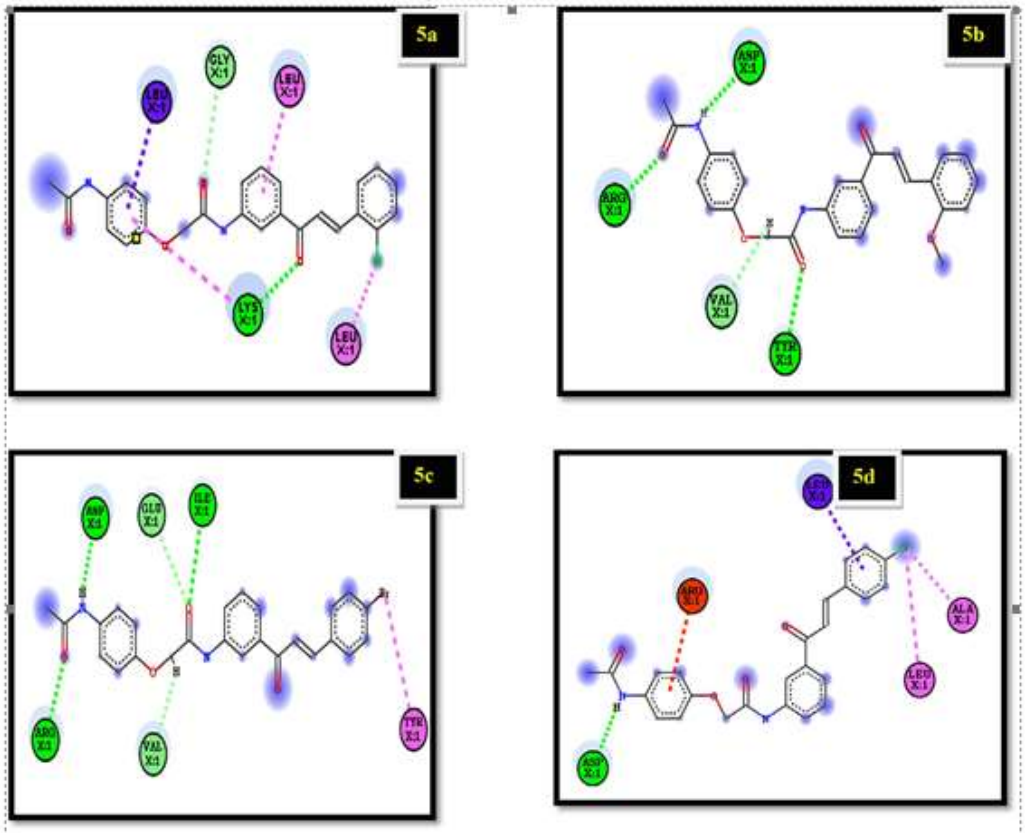
M. H37Rv strain of tuberculosis which favours antimicrobial bacterial activity [12–13]. Many chalcones also display potent anti- microbial activity [14–15] where as some quinolinyl chalcones and quinolinyl pyrimidines demonstrate respectively antimalarial and anti tubercular activity [16–19]. Chalcones ' antimicrobial effects are due to the presence of a strong unsaturated keto feature in the molecule. [20–23]

II. MATERIALS AND METHODS

The chemicals and reagents used by Finar, S.D. Fine Chem were of AR and LR quality. Ltd., The purity of the synthesized compounds is tested using the correct solvent method using thin layer chromatography on precoated TLC plates (Silica gel 60–120 mesh).Melting points were measured in open capillary tubes and uncorrected on melting point apparatus. The IR spectra on SHIMADZU FT-IR-4100 spectrophotometer was registered in KBR. Using DMSO as solvent and TMS as internal standard, the 1H NMR spectra are registered on Varian NMR 300 MHz spectrometer. LC-MS registered mass spectrum on Mass spectrophotometer (MODEL SHI- MADZU). The agar medium was purchased from HI media Laboratories Ltd., Mumbai, India. Preparation of nutrient broth, subculture, agar medium and peptone water was done as per the standard procedure.



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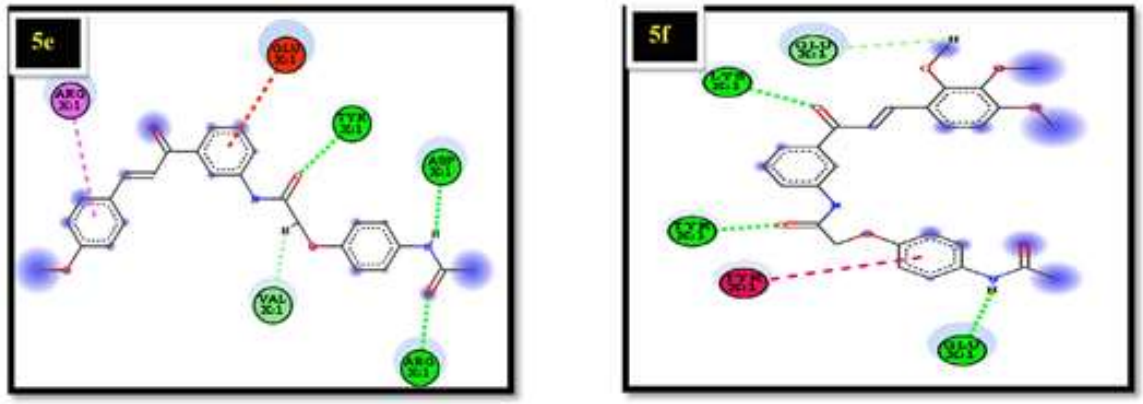

Fig. 1. 2D structure of synthesized chalcone derivatives and receptor protein molecules.

Synthesis of N-(3-acetylphenyl)-2-chloroacetamide (3)

3-amino acetophenone well mixed with glacial acetic acid at room temperature. A chloroacetylchloride solution in glacial acetic acid has been applied with incremental stirring to the above reaction mixture.Upon completion of the application, the stirring was continued for 30 min then 0.4 M Sodium acetate solution was applied, the precipitate obtained was cooled for 5 min in an ice water bath, washed with water. Crude oil from ethanol has been re-crystallised.

Table 1

Physical constants of the synthesized compounds.

Compound	Substituent	M. formula	Molecular Wt	Yield %	Melting Pt (^{0}C)
5a	2-Cl	C25H21ClN2O4	448.90	55–60	118
5b	4-Cl	C25H21ClN2O4	448.90	45–50	115
5c	4-Br	C25H21BrN2O4	493.35	55–60	123
5d	2-OCH3	C26H24N2O5	444.48	60–65	142
5e	4-OCH3	C26H24N2O5	444.48	55–60	146
5f	2,3,4-OCH3	C28H28N2O7	504.53	40–45	135

Synthesis of 2-(4-acetamidophenoxy)-N-(3-acetyl-phenyl) acetamide (4)

At room temperature, a solution of N-(3-acetyl-phenyl)-2-chloro-acetamide (3) was added dropwise to a potassium carbonate stirred solution in N, N-dimethyl formamide. Stirred a 30

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min reaction mixture, then added N-(Hydroxyphenyl)acetamide (4). The reaction mixture was refluxed for over 3 h. TLC monitored the progress of the reaction. After completion, the reaction mixture was then poured on crushed ice. The precipitated solid was treated with water, cleaned, and dried. The drug was crystallised by ethanol.

Synthesis of substituted chalcones (5a-f)

A constant stirring of 20 per cent of the NaOH solution, and the ethanol was dissolved with equimolar quantity 2-(4-acetamidophenoxy)-N-(3-acetyl-phenyl)acetamide, and various substituted benzaldehyde. This proceeded for 6 h after full stirring was applied, and was held overnight. The reaction mixture was poured on crushed ice and acidified to create a 10 per cent HCl content. Crude oil from ethanol has been recrystallized. IR, 1H NMR, and mass spectral analysis have verified the structures of the synthesized compounds. In Scheme-I the various reactions are described. The compounds ' chemical profile is as shown in the Table 1 Table 2.

(E)-2-(4-acetamidophenoxy)-N-(3-(3-(2-chlorophenyl)acryloyl) phenyl)acetamide (5a)

Pale yellow solid, **1H NMR**: d 2.07 (s, 3H), 4.60 (s, 2H), 6.92 (d,2H), 7.34–7.46 (m, 3H), 7.69–7.50 (m, 2H), 7.75 (d, 1H), 7.84 (d, 1H), 7.99 (d, 1H), 8.09 (d, 1H), 8.33 (s, 1H), 9.51 (s, 1H), 9.78(s, 1H). Exact mass of molecular ion calculated for $C_{25}H_{21}ClN_2O_4$ = 448.9.

(E)-2-(4-acetamidophenoxy)-N-(3-(3-(4-chlorophenyl)acryloyl) phenyl)acetamide (5b)

Pale yellow solid, 1H NMR: d2.07 (s, 3H), 4.59 (s, 2H), 6.92 (d, 2H), 7.37–7.46(m, 2H), 7.46–7.52 (m, 2H), 7.57–7.63 (m, 3H), 7.68–7.76 (m, 3H), 7.97 (d, 1H), 8.29 (s, 1H), 9.44 (s, 1H), 9.63 (s,1H). Exact mass of molecular ion calculated for $C_{25}H_{21}ClN_2O_4$ = 448.9.

(E)-2-(4-acetamidophenoxy)-N-(3-(3-(3-bromophenyl) acryloyl)phenyl)acetamide (5c)

Pale yellow solid, 1H NMR: d 2.06 (s, 3H), 4.57 (s, 2H), 6.83–6.92 (m, 3H), 7.08–7.21 (m, 5H), 7.41–7.66 (m, 4H), 7.93–8.21 (m, 2H),9.52 (s, 1H), 9.70 (s, 1H). Exact mass of molecular ion calculated for $C_{25}H_{21}BrN_2O_4$ = 493.3.

(E)-2-(4-acetamidophenoxy)-N-(3-(3-(2-methoxyphenyl) acryloyl)phenyl)acetamide (5d)

Pale yellow solid, 1H NMR: d 2.07 (s, 3H), 3.91 (s, 3H), 4.60 (s, 2H), 6.92–7.01 (m, 3H), 7.38–7.72(m, 5H), 7.96–8.06 (m, 2H), 8.27 (s, 1H), 9.43 (s, 1H), 9.57 (s, 1H). Exact mass of molecular ion calculated for $C_{26}H_{24}N_2O_5$ = 444.4.

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(E)-2-(4-acetamidophenoxy)-N-(3-(3-(4-methoxyphenyl) acryloyl)phenyl)acetamide (5e)

Pale yellow solid, 1H NMR: d 2.05 (s, 3H), 3.84 (s, 3H), 4,63 (s, 2H), 6.95–7.00 (m, 3H), 7.46–7.53 (m, 3H), 7.67–7.79 (m, 4H),7.95–8.00(m, 2H), 8.25–8.31 (m, 2H), 9.66 (s, 1H), 10.05 (s, 1H). Exact mass of molecular ion calculated for $C_{26}H_{24}N_2O_5$ = 444.4.

(E)-2-(4-acetamidophenoxy)-N-(3-(3-(3,4,5-trimethoxyphenyl)acryloyl)phenyl) acetamide (5f)

Pale yellow solid, 1H NMR: d 2.18 (s, 3H), 3.93 (s, 9H), 4.62 (s, 2H), 6.90 (m, 3H), 7.16–7.48 (m, 5H), 7.74–8.09 (m, 3H), 8.53 (s,1H). Exact mass of molecular ion calculated for $C_{28}H_{28}N_2O_7$ = 504.5.

Synthesis of substituted 1,3,5-trisubstituted pyrazolines (6 a-f)

A mixture of compound 5a-f (0.01 mol) and isonicotinic hydrazide (0.01 mol) in ethanol (30 ml) in the presence of sodium acetate were refluxed for 12 h on a water bath. The reaction mixture was concentrated, cooled and poured into ice-cold water. The resulting solid 2a was filtered, dried and recrystallized from ethanol.

Docking studies

Crystal structure of BRCA1 was extracted from protein data bank (PDB ID: 1 T15) and after retrieving protein structure were further carried into prepare the protein using protein preparation wizard, water molecules were removed hydrogen atoms, protein structure energy was minimized until the average root mean square was reached0.30 Å. Then prepared protein was further per- formed for molecular docking experiments. At the same time the receptor covered the polar hydrogen atoms and Kollman-united costs. For the AutoDock 4.2 software [24] the necessary pdb and pdbqt ligands and BRCA1receptor documents were prepared. In PyRx 0.8 software [25] AutoDock Vina used the normal docking protocol. The effects of the docking were analyzed via Discovery

[26] Studio 4.0.

Antimicrobial activity

Disc diffusion method [27–28] was used to carry out antibacterial activities of all the test compounds. The study concentrations are 100 lg, 200 lg and 10 lg / disc of standard drug Streptomycin.

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Table 2

Binding energy of synthesized chalcone derivatives with BRCA1.

Compounds	Binding energy(kcal/mol)	No.of hydrogen bond intraction
5a	—9.07	2
5b	—7.84	1
5c	—7.70	4
5d	—7.16	4
5e	—7.24	4
5f	—7.38	4

Mueller–Hinton broth (MHB) was the production of target microorganisms. The suspensions were modified to normal dilution of the subculture after 24 h. With diluted bacterial strain, the Petri dishes containing the medium Muller Hinton Agar (MHA) were cultivated. Disc made of Whatman No.1, 6 mm in diameter, was pre-sterilized and held in aseptic chamber. The sterile disc papers were sprayed with every concentration. The prepared discs were then put on the surface of culture. A positive reference standard for evaluating the sensitivity of each microbial species tested was the standard drug Streptomycin (10 lg). The inoculated plates were then incubated for 24 h at 37 °C. The diameter of the clear zone around the disk was measured and expressed as its anti-microbial activity in millimeters (Table 3).

For fungal cultivations, potato dextrose agar (PDA) was used. The culture medium was inoculated in Potato dextrose broth, with the fungal strains separately suspended. The compounds synthesized were sprayed on a sterile disk. Generic antibiotics (Fluconazole 15 lg & Clotrimazole 15 lg) were used as positive control, with fungal plates incubated for 72 h at 37 °C. Measured diameters of inhibition region observed (Table 4).

III. RESULTS AND DISCUSSION

The simulation of (E)-2-(4-acetamidophenoxy)-N-(3-(3-(2-chl orophenyl) acryloyl) phenyl acetamide (5a) in BRCA1 resulted in the creation of two hydrogen bond interactions with bond distance (2.13 Å) and it was observed that the LYS and GLY residue hydro- gen hydrogen atom acts as a hydrogen bond donor to interact with the compound oxygen atom 5a. The binding energy value for (E)-2- (4-acetamidophenoxy)-N-(3-(3-(2-chlorophenyl) acryloyl) aceta- mide (5a) was —9.07Kcal / mol, respectively. The compound 5b binding Energy value

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was —7.84Kcal / mol. Only one hydrogen bond interaction with bond length (1.70 Å) was found after analyz- ing the docking features between compound 5b into BRCA1. ASP's oxygen atom was well associated with the compound's hydrogen atom 5b. Docking simulation of (E)-2-(4-acetamidophenoxy)-N-(3-(3-(3-bromophenyl) acryloyl) acetamide (5c) within the BRCA1 active site has been investigated. The compound 5c binding Energy value was —7.75Kcal/mol. Docking simulation of (E)-2-(4-acetami dophenoxy)-N-(3-(3-(2-methoxyphenyl) acryloyl) acetamide (5d) within the BRCA1 active site was analyzed. The compound 5d bind- ing Energy value was —7.16Kcal / mol. Docking simulation of (E)-2- (4-acetamidophenoxy)-N-(3-(3-(4-methoxyphenyl) acryloyl) phenyl) acetamide (5e) within the BRCA1 active site was analyzed. Binding energy value for (E)-2-(4-acetamidophenoxy)-N-(3-(4-me thoxyphenyl) acryloyl) acetamide (5e) was observed at —7.24Kcal/mol. When the docking properties between compound 5e and BRCA1 are tested. Four hydrogen bond interactions were discov- ered. The TYR and ARG side chain hydrogen atom was well inter- acted with compound 5e oxygen atom and the ASP and VAL side.

Chain oxygen atom was well interacted with compound 5e hydro- gen atom;

Docking simulation of (E)-2-(4-acetamidophenoxy)-N-(3-(3-(3,4,5-trimethoxyphenyl) (Fig. 1) acryloyl) phenyl) acetamide (5f) within the active site of the BRCA1 has been analyzed.The binding Energy value for compound (5e) was observed —7.38Kcal/mol. When the docking properties between compound 5f and BRCA1 are studied. Four hydrogen bond interactions were discovered. The LYS and TYR side chain hydrogen atom was well interacted with compound oxygen atom 5f and the GLU side chain oxygen atom was well interacted with compound hydrogen atom 5f. Because there is a simple difference between side chains of all derivatives in this study (there are high similarities between all studied compounds in their structures in which their backbones are the same), the contribution of substituents in binding energy is a simple difference between the main scaffold and substituted derivatives [29–30].

Antibacterial activity

Compounds for their antibacterial activity against E are tested in vitro. Colly, S. Aurores, K. Pneumonia, with B. Subtilis is equiva- lent to normal Streptomycin (10 lg) treatment. Inhibition zones shaped against species for the compounds were calculated and given in Table 3. The results showed that the compounds synthe- sized displayed varying degrees of inhibition against Gram positive and Gram negative bacteria. The compound 5e and 5b showed great action against E. Colli, S. Aureus, K. Pneumonia, with B. Sub- tilis at both 100 lg / ml and 200 lg / ml concentrations; The 5a, 5c & 5d compounds exhibited

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strong to moderate activity against E. Colli, S. Aureus, K. Pneumonia, with B. Subtilis at both 100 lg / ml and 200 lg / ml concentrations; All the compounds were tested using disc diffusion technique for their antibacterial activity. In general it is worth noting that compounds having methoxy moiety in the scaffold exhibited excellent activity.

Antifungal activity

All of the compounds were tested by disc diffusion technique for antifungal activities. Compounds are tested in vitro against Candida albicans for their antifungal efficacy, and compared to standard drug fluconazole, Aspergillus niger. The study compound concentrations were 100 lg, 200 lg and regular drugs were 15 lg / disc. The zone of inhibition established against species was deter- mined for the compounds. Tabulated results are given in Table 4. Compounds 5a and 5c demonstrated equipotent activity with respect to clotrimazole in the case of C.albicans and compounds 5d and 5e and 5f showed good activity with respect to clotrimazole in the case of A.niger.

Table 3

Antibacterial activity of Chalcones derivatives (5a-f).

Compounds Zone of Inhibition (mm)

	S.aureus		*B. subtilis*		*E. coli*		*K. pneumonia*	
	100mg	200 mg	100mg	200mg	100mg	200mg	100mg	200mg
5a	8	12	9	13	8	14	–	–
5b	10	13	12	15	11	16	7	10
5c	–	11	9	13	9	12	–	–
5d	12	14	8	16	10	15	–	–
5e	9	15	12	14	12	16	–	9
5f	–	11	10	15	–	11	–	–
*Standard	25		24		26		19	

Table 4

Antifungal activity of Chalcones derivatives (5a-f).

Compounds	Zone of Inhibition (mm)			
	C.albicans		*A.niger*	
	100 mg	200	100 mg	200 mg

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		mg		
5a	17	19	–	11
5b	14	17	–	–
5c	16	18	9	14
5d	12	13	12	16
5e	14	18	11	15
5f	10	13	10	13
*Standard 1 *Standard 2	23		28	

*Standard 1:Fluconazole (15 mg), *Standard 2: Clotrimazole (15 mg).

IV. CONCLUSION

The present study explains the synthesis of Novel Replaced Chalcone Derivatives series. All of the compounds got in good yield and purity. IR, H1NMR, and Mass Spectral data verified the structure of the synthesized compounds. Antimicrobial activities of the newly synthesized chalcone molecules (5a-f) against selected bacterial and fungal strains were evaluated. Compared to the standard drug streptomycin and clotrimazole against bacterial and fun- gal species, 5e, 5c and 5d have shown strong antibacterial and moderate antifungal activity. A systematic SAR analysis on screened compounds shows that antimicrobial activity is tolerated by the effect of substitution on the aldehydrate phenyl ring with only small or electronegative substituents. The docking experi- ments inside the active site of BRCA1 (PDB ID: 1 T15) examined the binding mode analysis of the test compounds 5e-5f and indi- cated that the experimental results were comparable to those of antimicrobial in-vitro action.

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SPECTRAL, CONFORMATIONAL AND DOCKING STUDIES OF FURYL SUBSTITUTED HETEROCYCLIC COMPOUNDS

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ABSTRACT

A series of N-formyl-t(3),t(5)-dimethyl-r(2),c(6)-bis(2'-furyl)piperidin-4-one 1, N-acetyl-t(3),t(5)-dimethyl-r(2),c(6)-bis(2'-furyl)piperidin-4-one 2, N-propanoyl-t(3),t(5)-dimethyl-r(2),c(6)-bis(2'-furyl)piperidin-4-one 3, N-benzoyl-t(3),t(5)-dimethyl-r(2),c(6)-bis(2'-furyl)piperidin-4-one 4 have been synthesized and analyzed by ^{1}H and ^{13}C spectra at room temperature as well as low temperatures (30, 0, -15℃). For the symmetrical N-acyl-3,5-dimethyl derivatives, isochronous signals are observed at room temperature as well as low temperatures. Only at low temperatures, were the well-resolved signals observed. ^{1}H and ^{13}C spectra were obtained for the above series of compounds at -15ºC to confirm the signals. The structure of the compound was determined based on the coupling constant values, and the preferred conformation for compounds 1-4 was found to be boat form B_5, In docking studies, compounds 3 and 4 showed a strong hydrogen bond interaction with reference also compared with hydrophobic interactions, these two compounds have an ability to inhibit the protein.

Keywords: Conformational Studies, Furylpiperidin-4-Ones, Anisochronous Signals, Docking Studies, ^{1}H And ^{13}C NMR Spectrum.

I. INTRODUCTION

It is known that nitrogen-containing heterocyclic compounds exhibit a wide variety of biological activities.[1] NMR spectroscopy is useful for studying most of the heterocyclic compounds.[2-6] Substituted alkyl piperidin-4-ones and their oxime derivatives, hydrozones, and azine derivatives reported by Manimekalai *et al.*[7] This paper also explained the conformational effect on chemical shift and coupling constant values. Reports state that N-benzoyl-t (3)-alkyl-piperidin-4-one possesses antifungal and antibacterial properties.[8] It is also reported that N-Nitroso-*t* (3)-alkyl-oxime derivatives.[9-10] *N*-acyl- oxime derivatives reported by Manimekalai *et al.*[11] Pharmaceutical applications of synthetic and natural piperidines are discussed.[12] Piperidines are used in the field of drug delivery applications.[13-14] At present studies acylation of precursor 5 to give compounds 1-4, analyzed and confirmed by ^{1}H, ^{13}C NMR spectrum. This paper also explains the conformational and docking studies of compounds 1-4.

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II. EXPERIMENTAL

The precursor 5 was prepared by standard procedure.[15] Charged 0.05 mole of ammonium acetate, 0.01 mole of furfuraldehyde, and 0.05 mole of pentan-3-one in ethanol medium. The reaction mass continued to remain stirring until the completion of the reaction. After the reaction has concluded, concentrated sulfuric acid is added to the reaction mass. The piperidone hydrochloride salts were then filtered and aqueous ammonia was used to neutralize them. Diethyl ether was then used to filter and wash the compound. Yield:70%, m.p. 40ºC. The following procedure was used to prepare compound 1.[16] At 0 - 5^0C, formic acid and acetic anhydride were added. Afterward, the temperature was raised to 60°C and kept there for 30 minutes at 55–65°C. Then the above solution was added to parent piperidone 5 in benzene solution. The reaction mass was kept constant while stirring. The compound 1 was obtained by distilling out the solvent. 1: Yield: 65%, m.p. 38ºC. The remaining compounds 2-4 were prepared by the following procedures.[17] Charged 0.01 mole of acylating reagents and 0.01 mole of parent piperidone followed by 0.01 mole of triethylamine in benzene. The reaction mass was kept constant while stirring. Once the reaction was complete, the product was obtained by concentrating the reaction mass. 2: Yield: 30-40%, melting point. 116ºC 3: Product %: 40-50%; m.p. 115ºC, 4: Output: 55-65%; m.p. 154ºC.

III. RESULTS AND DISCUSSION

Analysis of Chemical Shifts

Proton NMR spectra of 1-4 have been recorded in $CDCl_3$ at -15ºC. The anisochronous signals were obtained in compounds 1-4 (Fig.-1). The ^{1}H NMR chemical shift values and coupling constant values are shown in Table-1. The ^{13}C chemical shifts are displayed in Table-2.

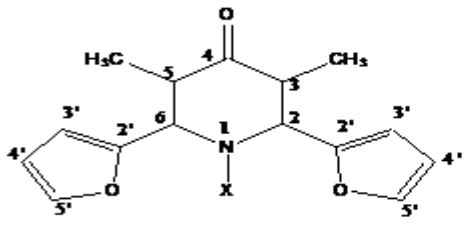

Fig.-1

α –Protons

Table-1 reveals the acylation effect of 1-4. The α protons of 1-4 with the parent compound of 5 reveal that N-acylation causes the resonances of 2, and 6 positions to move downfield (to higher frequency) considerably. Furyl substituted heterocyclic compounds 1-4, the deshielding magnitude

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observed for *anti* α proton (+0.94 ppm). However, for *syn* α proton considerable difference in the deshielding magnitude is observed (+1.52 ppm).

β-Protons

Table-1 also reveals the acylation effect observed on the β protons. The deshielding magnitude showed on syn β and anti β for 1-4.

Conformational Studies

The coupling constant and dihedral angle values are different from normal chair conformation (Table-3), we concluded the favoured conformation for compounds 1-4 is found to be in boat form B_5. The various possible conformations of compound 4 are shown in Scheme-1.

Table-1: Proton NMR Spectra of 1-4 and their Precursor 5

Organic Molecule	H(2) syn α	H(3) syn β	H(5) anti β	H(6) anti α	Alkyl protons	Formyl protons	Aromatic protons
1	5.27 (d, 6.47)	3.17 – 3.28	3.17 – 3.28	4.69 (d, 5.20)	1.09 (d, 6.96) (*syn*) 1.05 (d, 6.83) (*anti*)	8.27	6.12 (1H) 6.27 (1H) 6.19 (2H) 7.14 (1H) 7.28 (1H)
2	5.61 (d, 6.36)	3.25 – 3.28	3.25 – 3.28	4.89 (d, 4.68)	1.19 (d, 6.64) (*syn*) 1.06 (d, 6.55) (*anti*)	2.21	6.01 (1H) 6.15 (1H) 6.27 (1H) 6.31 (1H) 7.21 (1H) 7.29 (1H)
3	5.60 (d, 6.27)	3.21 – 3.24	3.21 – 3.24	4.91 (d, 4.79)	1.14 (d, 6.39) (*syn*) 1.00 (d, 6.40) (*anti*)	1.06 (t, 6.92) ($COCH_2\mathbf{CH_3}$) 2.35 – 2.44 ($CO\mathbf{CH_2}CH_3$)	5.96 (2H) 6.12 (1H) 6.21-6.24 (1H) 7.16 (1H) 7.23 (1H)
4	5.46 (d, 11.02)	3.34	3.11	5.08 (s)	1.12 (d, 6.40) (*syn*) 0.97 (d, 5.31) (*anti*)	_	6.31 (1H) 6.36 (2H) 6.43 (1H) 7.27 (1H) 7.35-7.41, 7.56-7.58 (COC_6H_5)
5	3.75	2.94	2.94	3.75	0.91	_	6.27 H(3)′

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	(d, 10.74)			(d, 10.74)	(d, 6.83)		& H(3″) 6.32 H(4′) & H(4″) 7.38 H(5′) & H(5″)

Table-2: Carbon NMR of N-Acylpiperidin-4-ones 1-4 and Starting Material 5

Organic Molecule	C(2) syn α	C(3) syn β	C(4)	C(5) anti β	C(6) anti α	Alkyl carbons	Acyl carbons
1	52.04	43.87	209.88	44.44	56.97	14.21 (*syn*) 14.37 (*anti*)	163.09
2	53.18	44.42	210.70	45.03	58.03	14.10 (*syn* CH_3) 14.47 (*anti* CH_3)	22.45 ($COCH_3$) 171.32 ($COCH_3$)
3	53.32	44.38	210.16	44.98	56.87	13.98 (*syn* CH_3) 14.39 (*anti* CH_3)	9.40 ($COCH_2CH_3$) 26.73 ($COCH_2CH_3$) 174.28 ($COCH_2CH_3$)
4	54.11	43.30	210.73	45.70	58.50	12.52 (*syn* CH_3) 15.47 (*anti* CH_3)	172.80
5	61.11	49.60	209.68	49.60	61.11	10.47	_

Table-3: Observed Coupling Constant (Hz) of 1-4

Compound	$J_{\alpha-\beta}$ (*syn*)	$J_{\alpha-\beta}$ (*anti*)	J_{H, CH_3} (*syn*)	J_{H, CH_3} (*anti*)
1	6.47	5.20	6.96	6.83
2	6.36	4.68	6.64	6.55
3	6.27	4.79	6.39	6.40
4	11.02	-	6.40	5.31

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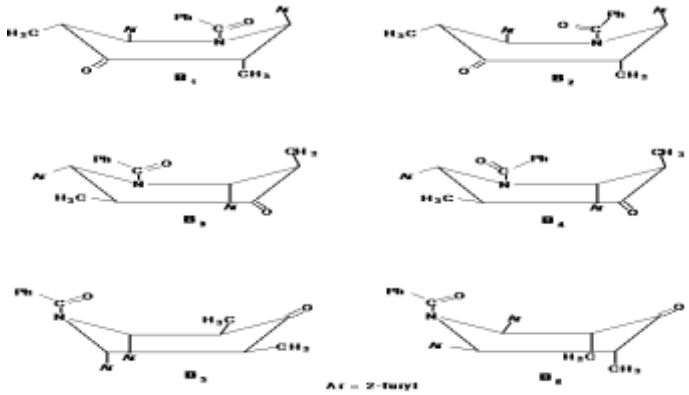
Docking Studies

The synthesized compounds 1, 2, 3, and 4 underwent the molecular docking study. The structure-based drug design approach gives an idea about above-said molecules have drug ability or not. We synthesized piperidone derivatives, which have antibacterial, anticancer, and antioxidant activities.[18-20] Herein we concentrate on cancer, hence, the related target protein (PDB 3EQM) was directly downloaded from RCSB with 4-Androstene-3-17-dione (ASD) for our docking study.[21] Molecular docking study performed through the Glide (Schrodinger 2018 Platform). *Protein preparation* wizard and *LigPrep* tool were used to prepare both protein and compounds, respectively. Before performing a docking study, we validate the docking method by the redocking procedure. Hence, retrieve the ASD from the protein active site and restock the in-active site. The docked pose and protein pose were superimposed; it showed the RMSD value of 0.90 Fig.-2.



Possible conformations of 1

Scheme-1

Hence, we confirm the docking tool is good for further study. After docking the compounds 1 to 4, which are utilized for redocking. Of the 4 compounds, 3 docked within the active region of the protein, and compound 2 did not indicate any docking poses at the protein's active site. The redocked structure ASD (reference) showed a Glide score of -7.901 and it is stabilized in the active by forming the hydrogen bond interaction with Met 437(Fig.-3a) and hydrophobic interaction Fig.-3b. Compound 1 scored -3.871 and it doesn't show any bond with the protein active site but it stabilized in the active site through the hydrophobic interaction (Fig.-4a) with phe430, lys440,gly439,ala438,cys437,gly436, etc., Fig.-4b. Carbonyl oxygen and furfurylidene oxygen of compound 3 (Glide score -4.431) make a strong two hydrogen bond with Ala438 in the active site Fig.-4c, this interaction confirmed the very strong position in the active site. Further, the hydrophobic interactions are shown in the Fig.-4d. Furfurylidene oxygen of compound 4 (Glide score -3.593) showed the hydrogen bond interaction with Ala438 Fig.-4e as well as hydrophobic interactions Fig.-4f were confirmed strong position in the active site. While comparing compounds with reference, compounds 3 and 4 showed a strong hydrogen bond interaction as like as reference one also compares with hydrophobic interactions, these

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2 compounds can inhibit the protein. Hence, we recommended these two compounds be further studied in *vitro*.

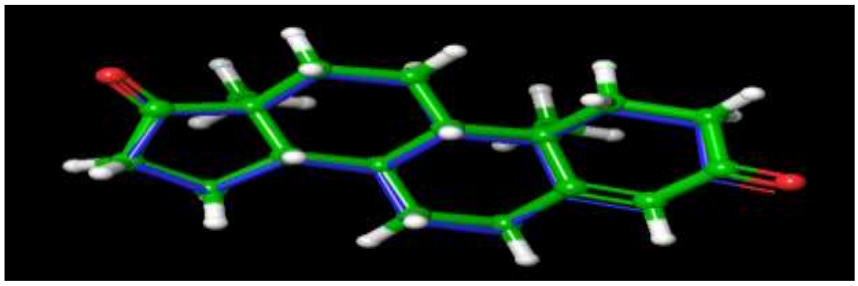

Fig.-2: Superimposed of Docked Pose and Protein Pose

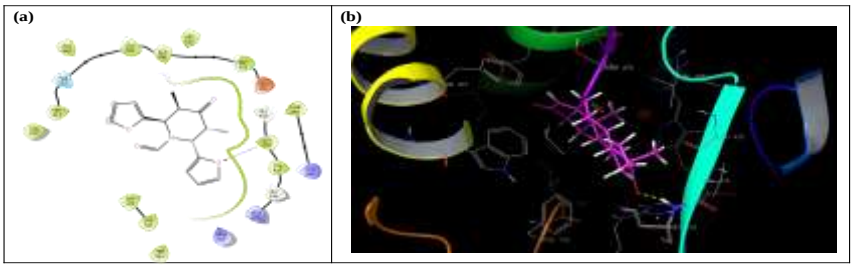

Fig.-3: (a) and (b) Molecular Interaction of ASD with Catalytically Important Residues

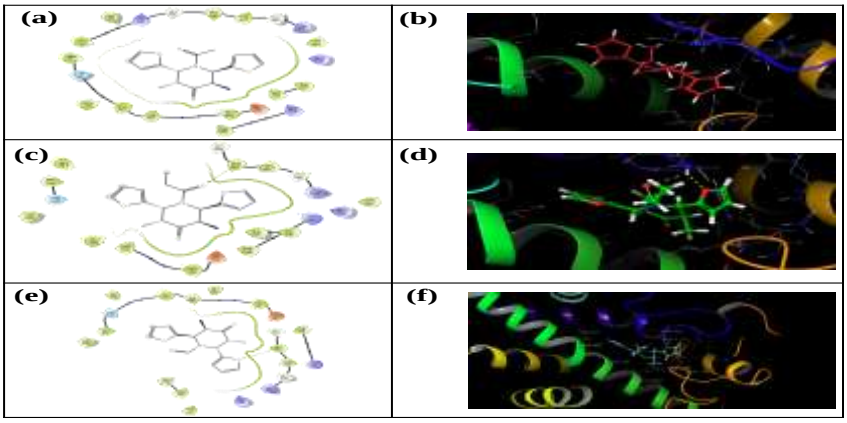

Fig.-4: Various Active and Binding Modes of **1-4**

IV CONCLUSION

The N-acyl-3,5-dimethyl derivatives 1-4 are analyzed at room temperature as well as at low temperatures. The well-resolved signals were obtained at low temperatures only (-15°C). ^{1}H and ^{13}C spectrum was recorded at -15°C for 1-4 and also calculated coupling constant values. The possible conformation for N-acyl derivatives 1-4 is found to be B_5 where distortion occurs to some extent. The observed coupling constants suggest boat form B_5 for compounds 1-4. Based on the molecular docking studies, compounds 3 and 4 showed strong hydrogen bond interaction as like as reference one also compares with hydrophobic interactions, these two compounds can inhibit the protein.

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GREEN NANOFABRICATION: LITHOGRAPHY, MILLING, AND RESPONSIBLE MANAGEMENT

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I. INTRODUCTION

Nanomaterials have revolutionized various scientific and industrial fields due to their unique physical, chemical, and mechanical properties at the nanoscale. These materials, typically ranging between 1-100 nanometers in size, exhibit enhanced strength, conductivity, and reactivity compared to their bulk counterparts. The fabrication of nanomaterials plays a critical role in tailoring these properties for applications in electronics, medicine, energy storage, and environmental protection. Understanding the fabrication methods is essential to optimizing their performance and functionality in specific applications.

The fabrication of nanomaterials involves a variety of top-down and bottom-up approaches, each offering distinct advantages depending on the desired properties and applications. Top-down methods, such as lithography and ball milling, involve breaking down bulk materials into nanoscale structures. In contrast, bottom-up techniques, including chemical vapor deposition and sol-gel synthesis, build nanomaterials from atomic or molecular components. Advances in fabrication techniques continue to drive innovation, enabling the development of highly controlled and customized nanomaterials for a wide range of cutting-edge technologies.

II. LITHOGRAPHY

The lithographic process consists of several critical steps, ensuring precision and reproducibility in nanoscale patterning. The fundamental steps involved in lithography for polymer resists are as follows:

1. **Resist Preparation:**
    - The resist material is initially dissolved in an appropriate solvent to convert it into a liquid form.
    - This liquid resist solution allows for uniform coating onto the substrate surface.
2. **Spin-Coating of the Resist:**

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- The substrate is placed on a high-speed turntable, where the resist solution is dispensed.
- The centrifugal force spreads the resist uniformly across the surface, forming a thin and even resist layer.

3. **Soft Bake (Pre-Exposure Bake):**
   - The coated substrate is heated to approximately 100°C to remove any excess solvent.
   - This step stabilizes the resist and enhances its adhesion to the substrate.
4. **Exposure to Lithographic Beam:**
   - The resist is exposed to a radiation source, such as photons (UV light), electrons, or ions, depending on the type of lithography used.
   - In photolithography, an organic polymerized resist is typically used, whereas inorganic materials like SiO2 are preferred for electron beam lithography.
   - The radiation alters the chemical structure of the resist, making it either more soluble (positive resist) or less soluble (negative resist) in the developer solution.
5. **Development of the Resist Pattern:**
   - The exposed sample is immersed in a chemical developer that selectively dissolves the treated or untreated areas of the resist.
   - This step reveals the desired pattern on the substrate.
6. **Post-Exposure Bake:**
   - A secondary bake, typically around 120°C, is performed to remove residual solvent and improve resist stability.
   - This step also enhances pattern fidelity and adhesion for subsequent processing.
7. **Etching Process:**
   - A chemical or plasma etching step is applied to remove the underlying material in the exposed regions, transferring the resist pattern onto the active layer.
   - Various etching techniques, such as dry (plasma) etching or wet chemical etching, can be employed based on the material and desired feature resolution.
8. **Resist Removal:**
   - The remaining resist is stripped off using a solvent or plasma ashing process, leaving behind the final nanostructured pattern on the substrate.

Lithography plays a crucial role in nanotechnology and microfabrication, enabling the production of miniaturized electronic devices, biosensors, and photonic circuits. Advances in lithographic techniques, such as extreme ultraviolet lithography (EUVL) and nanoimprint lithography (NIL), have further improved resolution, scalability, and cost-effectiveness. These innovations

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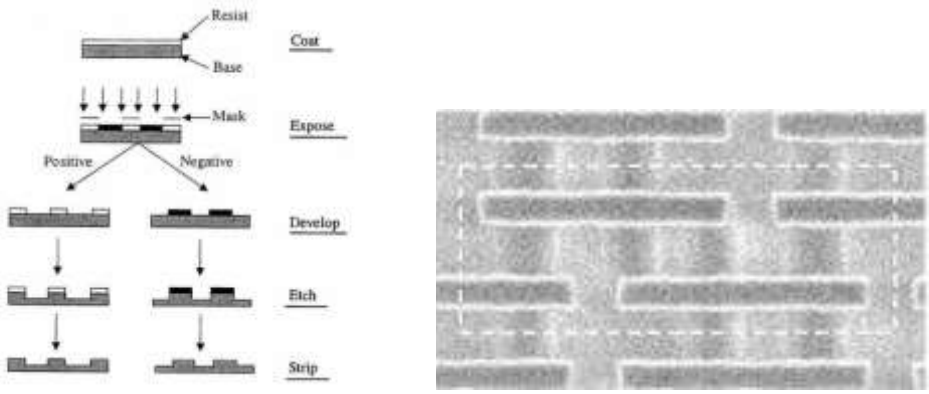
continue to drive progress in semiconductor manufacturing, quantum computing, and next-generation material design.

In conclusion, lithographic fabrication techniques provide a highly controlled and reproducible method for structuring nanomaterials, ensuring their integration into advanced technological applications. As research in this field progresses, novel lithographic approaches are expected to enhance the precision and efficiency of nanoscale material fabrication, paving the way for future innovations in science and engineering.



Photolithographic process. Intel 45 nm SRAM cell (2006).

Some reserve the term lithography only for the sacrificial process of cutting the outline of the future device on the resist.

There are at least 3 parameters of interest in lithography. The sensitivity of the resist refers to the intensity or dose of the radiation needed in order induce sufficient modification of the resist; a higher sensitivity will lead to a shorter exposure time. The contrast of the resist measures the variation of the solubility rate of the developer as a function of the exposure time; a higher contrast corresponds to a better spatial resolution of the lithographic process. The resolution or minimum size of elements is set by diffraction effects (for photons) or collision effects (for electrons) since the latter effect causes blurring at the resist boundary. Photolithography can reach down to 80 nm in resolution, deep UV to less than 50 nm, and electron to 1 nm. Various processes have been developed for the transfer stage. When the structures are made by etching into the exposed regions of the mask, this is known as subtractive pattern transfer.

When the sample is etched chemically by immersing into a solution (to which the substrate is reactive but not the mask), the process is known as wet etching. The process tends to be fairly rapid, with etch rate around microns per minute. There is also high specificity of the etchant and the mask material. However, it is also mostly isotropic which means that the

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etching can spread under the mask, leading to poor contrast; this is a disadvantage for making nanometric patterns with vertical profiles.

An alternative is dry etching, which involves bombarding the sample with high-energy ions (10s of eV to several keV's). These ions knock out surface atoms via elastic collisions; this phenomenon is known as sputtering. The efficiency of the process is quantified via the Sigmundsputteringyield

$$4\,N\pi^2\,CU$$

where $C = 1.81\,nm^2$, N is the atomic density of the material (in atoms/cm^3), U is the binding energy of the surface atoms (e.g., 6 eV for Si), and E_d is the energy deposited in an elastic collision between the ion and the surface (10s of eV/nm). Ions such as Ar accelerated to a few keV produces $S \sim 5-10$; thus, this is a cascade process. In ion-beam etching, the ions are normally incident which generates sharp vertical profiles. However, the process is inherently slow. Neither is it selective (since it is a physical process not a chemical one); hence, even the mask can be etched away. A reactive-ion etching is a combination of the wet etching and the ion-beam etching.

When the structures are made by depositing new material into the openings in the resist, this is known as an additive pattern transfer. The deposition is usually a physical process, such as vacuum vapor deposition or sputtering. Common types of lithography are optical, X-ray, and electron. The resolution is limited by diffraction. A rule of thumb is that the resolution is given by

$$D \sim \frac{\lambda}{(2n)}.$$

Typical values are ~ 0.04nm (at 1 keV) for the wavelength and a beam size of ~ 1nm

When comparing the write speed: optical is parallel, e-beam is sequential; hence, the former is faster.

Near-field lithography

It uses the tip-sample interaction of a near-field microscope to fabricate, e.g., nanowires. It modifies surfaces on the atomic scale. It is not suitable for large-scale fabrication.

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Epitaxial Methods

A technique that was developed in the 1970's consists in growing crystals atomic layer by atomic layer on a substrate. Such a growth technique is known as epitaxy. Three standard variations are: molecular beam epitaxy (MBE) [Fig. 4.2], metal-organo chemical vapor deposition (MOCVD), and liquid phase epitaxy (LPE). For example, instead of mixing two components as in alloying, one purposefully segregate them. The key here is that the layers can be made arbitrarily thin. An MBE reactor is an ultrahigh vacuum one ($< 10^{-10}$ torr).

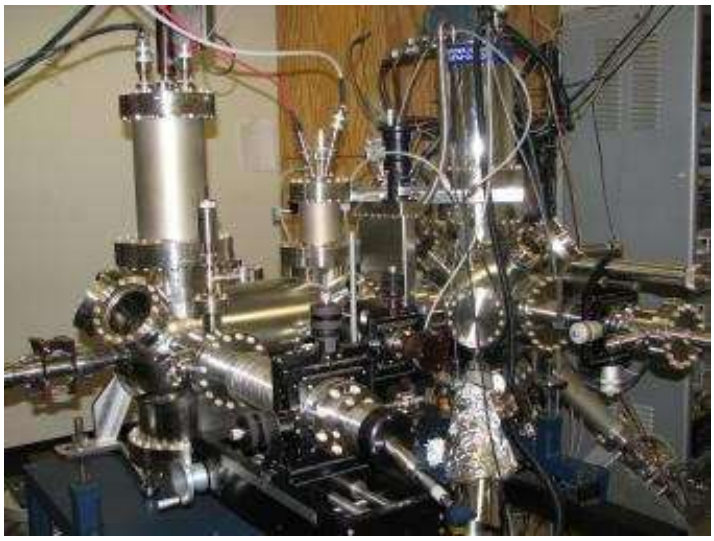

Figure Molecular beam epitaxy for epitaxial growth. Atomically-precise layer of Fe_3Si on Ge (111) [APL 89, 182511 (2006)]. The elements forming the epitaxial layers are evaporated in effusion cells at the appropriate temperature and deposit onto a substrate. Controlling the temperature and the deposi- tion time leads to an accurate control of the layer thicknesses down to single monolayer thicknesses.

The first demonstration of quantum confinement in a semiconductor quantum-well system was on an MBE-grown GaAs/AlGaAs nanostructure. The high-quality growth is made easy by the near lattice matching of GaAs and AlAs. Such systems also led to the discovery of the quantum Hall effect.

Growth morphologies

The competition between surface free energies G of the absorbate and substrate and that created at their interface determines the equilibrium shape of the absorbate. Thus, if

$$G_{substrate} > G_{absorbate} + G_{interface},$$

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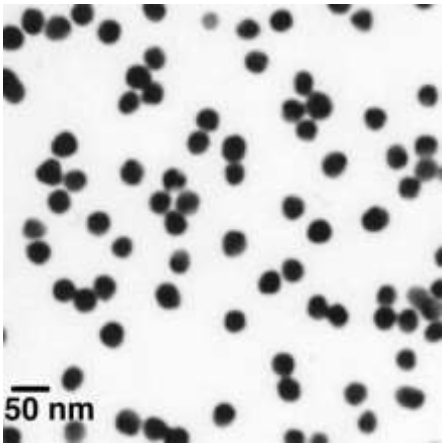
then it is less favorable to have an uncovered surface and the absorbate will wet the substrate. Should this continue with subsequent layers to form a thin film, the growth mode is known as Frank–van der Merwe. In some cases, competition with elastic energy due to lattice mismatch leads to subsequent island formation — this is known as the Stranski–Krastanov mode. If

$$G_{\text{substrate}} < G_{\text{absorbate}} + G_{\text{interface}},$$

then the absorbate favors 3D islands right away. This is known as the Volmer–Weber mode.

SK growth has been demonstrated for semiconductors (e.g., InAs/GaAsQD's) and organics. Another physical process is sputtering, whereby an inert gas is ionized then accelerated to bombard and vaporize a target.

TEM images of Ni/Cu multilayer nanowires. Top shows a bright-field image of a 130 nm diameter [Ni(20 nm)/Cu(10 nm)] multilayer nanowire. Disk-shaped nickel (dark) and copper (light) segments are clearly distinguished. Middle image shows an electron energy loss spectroscopy map of two 30 nm diameter [Ni(5 nm)/Cu(5 nm)] multilayer nanowires. Lower image shows an electron energy loss spectroscopy map of a 30 nm diameter [Ni(1.5 nm)/Cu(4 nm)] multilayer nanowire.



TEM image of 12 nm colloidal Au

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Nanomaterials have gained immense importance due to their exceptional properties and applications across diverse fields, including electronics, medicine, and energy storage. Various fabrication techniques have been developed to control their structure, composition, and properties at the nanoscale. These techniques can be broadly classified into **top-down** and **bottom-up** approaches.

Top-down methods involve reducing bulk materials to the nanoscale, often through lithography or mechanical milling. In contrast, bottom-up approaches build nanomaterials atom by atom or molecule by molecule, using techniques such as chemical vapor deposition, sol-gel synthesis, and self-assembly. This document explores several key methods of nanomaterial fabrication, including **lithography, chemical vapor deposition (CVD), sol-gel processing, electrodeposition, and mechanical milling.**

Lithography is a top-down approach used extensively for fabricating nanoscale patterns and structures. The process consists of several critical steps:

1. **Resist Preparation:** The resist material is dissolved in a solvent to convert it into a liquid form.
2. **Spin-Coating of the Resist:** The resist is uniformly spread on the substrate using a turntable.
3. **Soft Bake:** The substrate is heated (~100°C) to remove excess solvent and enhance adhesion.
4. **Exposure to Lithographic Beam:** The resist is exposed to photons (UV light), electrons, or ions to alter its chemical properties.
5. **Development of the Resist Pattern:** A chemical developer dissolves selected areas of the resist, revealing the desired pattern.
6. **Post-Exposure Bake:** A secondary bake (~120°C) improves pattern fidelity and resist stability.
7. **Etching Process:** A chemical or plasma etching step transfers the resist pattern onto the active layer.
8. **Resist Removal:** The remaining resist is stripped off, leaving behind the final nanostructured pattern.

Lithography enables the creation of intricate nanoscale patterns, crucial for semiconductor fabrication, microelectromechanical systems (MEMS), and optoelectronic devices.

2. Chemical Vapor Deposition (CVD) Process

CVD is a bottom-up method for growing thin films and nanostructures with high precision. It involves the decomposition of gaseous precursors on a heated substrate, forming a solid deposit. The process consists of:

1. **Precursor Selection:** Gaseous precursors containing silicon, carbon, or metals are chosen based on the desired material properties.
2. **Substrate Preparation:** The substrate is cleaned to ensure proper adhesion and uniform deposition.

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3. **Reaction Chamber Heating:** The substrate is heated to facilitate chemical reactions.
4. **Precursor Introduction:** The precursors decompose on the heated substrate to form a solid film.
5. **Film Growth:** Nanostructures grow as gases continue reacting and depositing material.
6. **Byproduct Removal:** Gaseous byproducts are eliminated to maintain process efficiency.
7. **Cooling and Final Processing:** The substrate is cooled, followed by treatments like annealing or doping.

CVD is widely used for synthesizing carbon nanotubes, graphene, and thin-film coatings in semiconductor manufacturing.

3. Sol-Gel Processing

The sol-gel method is a bottom-up chemical synthesis technique used to fabricate nanomaterials from liquid precursors. The process involves:

1. **Formation of a Sol:** A colloidal solution (sol) containing metal alkoxides or inorganic salts is prepared.
2. **Gelation:** Hydrolysis and condensation reactions convert the sol into a gel-like network.
3. **Aging and Drying:** The gel is aged and dried to remove excess solvent.
4. **Heat Treatment:** The dried gel is calcined or sintered to improve crystallinity and remove organic residues.
5. **Nanoparticle Formation:** Controlled processing results in nanoparticles, nanocoatings, or porous nanostructures.

Sol-gel synthesis is extensively used in the production of silica, titanium dioxide, and various ceramic nanomaterials for applications in catalysis, coatings, and biomedical implants.

4. Electrodeposition

Electrodeposition is an electrochemical bottom-up technique for fabricating metal and composite nanomaterials. It is widely used in electroplating, battery electrode manufacturing, and nanostructured coatings. The process involves:

1. **Electrolyte Preparation:** A solution containing metal ions is prepared.
2. **Substrate Placement:** The substrate acts as the cathode in an electrochemical cell.
3. **Application of Electric Potential:** A voltage is applied, causing metal ions to deposit onto the substrate.
4. **Growth of Nanostructures:** By controlling voltage, time, and electrolyte composition, nanoscale films or nanowires can be grown.
5. **Post-Treatment:** The deposited layer may undergo heat treatment or chemical modification to enhance its properties.

Electrodeposition is commonly used for synthesizing nanostructured copper, gold, nickel, and conductive polymers for sensors, electronics, and energy storage devices.

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5. Mechanical Milling

Mechanical milling (or ball milling) is a top-down technique used to reduce bulk materials to the nanoscale by mechanical forces. The process is simple and scalable, making it ideal for producing nanostructured metals and oxides. The steps involved are:

1. **Selection of Raw Material:** Bulk metal, ceramic, or composite powders are chosen.
2. **High-Energy Milling:** The material is placed in a ball mill, where rotating steel balls grind it into nanoparticles.
3. **Process Optimization:** Controlling milling time, speed, and atmosphere (e.g., inert gas) determines the final particle size.
4. **Post-Treatment:** The milled nanoparticles may undergo annealing or surface modification to improve properties.

Mechanical milling is widely used for preparing nanocrystalline metals, oxides, and composite materials for structural and functional applications.

III. CONCLUSION

The fabrication of nanomaterials involves a diverse set of techniques, each suited to specific applications and material properties. Lithography and mechanical milling represent top-down methods that reduce materials to the nanoscale, while CVD, sol-gel processing, and electrodeposition exemplify bottom-up approaches that build nanostructures from atomic or molecular precursors. Recent advancements in nanofabrication continue to push the boundaries of miniaturization, precision, and scalability. Hybrid approaches that combine multiple methods, such as lithography-assisted CVD or electrochemical templating, are paving the way for next-generation nanomaterials with tailored properties for electronics, energy, healthcare, and environmental applications.

By understanding the strengths and limitations of each fabrication technique, researchers and engineers can design more effective nanomaterials for emerging technologies. As the field progresses, further innovations in process control, automation, and sustainable manufacturing will continue to enhance the impact of nanotechnology on modern industries.

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STUDIES ON STRUCTURAL, MAGNETIC AND ELECTRICAL PROPERTIES OF CO_3O_4 NANOPARTICLES

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ABSTRACT

*Co_3O_4 nanoparticles are synthesized using a **modified sol-gel method**, which involves a series of chemical reactions to produce high-purity nanoparticles with controlled size and morphology. The **synthesized product** is thoroughly characterized by several techniques to understand its structural, morphological, and magnetic properties. Depending on the varying calcinations temperature the Co_3O_4 powder exhibits increased particle size in the range of 16-25nm. The designated results strongly influenced the microstructure, particle diameter and also the Electrical properties.*

Key words: Nanomaterials, Magnetic properties, Electrical Properties

I. INTRODUCTION

In recent decades, the growing demand for metal oxide materials with enhanced structural properties has spurred significant research into their semiconductor performance and potential applications. The exploration of metal oxides, particularly **Co_3O_4,** has gained attention due to their interesting **physical and chemical properties**, which are closely related to their **crystallite size** and the **surface-to-volume ratio**. Additionally, factors such as **crystal defects** play a critical role in determining the electronic structure, thermal behavior, catalytic properties, and oxidation states of these materials, influencing their **metallic, semiconducting**, and **adsorptive** characteristics [1, 2]. **Co_3O_4**, a cobalt oxide, has been extensively studied due to its diverse range of applications, including its use in **catalysis, energy storage**, and **magnetic devices**. Through **bottom-up methods**, Co_3O_4 nanoparticles can be synthesized with well-ordered nano- and microstructures. These properties make Co_3O_4 a promising material for **eco-friendly** technologies that aim to reduce environmental impact, such as **catalysis** for reducing emissions or **energy storage** solutions that require high surface area and controlled morphology [3]. Several methods have been developed to synthesize Co_3O_4 nanoparticles, including **hydrothermal methods** [4], **sonochemical techniques** [5], **citrate-nitrate methods** [6, 7], and **microwave synthesis** [8]. While these methods offer specific advantages, they tend to be **energy-intensive, time-consuming, complex**, and often yield **low amounts** of the desired product at **high costs** [8, 9]. In contrast, the **sol-gel method** stands out as an attractive alternative for synthesizing Co_3O_4 nanoparticles. This method offers several advantages, including **low cost, low temperature requirements**, and the ability to achieve **high yield** with **controlled particle morphology and size.**

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These advantages make the sol-gel method a desirable choice for the development of **eco-friendly** synthesis routes, contributing to the creation of nanoparticles with improved properties for a variety of applications. This work focuses on the synthesis of **Co_3O_4 nanoparticles** using the sol-gel method, which provides an efficient, cost-effective, and scalable approach for producing nanoparticles with desirable characteristics.

II. EXPERIMENTAL

Materials

In this research work, the reagent grade MDEA (~ 99% pure) starch, $Co(NO_3)_2.6H_2O$ were purchased and used as such without further purification.

Synthesis

In this experimental work, initially starch was dissolved in 20mL hot distilled water and $Co(NO_3)_2.6H_2O$ is dissolved in 50mL of distilled water in the molar ratio (1:2) by adding their salt and mixing them well using magnetic stirrer for 20 minutes. Then these two solutions were mixed, by adding drop wise starch solution to $Co(NO_3)_2.6H_2O$ solution under constant stirring for 1hr while transparent homogeneous solution is turned into exceedingly viscous transparent gel at 80°C, then it was dried on hot plate at 120°C for 6h. In the last stage, the precursor obtained was annealed at 300°C (A),400°C (B),500°C (C) for 3h, so that the carbonaceous material are removed and the spherical like Co_3O_4 nanoparticles are obtained.

Characterization:

The X-ray diffraction (XRD) patterns were collected using an X'Pert Pro diffractometer from Philips Company, equipped with monochromatized Cu Kα radiation (λ = 1.54 Å). Field Emission Scanning Electron Microscopy (FE-SEM) and Transmission Electron Microscopy (TEM) images were obtained with a MIRA FEG-SEM and a JEM-2100, respectively, both of which were operated at an accelerating voltage range of 60–200 kV and equipped with high-resolution CCD cameras. The emission properties of the material were measured using a Varian Cary Eclipse Fluorescence Spectrophotometer. The electrical conductivity of the synthesized sample was analyzed with an AZ86505 benchtop multimeter from AZ Instrument Corp. The magnetic behavior of the sample at room temperature was studied using a Vibrating Sample Magnetometer (VSM 7403, Lakeshore, USA), with an applied magnetic field of up to 710 kOe.

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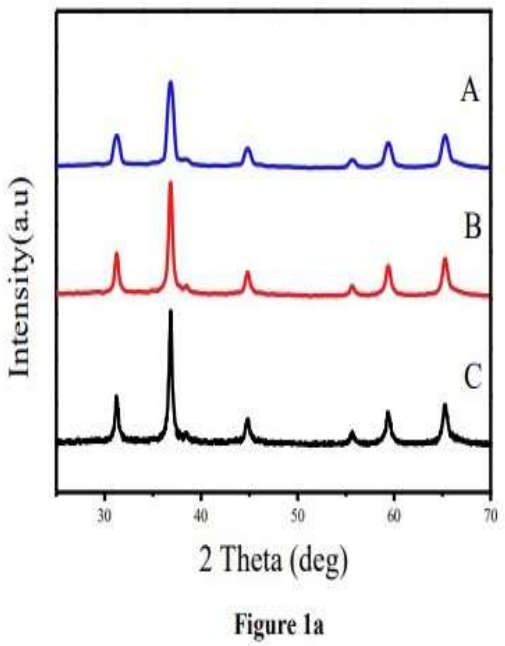
III. RESULTS AND DISCUSSION

XRD Spectra:

The X-ray powder diffraction (XRD) patterns of Co_3O_4 nanoparticles, synthesized by heating at various calcination temperatures (300°C, 400°C, and 500°C), are shown in Fig. 1a. Most of the diffraction peaks correspond to the pure cubic spinel phase of Co_3O_4 [space group: Fd3m (227)], with a lattice constant of $a = 8.393$ Å (JCPDS 85-1436). As the calcination temperature increases, the diffraction peaks become stronger and sharper, indicating improved crystallinity of the synthesized material. The average crystal size of the nanoparticles, determined using Scherrer's equation, is in the range of 15-25 nm. No significant impurities were observed in the XRD patterns, confirming the high purity of the synthesized samples. The average crystal size is further shown in Fig. 1b.



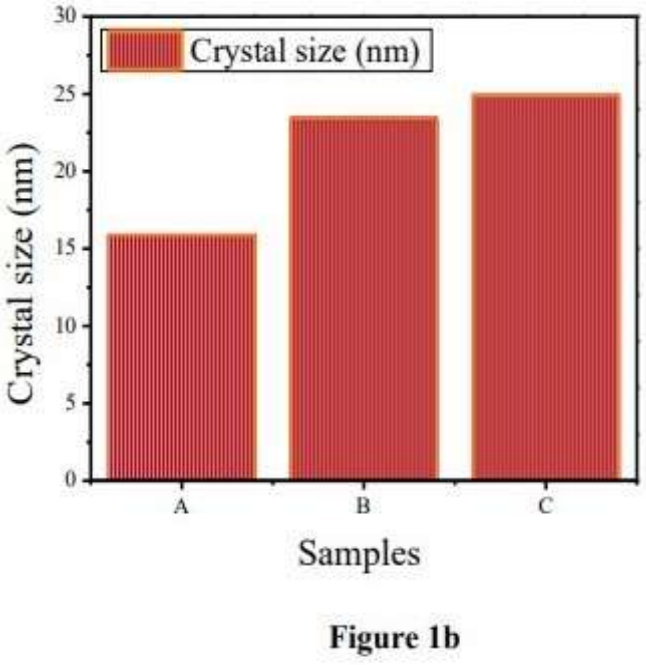


Fig. 1a. Xrd pattern of Co_3O_4

Fig.1b. Average crystal size of Co3O4

Morphology Analysis:

The surface morphology of calcined Co_3O_4 was analyzed using SEM and TEM. Figures 3 and 4 display the results. In the SEM analysis, the particles are observed to be agglomerated, with a grain size in the range of 15–28 nm. The particle size obtained from the XRD diffraction pattern is consistent with the TEM analysis, which shows particle dimensions ranging from 18–30 nm.

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Electrical Conductivity Measurement:

In this study, the electrical conductivity of the nanofluids was measured using the AZ86505 benchtop multimeter (AZ Instrument Corp), which offers a conductivity range from 0 to 1999 μS/cm. The measurement accuracy for Co_3O_4 nanoparticles is ±2%. Calibration was performed using a standard calibration solution provided by the equipment manufacturer. A calculated quantity of Co_3O_4 nanoparticles was decanted into a beaker, and the temperature was maintained at a constant value using a water bath. The accuracy of the temperature sensor is 0.1°C. The electrode was fully immersed in the Co_3O_4 nanoparticle samples (A, B, and C), and the data were recorded.

Electrical conductivities were measured for the synthesized Co_3O_4 nanoparticles at various temperatures (T) and volume fractions (φ), and the results are listed in Table 1. The observed values are in good agreement with the literature [10, 11].

A 25% wt aqueous solution was used for the investigation, with distilled water serving as the base fluid. To ensure uniform nanoparticle dispersion, the nanoparticle suspension was thoroughly mixed. Distilled water was added to the suspension to achieve the desired concentration of the nanofluids. It was observed that electrical conductivity increased linearly with an increase in the calcination temperature of the synthesized sample.

The measured values of electrical conductivity of pure water in Fe3O4 nanoparticle for sample A B and C

Temperature (°C)	20	30	40	50	60
Measured data (μs/cm) (A)	4.64	6.88	7.90	7.36	8.97
Measured data (μs/cm) (B)	5.07	6.32	7.20	8.87	9.06
Measured data (μs/cm) (C)	6.88	7.97	8.44	9.53	10.97

Vibrating Sample Measurements (VSM):

The magnetic properties of the synthesized Co_3O_4 nanoparticles (samples A, B, and C) were studied using a vibrating sample magnetometer (VSM) at room temperature, with the applied magnetic field varying from -10 to +10 kOe. Key magnetic parameters such as coercivity (Hc), remanent magnetization (Mr), and saturation magnetization (Ms) are presented in Table 4.11. The magnetic hysteresis (M-H) loop demonstrates ferromagnetic behavior with a soft magnetic nature, confirming the ferromagnetic characteristics of the Co_3O_4 nanoparticles.

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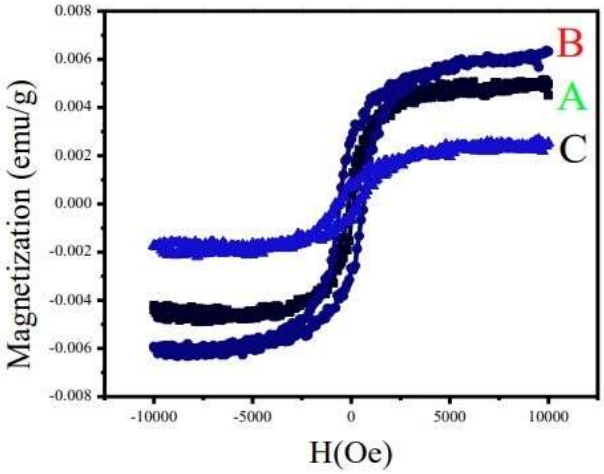
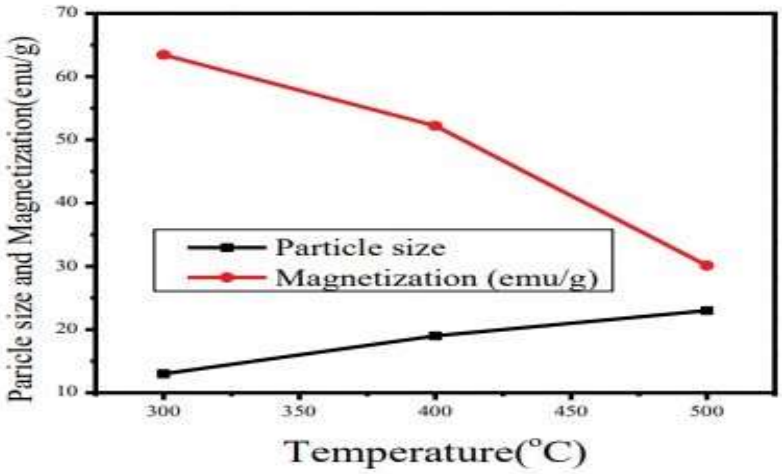


Fig.2. Room-temperature magnetic hysteresis loops of Co3O4 nanoparticles



Samples	Crystallite size (nm)	coercivity (H_c)	Remanant magnetization (M_r)	Saturation magnetization (M_s)
A (300 °C)	13.66	18.71	2.469	63.47
B (400 °C)	17.32	16.12	1.735	52.20
C (500 °C)	23.44	15.77	1.234	30.13

IV. CONCLUSION:

The modified sol-gel method produces Co_3O_4 nanoparticles with tunable size and morphology. The calcination temperature is a key factor in determining the particle size, microstructure, and electrical properties of the nanoparticles. The XRD patterns demonstrate the absence of impurities and an increase in crystallite size with increasing calcination temperature. Room temperature VSM studies reveal an enhancement in the ferromagnetic properties as the calcinations temperature increases.

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Additionally, the results indicate a significant increase in the electrical conductivity of the synthesized samples.

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BIOLOGICAL APPLICATIONS OF SILVER NANOPARTICLES – AN OVERVIEW

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ABSTRACT

Silver nanoparticles (AgNPs) have garnered significant attention in the field of biological applications due to their unique physicochemical properties, including high surface area, stability, and antimicrobial activity. These nanoparticles exhibit potent antibacterial, antifungal, and antiviral properties, making them valuable in medical and pharmaceutical applications. AgNPs are increasingly utilized in wound dressings, coatings for medical devices, and as additives in consumer products to prevent microbial growth. Additionally, their use in drug delivery systems enhances therapeutic efficacy while minimizing side effects. Recent advancements in biosynthesis methods highlight environmentally friendly approaches to produce AgNPs, further expanding their potential in nanomedicine. This review explores the mechanisms of action of silver nanoparticles, their synthesis methods, and their diverse applications in diagnostics, therapeutics, and as antimicrobial agents, emphasizing the need for continued research

Keywords: silver nanoparticles, synthesis, characterization,Antibacterial, Antifungal,Antihelmintic applications

I. INTRODUCTION

Silver nanoparticles (AgNPs) are increasingly used in various fields, including medical, food, health care, consumer, and industrial purposes, due to their unique physical and chemical properties. These include optical, electrical, and thermal, high electrical conductivity, and biological properties .Due to their peculiar properties, they have been used for several applications, including as antibacterial agents, in industrial, household, and healthcare-related products, in consumer products, medical device coatings, optical sensors, and cosmetics, in the pharmaceutical industry, the food industry, in diagnostics, orthopedics, drug delivery, as anticancer agents, and have ultimately enhanced the tumor-killing effects of anticancer drugs . Recently, AgNPs have been frequently used in many textiles, keyboards, wound dressings, and biomedical devices. Nanosized metallic particles are unique and can considerably change physical, chemical, and biological properties due to their surface-to-volume ratio; therefore, these nanoparticles have been exploited for various purposes. Generally, conventional physical and chemical methods seem to be very expensive and hazardous . Interestingly, biologically-prepared AgNPs show high yield, solubility, and high stability . Among several synthetic methods for

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AgNPs, biological methods seem to be simple, rapid, non-toxic, dependable, and green approaches that can produce well-defined size and morphology under optimized conditions for translational research. In the end, a green chemistry approach for the synthesis of AgNPs shows much promise.

II. GREEN CHEMISTRY APPROACH FOR THE SYNTHESIS OF AGNPS

Recently, biologically-mediated synthesis of nanoparticles have been shown to be simple, cost effective, dependable, and environmentally friendly approaches and much attention has been given to the high yield production of AgNPs of defined size using various biological systems including bacteria, fungi, plant extracts, and small biomolecules like vitamins and amino acids as an alternative method to chemical methods.Bio-sorption of metals by Gram-negative and Gram-positive bacteria provided an indication for the synthesis of nanoparticles before the flourishing of this biological method. Several studies reported the synthesis of AgNPs using green, cost effective, and biocompatible methods without the use of toxic chemicals in biological methods. In this green chemistry approach, several bacteria, including *Pseudomonas stutzeri* AG259, *Lactobacillus* strains, *Bacillus licheniformis*; *Escherichia coli* (*E. coli*) , *Brevibacterium casei* , fungi including *Fusarium oxysporum* , *Ganoderma neo-japonicum* Imazeki ,plant extracts such as *Allophylus cobbe* , *Artemisia princeps* , and *Typha angustifolia* were utilized. In addition to these, several biomolecules, such as biopolymers, starch, fibrinolytic enzyme and amino acids were used. The biological synthesis of nanoparticles depends on three factors, including (a) the solvent; (b) the reducing agent; and (c) the non-toxic material. The major advantage of biological methods is the availability of amino acids, proteins, or secondary metabolites present in the synthesis process, the elimination of the extra step required for the prevention of particle aggregation, and the use of biological molecules for the synthesis of AgNPs is eco-friendly and pollution-free. Biological methods seem to provide controlled particle size and shape, which is an important factor for various biomedical applications . Using bacterial protein or plant extracts as reducing agents, we can control the shape, size, and monodispersity of the nanoparticles .The other advantages of biological methods are the availability of a vast array of biological resources, a decreased time requirement, high density, stability, and the ready solubility of prepared nanoparticles in water.

The biological activity of AgNPs depends on the morphology and structure of AgNPs, controlled by size and shape of the particles.As far as size and shape are concerned, smaller size and truncated-triangular nanoparticles seem to be more effective and have superior properties. Although many studies successfully synthesized AgNPs with different shape and size ranges, they still have certain limitations.Compared to chemical methods, biological methods allow for more ease in the control of shape, size, and distribution of the produced nanoparticles by optimization of the synthesis methods,

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including the amount of precursors, temperature, pH, and the amount of reducing and stabilizing factors .(pic)

III. ANTIBACTERIAL APPLICATIONS

Silver nanoparticles (AgNPs) have emerged as potent antibacterial agents, utilized in various applications due to their unique properties and mechanisms of action. Here are some key areas where AgNPs are applied for antibacterial purposes:

1. **Wound Dressings**: AgNPs are incorporated into wound dressings to prevent infections and promote healing. Their sustained release of silver ions effectively reduces bacterial load and inflammation, making them ideal for treating chronic wounds and burns.
2. **Coatings for Medical Devices**: Silver nanoparticles are applied as coatings on medical devices, such as catheters and implants, to minimize the risk of hospital-acquired infections. The antimicrobial properties of AgNPs help inhibit biofilm formation and bacterial colonization.
3. **Consumer Products**: Silver nanoparticles are incorporated into various consumer products, including antibacterial soaps, cosmetics, and household items, to provide long-lasting antimicrobial protection against bacteria and other pathogens.
4. **Water Treatment**: AgNPs are explored for water purification systems due to their ability to kill bacteria and inhibit the growth of biofilms in water supplies, ensuring safe drinking water.
5. **Drug Delivery Systems**: Researchers are investigating AgNPs as carriers for antibiotics, enhancing their delivery and effectiveness against resistant bacterial strains. This approach aims to reduce the dosage required and minimize side effects.

Mechanisms of Action: The antibacterial effects of AgNPs are attributed to several mechanisms, including:

- **Disruption of Bacterial Membranes**: AgNPs can penetrate bacterial membranes, leading to cell lysis.
- **Generation of Reactive Oxygen Species (ROS)**: The interaction of AgNPs with bacteria generates ROS, causing oxidative stress and damaging cellular components.
- **Release of Silver Ions**: Silver ions released from nanoparticles can interact with bacterial DNA and proteins, inhibiting replication and metabolic functions.

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In conclusion, the antibacterial applications of silver nanoparticles hold great promise across various fields, from healthcare to consumer products. Ongoing research is focused on optimizing their efficacy and safety, as well as exploring new methods for synthesis and application.

IV. ANTIFUNGAL APPLICATIONS

Silver nanoparticles (AgNPs) are increasingly recognized for their antifungal properties, offering a promising alternative in the fight against fungal infections. Their unique characteristics enable them to be effective against a wide range of fungal pathogens. Here are some key areas of application:

1. **Medical Applications**: AgNPs are used in antifungal treatments for various medical conditions, including candidiasis and aspergillosis. Their incorporation into topical formulations, creams, and ointments enhances the effectiveness of antifungal agents and aids in wound healing.
2. **Coatings for Medical Devices**: Silver nanoparticles can be applied as antimicrobial coatings on medical devices such as catheters and implants to prevent fungal infections. This is particularly important in preventing biofilm formation, which can lead to chronic infections.
3. **Agricultural Uses**: In agriculture, AgNPs are utilized as fungicides to protect crops from fungal pathogens. Their application helps to reduce the reliance on traditional chemical fungicides, promoting sustainable farming practices.
4. **Food Preservation**: Silver nanoparticles can be incorporated into packaging materials to prevent fungal spoilage of food products. This application extends shelf life and maintains food quality by inhibiting mold growth.
5. **Textiles**: The textile industry uses AgNPs to produce antifungal fabrics that prevent fungal contamination and odor. These textiles are especially valuable in sportswear, medical uniforms, and other applications where hygiene is critical.
6. **Biosensors**: AgNPs are employed in the development of biosensors for the detection of fungal infections. Their antifungal properties help maintain the integrity of the biosensor, ensuring accurate results by preventing contamination.

Mechanisms of Action: The antifungal effects of silver nanoparticles can be attributed to several mechanisms:

- **Disruption of Fungal Cell Membranes**: AgNPs can penetrate fungal cell walls, leading to cell lysis and death.

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- **Generation of Reactive Oxygen Species (ROS)**: The interaction between AgNPs and fungal cells produces ROS, causing oxidative damage to cellular components.
- **Inhibition of Fungal Growth**: Silver ions released from AgNPs can interfere with fungal metabolism and replication, effectively inhibiting growth.

Silver nanoparticles show significant potential in various antifungal applications across healthcare, agriculture, and food preservation. Ongoing research is focused on optimizing their formulation, understanding their mechanisms of action, and addressing safety concerns to enhance their efficacy in combating fungal infections.

V. ANTI-INFLAMMATORY APPLICATIONS

Silver nanoparticles (AgNPs) have gained attention for their anti-inflammatory properties, making them valuable in various biomedical and therapeutic applications. Here are some key areas where AgNPs are applied for their anti-inflammatory effects:

1. **Wound Healing**: AgNPs are incorporated into wound dressings to promote healing and reduce inflammation. Their antibacterial properties prevent infections, while their anti-inflammatory effects help to minimize swelling and redness, facilitating faster recovery.
2. **Topical Formulations**: Silver nanoparticles are used in creams and gels designed for treating inflammatory skin conditions, such as dermatitis and psoriasis. Their application helps reduce inflammation and irritation, providing relief to affected areas.
3. **Orthopedic Applications**: In orthopedic implants and devices, AgNPs are utilized to reduce inflammation around the site of implantation. This can help improve patient outcomes by minimizing post-operative complications related to inflammation.
4. **Nanomedicine**: AgNPs are being explored as carriers for anti-inflammatory drugs. By delivering these drugs more effectively to the site of inflammation, AgNPs can enhance therapeutic efficacy while reducing systemic side effects.
5. **Dental Applications**: In dentistry, silver nanoparticles are used in materials and coatings to reduce inflammation in periodontal treatments. Their antibacterial and anti-inflammatory properties contribute to better healing outcomes.
6. **Chronic Inflammatory Diseases**: Research is ongoing into the use of AgNPs for treating chronic inflammatory diseases, such as arthritis. Their ability to modulate inflammatory responses may offer new avenues for therapeutic interventions.

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Mechanisms of Action: The anti-inflammatory effects of silver nanoparticles can be attributed to several mechanisms:

- **Inhibition of Pro-inflammatory Cytokines**: AgNPs can modulate the expression of pro-inflammatory cytokines, reducing inflammation at the cellular level.
- **Reduction of Oxidative Stress**: By scavenging reactive oxygen species (ROS), AgNPs help decrease oxidative stress, which is often associated with inflammation.
- **Regulation of Immune Response**: Silver nanoparticles may influence immune cell activity, promoting a balanced inflammatory response.

In summary, silver nanoparticles hold significant promise for anti-inflammatory applications across various fields, including wound care, dermatology, and nanomedicine.

VI. ANTI-ANGIOGENIC APPLICATIONS OF SILVER NANOPARTICLES

Silver nanoparticles (AgNPs) are being investigated for their potential anti-angiogenic properties, making them valuable in the treatment of various conditions, particularly in cancer and other diseases characterized by abnormal blood vessel growth. Here are some key applications:

1. **Cancer Treatment**: AgNPs are explored for their ability to inhibit angiogenesis, which is crucial for tumor growth and metastasis. By preventing the formation of new blood vessels that supply nutrients to tumors, AgNPs may enhance the efficacy of existing cancer therapies and limit tumor progression.
2. **Wound Healing**: While primarily known for promoting healing, AgNPs can also modulate angiogenesis in wound repair. By balancing angiogenic factors, they can support proper vascularization in healing tissues, preventing excessive blood vessel formation that may lead to complications.
3. **Cardiovascular Applications**: In conditions such as atherosclerosis, where abnormal blood vessel growth occurs, AgNPs may offer therapeutic benefits by inhibiting angiogenesis and reducing plaque formation, thus improving cardiovascular health.
4. **Ophthalmology**: In diseases like diabetic retinopathy, where abnormal blood vessel growth in the eye occurs, AgNPs are being investigated for their potential to inhibit angiogenesis, helping to preserve vision and prevent further complications.
5. **Regenerative Medicine**: In tissue engineering, controlling angiogenesis is crucial for the integration of implants and engineered tissues. AgNPs can be utilized to regulate blood vessel formation, ensuring optimal vascularization for tissue viability.

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Mechanisms of Action: The anti-angiogenic effects of silver nanoparticles can be attributed to several mechanisms:

- **Inhibition of Growth Factors**: AgNPs can interfere with the signaling pathways of angiogenic growth factors, such as vascular endothelial growth factor (VEGF), reducing their activity and subsequent blood vessel formation.
- **Modulation of Cytokines**: Silver nanoparticles may influence the expression of cytokines involved in angiogenesis, leading to a balanced inflammatory response and inhibition of excessive vessel growth.
- **Induction of Apoptosis in Endothelial Cells**: AgNPs can induce cell death in endothelial cells, which are essential for new blood vessel formation, thereby hindering angiogenesis.

In summary, silver nanoparticles show significant potential in anti-angiogenic applications, particularly in cancer therapy and regenerative medicine. Ongoing research aims to optimize their use, understand their mechanisms, and assess their safety to enhance their effectiveness in controlling abnormal blood vessel growth.

VII. ANTI-CANCER APPLICATIONS

Silver nanoparticles (AgNPs) are gaining recognition in oncology for their potential anti-cancer properties. Their unique physicochemical characteristics make them effective in various therapeutic and diagnostic applications. Here are some key areas where AgNPs are utilized in cancer treatment:

1. **Cytotoxicity Against Cancer Cells**: AgNPs exhibit cytotoxic effects on a range of cancer cell lines. Their ability to induce apoptosis (programmed cell death) and disrupt cellular functions makes them effective in targeting tumors.
2. **Drug Delivery Systems**: Silver nanoparticles can be used as carriers for anti-cancer drugs. By improving the bioavailability and targeted delivery of these drugs, AgNPs enhance therapeutic efficacy while reducing side effects associated with conventional chemotherapy.
3. **Combination Therapy**: AgNPs are often studied in combination with traditional cancer therapies, such as chemotherapy and radiotherapy. Their ability to enhance the effects of these treatments can lead to improved outcomes in tumor regression and patient survival.
4. **Photothermal and Photodynamic Therapy**: AgNPs can be employed in photothermal therapy, where they convert light into heat, selectively destroying cancer cells. In photodynamic therapy, AgNPs can be activated by specific wavelengths of light to generate reactive oxygen species (ROS), further contributing to tumor destruction.

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5. **Diagnostic Applications**: Silver nanoparticles are used in imaging techniques, such as ultrasound and magnetic resonance imaging (MRI), to enhance the visibility of tumors. Their surface modifications can improve the targeting of cancer cells, allowing for better diagnostics.
6. **Targeted Therapy**: Researchers are developing AgNPs that can specifically target cancer cells through surface modifications with antibodies or ligands. This targeted approach minimizes damage to healthy cells and enhances treatment efficacy.

Mechanisms of Action: The anti-cancer effects of silver nanoparticles involve several mechanisms:

- **Induction of Oxidative Stress**: AgNPs can generate reactive oxygen species (ROS) that cause oxidative damage to cancer cells, leading to cell death.
- **Disruption of Cellular Functions**: AgNPs can interfere with cellular processes, including DNA replication and protein synthesis, contributing to cancer cell apoptosis.
- **Modulation of Signaling Pathways**: AgNPs may influence signaling pathways involved in cell proliferation, survival, and metastasis, thus inhibiting tumorgrowth and spread.

In summary, silver nanoparticles hold significant promise for anti-cancer applications, ranging from direct cytotoxic effects to enhanced drug delivery and diagnostic imaging. Ongoing research aims to further explore their mechanisms, optimize formulations, and assess safety to improve their effectiveness in cancer therapy.

VIII. ANTIHELMINTIC APPLICATIONS

Silver nanoparticles (AgNPs) are emerging as potential agents in the treatment of helminth infections (infections caused by parasitic worms). Their unique properties offer several advantages in combating these challenging infections. Here are key applications and mechanisms of action:

1. **Direct Anthelmintic Activity**: AgNPs have demonstrated the ability to exhibit direct anthelmintic effects against various helminth species, including nematodes and trematodes. Studies show that AgNPs can disrupt the normal physiology of these parasites, leading to decreased viability and increased mortality.
2. **Enhancement of Conventional Anthelmintics**: AgNPs can be used in combination with traditional anthelmintic drugs to enhance their efficacy. This synergistic effect may allow for lower dosages of conventional drugs, reducing potential side effects and resistance development.

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3. **Targeting Helminth Cuticle**: The unique surface properties of silver nanoparticles enable them to interact with the cuticle of helminths. This interaction can lead to structural damage, impairing the parasite's ability to survive and reproduce.
4. **Biosynthesis and Safety**: The biosynthesis of AgNPs using plant extracts or microorganisms can provide a safer and more environmentally friendly approach. This method can also enhance the antihelmintic activity of the nanoparticles due to the presence of bioactive compounds.
5. **Diagnostic Applications**: Silver nanoparticles can be utilized in the development of biosensors for the rapid detection of helminth infections. Their ability to enhance imaging techniques can improve diagnostic accuracy.

Mechanisms of Action:

- **Cellular Disruption**: AgNPs can penetrate the helminth's cells, leading to cell lysis and death.
- **Oxidative Stress Induction**: The generation of reactive oxygen species (ROS) by AgNPs can cause oxidative damage to the helminths, disrupting their metabolic processes.
- **Interference with Reproductive Functions**: Silver nanoparticles may affect the reproductive capabilities of helminths, leading to reduced fertility and population control.

In summary, silver nanoparticles show promise as antihelmintic agents, with potential applications in direct treatment, enhancement of conventional therapies, and diagnostic methods. Ongoing research is focused on optimizing their formulations, understanding their mechanisms of action, and evaluating their safety for broader clinical use.

IX. ECOTOXICITY ASSESSMENT OF SILVER NANOPARTICLES

Silver nanoparticles (AgNPs) have garnered attention for their antimicrobial properties and potential applications in various fields. However, their environmental impact and ecotoxicity are critical considerations, given their widespread use. Here's an overview of the key aspects involved in the ecotoxicity assessment of AgNPs:

1. Toxicity to Aquatic Organisms

Fish: Studies indicate that AgNPs can be toxic to fish species, affecting growth, behavior, and survival. The mechanisms of toxicity often include oxidative stress and disruption of cellular functions.

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Invertebrates: Organisms such as Daphnia and algae are commonly used in ecotoxicological studies. AgNPs can impair reproduction, growth, and overall health in these species, with effects observed at varying concentrations.

2. Toxicity to Terrestrial Organisms

Soil Microorganisms: AgNPs can affect soil microbial communities, disrupting microbial diversity and function, which can lead to altered nutrient cycling and soil health.

Plants: Exposure to AgNPs can hinder seed germination, root growth, and overall plant development, impacting agricultural productivity and ecosystem health.

3. Bioaccumulation and Biomagnification

Bioaccumulation: Silver nanoparticles can accumulate in organisms, potentially leading to increased toxicity in higher trophic levels. Assessing the bioaccumulation potential of AgNPs in aquatic and terrestrial organisms is essential for understanding long-term ecological impacts.

Food Web Implications: The transfer of AgNPs through the food web raises concerns about biomagnification, where higher concentrations of nanoparticles accumulate in predators.

4. Environmental Persistence

The stability and persistence of silver nanoparticles in various environmental conditions (e.g., pH, temperature, and organic matter) influence their ecotoxicity. Studies show that AgNPs can aggregate or dissolve, altering their bioavailability and toxic effect.

Regulatory Frameworks

Ecotoxicity assessments of AgNPs are guided by regulatory frameworks, such as those established by the Environmental Protection Agency (EPA) and the European Chemicals Agency (ECHA). These frameworks promote standardized testing methods to evaluate the environmental risks associated with nanomaterials.

X. TESTING METHODS

Various testing methods are employed to assess the ecotoxicity of AgNPs, including acute and chronic toxicity tests, bioassays with model organisms, and field studies. These methods help determine lethal concentrations, sub-lethal effects, and the ecological relevance of laboratory findings.

XI. CONCLUSIONS AND FUTURE PERSPECTIVES

This review comprehensively addressed synthesis, characterization, and bio-applications of silver nanoparticles, with special emphasis on anticancer activity and its mechanisms and also therapeutic

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approaches for cancer using AgNPs. Recently, both academic and industrial research has explored the possibility of using AgNPs as a next-generation anticancer therapeutic agent, due to the conventional side effects of chemo- and radiation therapy. Although AgNPs play an important role in clinical research, several factors need to be considered, including the source of raw materials, the method of production, stability, bio-distribution, controlled release, accumulation, cell-specific targeting, and finally toxicological issues to human beings. The development of AgNPs as anti-angiogenic molecules is one of the most interesting approaches for cancer treatment and other angiogenesis-related diseases; it can overcome poor delivery and the problem of drug resistance. Further, it could provide a new avenue for other angiogenic diseases, such as atherosclerosis, rheumatoid arthritis, diabetic retinopathy, psoriasis, endometriosis, and adiposity.

In addition, the potential use of AgNPs for cancer diagnosis and treatment is immense; to address this issue, a variety of modalities have been developed. Although various methods are available, the synergistic effects of AgNPs and antibiotics on antibacterial agents or multiple therapeutic agents on anti-cancer activity/tumor reduction are still obscure.If we succeed in all these studies, it would help the researchers of the nanoscience and nanotechnology community to develop safer, biocompatible, efficient cancer or anti-angiogenic agents containing AgNPs. Eventually, to ensure the biosafety of the use of AgNPs in humans, studies dealing with biocompatibility of AgNPs and their interaction with cells and tissues are inevitable. Finally, the great concern is that the developing nanotechnology-based therapy should be better than available technologies, and it should overcome the limitations of existing treatment techniques. Finally, it has to provide a safe, reliable, and viable treatment of diseases with high accuracy in a patient-friendly manner.

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BIOGENIC METHODS OF SYNTHESIS AND THEIR ENGINEERING FIELD APPLICATIONS

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I. INTRODUCTION

The biogenic approach to nanoparticle synthesis involves the use of living organisms, such as bacteria, fungi, algae, or plant extracts, to create a variety of materials, including nanoparticles, enzymes, and biopolymers. This environmentally friendly method has gained increasing popularity due to its sustainable nature, as it reduces the reliance on toxic chemicals, minimizes energy use, and eliminates harmful by-products commonly produced in conventional chemical and physical synthesis processes. In contrast to traditional techniques, which often require high energy consumption and harsh conditions, biogenic methods present a greener, more sustainable alternative that aligns with the principles of green engineering. Biogenic nanoparticles possess distinctive features, such as biocompatibility and the ability to be functionalized, and they have a broad range of applications in fields such as materials science, biotechnology, environmental engineering, and energy. These applications include targeted drug delivery, wastewater purification, biosensors, energy storage solutions, and antimicrobial coatings. As interest in biogenic nanoparticle synthesis continues to grow, it highlights the potential for advancing cutting-edge engineering solutions, providing eco-friendly alternatives for both industrial and environmental applications.

II. IMPORTANCE OF BIOGENIC SYNTHESIS:

Biogenic methods are becoming central to sustainable production processes in the fields of medicine, energy, agriculture, and materials engineering. They provide efficient, low-cost, and low-energy solutions to produce functional materials with applications ranging from drug delivery to environmental remediation. This approach facilitates the efficient production of a wide range of functional materials, from nanoparticles to biopolymers, with applications spanning from targeted drug delivery systems to environmental remediation. Moreover, biogenic synthesis supports the development of renewable bio-based materials, including bioplastics and biofuels, contributing to a greener, more sustainable future. By addressing both industrial and environmental needs, biogenic synthesis plays a vital role in shaping the future of materials science, biotechnology, and green engineering.

Key Areas of Focus:

- ✓ Synthesis of nanoparticles, enzymes, biofuels, bioplastics, and bio-based materials.

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- ✓ Engineering applications in fields such as environmental remediation, sustainable manufacturing, biomedical devices, and renewable energy.

III. BIOGENIC SYNTHESIS METHODS

Biological Systems Involved in Synthesis:

- **Microorganisms**: Microbial biotransformation's are among the most widely explored biogenic synthesis methods. Microorganisms like bacteria (*Bacillus*, *Escherichia coli*) and fungi (*Aspergillus*, *Penicillium*) are used to produce nanoparticles, enzymes, and metabolites. These microorganisms use enzymes to facilitate the reduction, oxidation, or bioaccumulation of various materials, including metals and polymers.
- **Plant Extracts**: Plant-based synthesis involves the use of plant extracts rich in secondary metabolites, which are responsible for reducing metal ions to produce nanoparticles. Plants like *Coriandrum sativum* (coriander) and *Azadirachta indica* (neem) have been studied for the biosynthesis of gold, silver, and copper nanoparticles.
- **Enzymes and Enzyme Catalysis**: Enzymatic processes use naturally occurring biological catalysts (enzymes) to convert raw materials into desired products. Examples include lipases in biodiesel production and cellulases in biofuel production.

Mechanism of Biogenic Synthesis:

- The process typically involves a **reduction reaction**, where metal ions (e.g., silver, gold) are reduced to nanoparticles through microbial or plant-based metabolic pathways.
- Microorganisms like *Fusarium oxysporum* can reduce metal ions in the presence of enzymes like reductases, leading to the formation of nanoparticles.
- **Bio-oxidation** and **bioaccumulation** are also crucial processes, where living organisms alter the oxidation states of elements and concentrate materials within cells or extracellular spaces, facilitating nanoparticle synthesis.

IV. BIOGENIC NANOPARTICLE SYNTHESIS

Types of Biogenic Nanoparticles:

- **Metal Nanoparticles**: Biogenic synthesis of metal nanoparticles (such as gold, silver, iron, and copper) has significant applications in electronics, medicine, and environmental monitoring. For instance, gold nanoparticles have been used in drug delivery, while silver nanoparticles exhibit antimicrobial properties.

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- **Carbon-Based Nanomaterials**: **Graphene oxide** and **carbon nanotubes** are another class of nanomaterials synthesized using biological systems. These materials have applications in energy storage, environmental remediation, and as catalysts.

Applications of Biogenic Nanoparticles:

- **Medicine**: Biogenic nanoparticles are widely used in targeted drug delivery, imaging, and diagnostics. For instance, gold nanoparticles can be functionalized with antibodies to selectively target cancer cells (Sasidharan et al., 2015).
- **Environmental Applications**: Biogenic nanoparticles, particularly those synthesized using microorganisms, have applications in **wastewater treatment** and **pollution control** (Balamurugan et al., 2017). For example, silver nanoparticles are effective in removing bacterial contaminants from water.
- **Material Science**: Biogenic nanoparticles are also used in the development of **smart materials**, such as conductive nanocomposites and coatings with anti-corrosion properties.

V. BIOGENIC ENZYME PRODUCTION AND APPLICATIONS

Enzyme-Catalyzed Processes:

- Enzymes are proteins that catalyze biochemical reactions, often in mild conditions (low temperature, neutral pH). In biogenic synthesis, microorganisms or plants are used to produce these enzymes, which can then be employed in various applications.

Applications of Biocatalysis in Engineering:

- **Food Industry**: Enzymes like amylases and proteases are used in food processing for starch breakdown, protein modification, and flavor development.
- **Biofuel Production**: Enzymatic transesterification processes convert triglycerides from oils into biodiesel. Enzymes such as lipases are used for more efficient biodiesel production (Matsumoto et al., 2014).
- **Pharmaceutical Engineering**: Enzymes are increasingly used in the pharmaceutical industry for the synthesis of **active pharmaceutical ingredients (APIs)**. For instance, the enzyme *chymosin* is used in cheese production and has applications in biocatalysis.
- **Environmental Engineering**: Bioremediation techniques use enzymes to degrade environmental pollutants such as petroleum hydrocarbons, pesticides, and plastics.

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VI. DIFFERENT SYNTHESIS OF BIOGENIC METHOD AND ITS ENGINEERING APPLICATIONS:

Biogenic Method	**Engineering Application**	**Particle Size Range (nm)**	**Synthesis Method Details**	**References**
Microbial Synthesis	**Environmental Remediation, Biodegradation**	5-100	Microorganisms like *Bacillus* and *Pseudomonas* are used for the reduction of metal ions to nanoparticles. Nanoparticle size is influenced by the microbial strain and environmental conditions.	Balamurugan et al., 2017
Fungal Synthesis	**Biomedical Applications, Drug Delivery**	10-80	Fungi such as *Aspergillus* and *Penicillium* synthesize nanoparticles through the reduction of metal salts. Particle size can be controlled by pH and reaction time.	Ahmad et al., 2013
Plant Extract Synthesis	**Antimicrobial Coatings, Sensors, Biocatalysis**	2-150	Plant extracts like *Coriandrum sativum* and *Azadirachta indica* facilitate the reduction of metal ions to nanoparticles. Extract concentration and reaction parameters determine the particle size.	Sasidharan et al., 2015
Enzyme-Assisted Synthesis	**Biocatalysis, Biosensors, Pharmaceuticals**	5-50	Enzymes such as reductases catalyze the conversion of metal ions into nanoparticles. The enzyme concentration and conditions influence particle size.	Matsumoto et al., 2014
Algal Synthesis	**Renewable Energy (Solar Cells), Biocatalysis**	5-70	Algae like *Chlorella vulgaris* are used to synthesize nanoparticles through intracellular processes, influenced by light and nutrient conditions.	Soni et al., 2017
Bacterial Synthesis	**Environmental Monitoring, Water Treatment**	10-60	Bacteria like *Escherichia coli* and *Streptomyces* are involved in the synthesis of metal nanoparticles by utilizing enzymatic pathways for	Ramasamy et al., 2019

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			metal reduction.	
Yeast Synthesis	**Biomedical, Drug Delivery, Diagnostics**	15-100	Yeasts such as *Saccharomyces cerevisiae* produce nanoparticles by reducing metal salts. The size can be controlled by varying growth conditions and precursor concentrations.	Wazir et al., 2020
Fungal Exopolysaccharide Synthesis	**Food Industry, Agriculture**	10-80	Fungal exopolysaccharides are used to stabilize nanoparticles, especially for agricultural applications like pest control.	Gupta et al., 2021
Cyanobacteria Synthesis	**Environmental Remediation, Catalysis**	3-80	Cyanobacteria such as *Spirulina* reduce metal ions to nanoparticles for use in catalysis and remediation applications.	Rajendran et al., 2018
Plant-Mediated Synthesis	**Sustainable Packaging, Biodegradable Polymers**	10-150	Plant-based materials reduce metal salts to produce nanoparticles, and the size can be controlled through temperature and reaction time.	Nguyen et al., 2020
Microalgae Synthesis	**Biomedical, Anticancer Therapy**	5-50	Microalgae like *Chlorella* are used for the biosynthesis of nanoparticles, and particle size is influenced by nutrient conditions.	Sharma et al., 2022
Biomass-Derived Synthesis	**Electronics, Energy Storage**	2-100	Biomass like wood extracts can be used to synthesize nanoparticles for use in energy storage devices, with particle size controlled by extraction methods.	Ravi et al., 2021
Corynebacterium Synthesis	**Water Purification**	20-50	*Corynebacterium* species produce nanoparticles by reducing metal salts, commonly used in water purification processes.	Benanou et al., 2017
Bacterial Cell Wall Synthesis	**Nanocomposites, Biocatalysts**	30-100	Bacterial cell walls are used as templates for the synthesis of nanoparticles, where particle size depends on bacterial strain and growth conditions.	Kour et al., 2020
Magnetotactic Bacteria Synthesis	**Magnetic Materials,**	10-40	Magnetotactic bacteria like *Magnetospirillum* synthesize magnetic nanoparticles, primarily	Xie et al., 2018

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	Imaging		used in imaging applications.	
Filamentous Fungi Synthesis	**Antioxidant, Food Preservation**	50-150	Filamentous fungi are used to synthesize nanoparticles for their antioxidant properties, useful in food preservation.	Azzouz et al., 2021
Actinobacteria Synthesis	**Drug Delivery Systems**	5-70	*Streptomyces* species reduce metal ions to nanoparticles for targeted drug delivery applications.	Pandey et al., 2018
Pollen-Mediated Synthesis	**Cosmetics, Biomedical Devices**	20-100	Pollen grains are used for the synthesis of nanoparticles, often applied in cosmetic products and biomedical devices.	Singh et al., 2019
Bacterial Biopolymer Synthesis	**Bio-Plastics, Medical Devices**	5-80	Bacterial biopolymers like PHAs (Polyhydroxyalkanoates) are used in the production of biodegradable nanoparticles for medical and environmental uses.	Firoz et al., 2022
Bacterial Biofilm Synthesis	**Sensors, Environmental Monitoring**	10-50	Bacterial biofilms are used to create nanostructures for environmental monitoring and sensors.	Liu et al., 2020
Polymer-Assisted Synthesis	**Drug Delivery, Environmental Remediation**	5-100	Polymers such as chitosan are used to stabilize nanoparticles during synthesis, controlling the size through polymer concentration.	Ahmed et al., 2020
Biological Template Synthesis	**Nanostructures for Electronics**	10-100	Biological templates such as proteins and lipids are used to control the size and morphology of nanoparticles for electronic applications.	El-Sayed et al., 2019
Sponge-Derived Synthesis	**Biomedical, Antibacterial Applications**	30-80	Sponges serve as a source for the synthesis of silver nanoparticles, with applications in biomedical and antibacterial fields.	Zhao et al., 2021
Enzyme-Mediated Synthesis	**Biofuel, Pharmaceuticals**	5-50	Enzyme-mediated processes, particularly for biodiesel and pharmaceutical production, offer controlled particle size via enzyme activity.	Matsumoto et al., 2021

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Lipid-Based Synthesis	**Nanomedicine, Gene Delivery**	10-50	Lipid nanoparticles are used in gene delivery and nanomedicine, with size control dependent on lipid composition and reaction conditions.	Pompella et al., 2020
Bacterial Aggregates	**Toxic Waste Removal**	20-60	Bacterial aggregates facilitate nanoparticle synthesis, applied in the removal of toxic metals and pollutants from industrial effluents.	Razzak et al., 2022

VII. . BIODEGRADABLE POLYMERS AND BIO COMPOSITES

Synthesis of Biodegradable Polymers:

- **Polyhydroxyalkanoates (PHAs)** and **polylactic acid (PLA)** are examples of bioplastics produced via biogenic processes. Microorganisms such as *Rhodobacter sphaeroides* can produce PHAs as intracellular carbon reserves, and PLA can be produced by fermentation processes involving microorganisms like *Lactobacillus* species.

Applications of Biodegradable Polymers:

- **Packaging**: PLA is commonly used in biodegradable packaging materials.
- **Biomedical Engineering**: Polymers such as PHA are used in tissue engineering and controlled drug delivery systems.
- **Agriculture**: Biodegradable films are used in agriculture to improve soil moisture retention.

VIII. ENGINEERING APPLICATIONS OF BIOGENIC SYNTHESIS

Green Engineering in Biotechnology:

- Biogenic methods align with **green engineering** principles by utilizing renewable resources, reducing energy consumption, and minimizing environmental impact. Applications include the production of bio-based materials, biofuels, and bioactive compounds that serve as sustainable alternatives to petrochemical-based products.

Scaling Biogenic Synthesis:

- Engineering challenges in scaling up biological synthesis from laboratory to industrial production are significant. These challenges involve optimizing growth conditions for microorganisms, enhancing production yields, and ensuring the purity and consistency of the bioproducts.
- Large-scale reactors such as **bioreactors** and **fermenters** are used to scale up microbial or plant-based synthesis processes.

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Cost and Efficiency Considerations:

- One of the primary challenges with biogenic synthesis is cost-effectiveness. Factors such as the cost of raw materials, bioreactor design, and downstream processing must be considered when evaluating the commercial viability of biogenic synthesis methods.

IX. CHALLENGES AND LIMITATIONS OF BIOGENIC SYNTHESIS

- **Scale-up Challenges**: Transitioning from laboratory scale to industrial scale can lead to inconsistencies in product quality and yield.
- **Regulatory Issues**: Biogenic products, especially in the pharmaceutical and food industries, must undergo strict regulatory approval, which can be a barrier to commercialization.
- **Stability and Purity**: Ensuring the stability and purity of biogenic products, particularly nanoparticles, can be challenging due to potential impurities from biological sources.

X. FUTURE DIRECTIONS AND INNOVATIONS

- **Synthetic Biology**: The development of genetically engineered organisms for the production of novel materials is a promising area. These organisms can be designed to produce new compounds that are otherwise difficult to synthesize.
- **Nanobiotechnology**: The integration of nanotechnology with biogenic methods has the potential to produce more advanced and multifunctional materials for use in medicine, electronics, and environmental applications.
- **Sustainability**: The continued focus on sustainability will drive the adoption of biogenic methods in various industrial sectors, promoting the use of renewable resources and reducing waste.

XI. CONCLUSION

- Biogenic synthesis offers an eco-friendly, efficient, and scalable alternative to traditional chemical processes. With continuous advancements in synthetic biology, nanotechnology, and biocatalysis, biogenic methods will play an increasingly important role in the future of engineering and biotechnology.

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PLANT MEDIATED GREEN SYNTHESIZED SILVER NANOPARTICLE – A PROMISING CANDIDATE FOR THERAPEUTIC APPLICATIONS

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ABSTRACT

This review article aims to analyze critically the *antimicrobial applications of silver metallic nanoparticles produced via green synthesize. The creation of dependable and environmentally friendly processes for the production of nanoparticles is a crucial stage in the field of nanotechnology. The green synthesis method offers a straightforward, affordable, reproducible, and environmentally friendly way to produce metallic nanoparticles more quickly. Plants, fungi and microorganisms plays important role in this field work as stabilizing agent and reducing agent. Silver nanoparticles are important because of their exceptional chemical, physical, and biological properties, and hence its applications. AgNPs due to their morphology and composition have excellent biocompatibility and hence as a wide application. The exceptional optical, catalytic and electronic property of silver attracted researchers to synthesis AgNPs that have wide application in chemical, biological and medical sensors. An important area that calls for attention is broad-spectrum antibacterial action that efficiently fights off both Gram-positive and Gram-negative bacteria, including those that are resistant to antibiotics. Literature discusses greener, more efficient synthesis approaches than physical and chemical ones.*

Keywords: Green synthesis; silver nanoparticles; plant extracts; antimicrobial; anti bacterial.

I. INTRODUCTION

The synthesis of metal nanoparticles (MNPs) is elevating up significantly throughout the world. MNPs shows intensifying properties on account of its characteristics, i.e., size (1–100 nm), shape, composition, and many opto-electronic properties such as larger surface area-volume ratio compared to their corresponding bulk material, plasmonic excitation and quantum confinement and structure[1-3]. The ability of Nanomaterials to transform into functionalized substitute that can be further re-accessed give a rising awareness and utility in various field. These exquisiteness properties make them receptive to be used as versatile material such as nano-magnets, in drug/gene delivery system, water disinfectants, as catalysts, quantum dots for electronic devices, medicines, polymer, pharmaceutical and as pollutant remediating agents [4-6].

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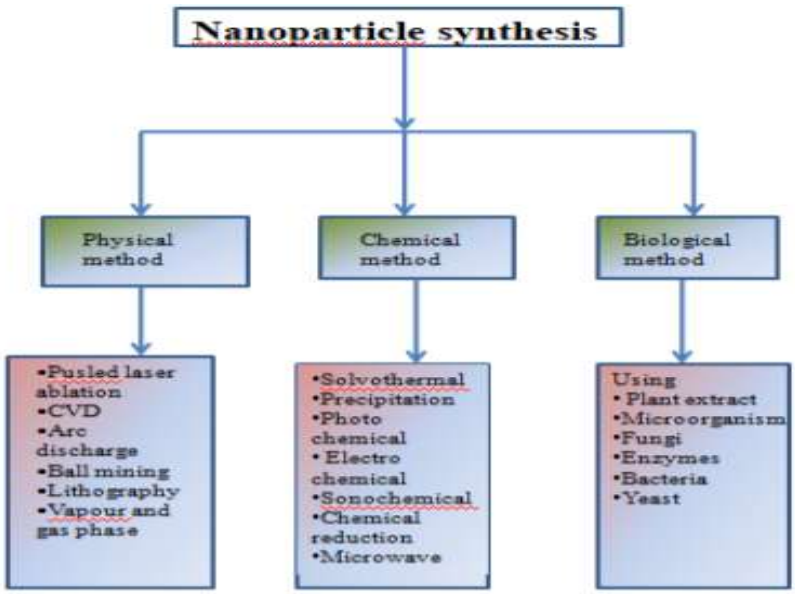
Flow chart 1. General methods of Nanoparticle synthesis



Synthesis of AgNPs by green route:

Flow chart 2. Steps in the synthesis of AgNPs by green route:

Fresh, healthy, and mature plant parts were selected (step 1)

Washed frequently with tap water (Step 2)

Then with deionized water to remove surface contaminants (Step 3)

Cleaned plant parts are sliced into fine pieces, air-dried in the shade for several days (Step 4)

Pulverized into fine powder (Step 5)

Extracted with water or organic solvents (Techniques mentioned below) (Step 6)

The extract is vacuum-dried and concentrated using a rotary evaporator. (Step 7)

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The plant extract is mixed with a definite amount of silver nitrate (AgNO3) (Step 8)

The reaction mixture is then kept undisturbed until a reddish-brown color forms from the colorless $AgNO_3$ (Step 9)

Confirms the formation of AgNPs.

Flow chart 2. Steps in the synthesis of AgNPs by green route:

The above process can be carried out at room temperature or by varying the temperature. Further, the AgNPs so prepared are lyophilized and kept in tight-packed vials under ambient conditions for their characterization and application.

II. THERAPEUTIC APPLICATIONS OF PMGS-AgNPs.

Ag-NPs have numerous antibacterial, antifungal, antiviral, larvicidal and anticancer applications (**Fig.1**). Antibacterial activity of AgNPs is due to its interaction with the bacterial cell wall which result in change in bacterial cell wall structure. AgNPs thereby damage the genetic material in the cell wall and inhibit the transcription and translation process[7]. Depending on the uptake of AgNPs by bacteria it shows different antibacterial effects on gram positive and gram negative bacteria. It is conceded that silver nanoparticles smaller than 10 nm can directly alter cell permeability by entering bacterial cells and cause cell damage[8]. Antimicrobial activity against the bacteria E. coli which were isolated from the clinically infectious specimens were tested using the AgNPs synthesized from ginger extract. Urinary tract infections (UTI) are one of the most frequently affecting bacterial infections in humans. UTIs is caused most frequently by the Escherichia coli (E.Coli), pathogen. The most commonly prescribed fluoroquinolone is Ciprofloxacin for UTIs as it's available in oral and intravenous preparations. For the prevention and reduction of deterioration of pathogenic microorganisms Nps containing antimicrobial substances could be considered as a new trend of antimicrobial therapeutic agents. Ag-NPs have been broadly used as antibacterial coat in therapeutic applications, such as cardiovascular implants, wound dressings, catheters, orthopedic implants, dental composites, nano-biosensing, and agriculture engineering. Commercial antifungal agents used have only limited applications due to its side effects such as renal failure, increased body temperature, liver damage and nausea.[9] This pays way to biosynthesized AgNPs in preparation of drugs against fungal diseases. Diverse plant extracts, such as Phyllanthus urinaria, Pouzolziazeylanica, and Scoparia dulcis leaf extracts exhibited the effective antifungal ability against Aspergillusniger, Aspergillus flavus, and Fusarium oxysporum, revealing their potentials as fungicides in the biomedical and

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agricultural applications. AgNPs synthesized from Justicia spicigera showed the antimicrobial activity against several food-borne bacteria (Bacillus cereus, Klebsiella pneumoniae and Enterobacter aerogenes) and phytopathogenic fungi (Colletotrichum sp., Fusarium solani, Alternaria alternata and Macrophominaphaseolina). AgNPs with particle sizes in the range of 86–100 nm and spherical morphology showed effective antibacterial and antifungal activity against the tested microorganisms. AgNPs synthesized from leaf extract of Indian acalypha (Acalypha indica L.) were tested for its potent antifungal activity against few phytopathogens. Alternaria alternata, Sclerotiniasclerotiorum, Macrophominaphaseolina, Rhizoctoniasolani, Botrytis cinerea,Curvularialunat.

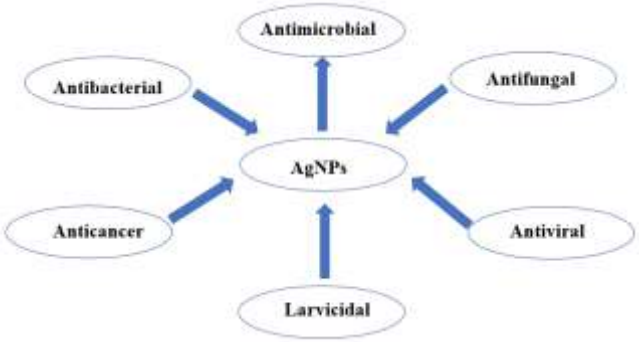

Figure 1. Application of plant mediated green synthesized AgNPs in various medicinal field

Mosquitoes acts as vector to several diseases and are a serious threat to our society. Use of chemical insecticides and larvicides leads to resistance and also reduce other environmental and health issues. Thence the need for alternative larvicides arises, the plant developed AgNPs mainly suppress the number of malarial productions in an eco-friendly method thus controls the malaria population and also kills the larvae of different pathogens. Essential oils or plant extracts are good and safe alternatives due to their low toxicity to mammals and easy biodegradability. The aqueous leaf extract of Tinospora cordifolia Miers (Menispermaceae) were used to synthesis AgNPs and found effective larvicidal activity against the head louse Pediculus humanus capitis De Geer (Phthiraptera: Pediculidae) and fourth instar larvae of malaria vector, Anopheles subpictus Grassi and filariasis vector, Culex quinquefasciatus Say (Diptera: Culicidae).

Viruses are like hijackers. The entry of virus is incautious and involves faster translational and multiplication process in living cells, they can kill, damage, or change the cells and make human sick. Biosynthesized AgNPs can act as as potent antiviral agent to resist virus cell functions. The life-threatening viruses like hepatitis, influenza, herpes simolex virus (HSV), humam immunodeficiency virus (HIV) is inhibited by AgNPs. The size,shape, absorption, and its aggregation in specific growth media shows its effectiveness as antiviral effects. HSV-1 infectionsis blocked by the attachment of

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AgNPs and thereby inhibit and prevent the entrance of the virus into the cells and preventing the cell-to-cell spread of the virus.

The bio-extracts collected from different plant parts (e.g., leaf, root, flower or fruit) were used as reducing agents for AgNPs preparation. A great deal of these AgNPs were either toxic to the breast cancer cell line MCF-7 or inhibited its growth. According to various literature report, the size of NPs ranging from 5–80 nm and with different shapes (e.g., spherical, cuboidal, pentagonal and hexagonal) shows good anticancer activity. TheAgNPs ranging from 59–94 nm and having shape (Cuboidal and spherical) , inhibited the A431 cell line, an epidermoid carcinoma [Nayak, D 2015].Biosynthesized AgNPs have also been found to inhibit the brain cancer cell line HNGC2. A hepatic cancer cell line (Hep-G2) was inhibited by spherical AgNPs that ranged in size from 6.4–1200nm.[10]

III. CONCLUSION

Nanoparticles have remarkable features that have made them important in a variety of industries. Technologies utilizing the nanoparticles have considerable potential because they can transform unstable, poorly soluble, and poorly absorbed physiologically active compounds into viable deliverable chemicals. The current review offers a brief, informative overview of greener synthetic methods for the synthesis of AgNPs. The review takes the opportunity to combine various viewpoints and terminologies used in PMGS-AgNPs. The literature reports cited here highlights the advantages of the respective materials, which leads to potential directions for future research are further developments to be explored, emphasising the challenges for PMGS-AgNPs .

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A REVIEW OF BIOLOGICAL AND DNA BINDING STUDIES OF SCHIFF BASE COMPLEXES

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ABSTRACT

The condensation of an amino compound with carbonyl compounds synthesizes the Schiff bases and their complexes are reported for their wide range of biological activities. These complexes have special attention on activities such as antifungal, antibacterial, antiviral, antitumor and anticancer properties. In the recent years, these complexes have gained good attention because of their unique biological properties. The biological applications of these complexes are reported in the large extent in the recent years. Development of a new chemotherapeutic Schiff bases and their metal complexes is now attracting the attention of medicinal chemists. In this review, a small attempt to show some examples for the biological applications of the Schiff base complexes.

Key Words: Schiff base Ligands, metal complexes, Antifungal properties, Antiviral activities and Anti cancer activities, DNA binding Activities.

I. INTRODUCTION

In 1864, Hugo Schiff undergone the condensation process between primary amines and carbonyl compounds, he synthesized the product called as Schiff Bases. Due to the conjugated system, Schiff bases of aromatic aldehydes show more stability than with the aliphatic varieties which are readily polymerized and unstable in nature. The presence of imine group (-RC=N-) in the Schiff base compounds have interestingly shown many applications like designing molecular ferromagnets, in catalysis, in biological modeling applications, as liquid crystals, as heterogeneous catalysts and also in self assembling cluster complexes. [1]

The presence of hetero atoms like oxygen, nitrogen and sulfur donors in transition metal complexes shows carcinostatic, antitumour, antiviral, antifungal and antibacterial activities.

The complex biological properties of these systems are studied from the structural chemistry of Schiff base ligands and their complexes. The presence of the characteristic azomethine (-N=CH) group, shows biological activities of complexes of heterocyclic Schiff base ligands. [2]

Sp2 hybridized nitrogen atom of the azomethine linkage shows biological activities due to the presence of lone pair on nitrogen atom. These Schiff base complexes have great attention due to their active part in metalloenzymes and as biomimetic model compounds. They are very often found inside

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the natural proteins and enzymes. The presence of N atom has an important role in the coordination of metals as the active site of numerous metallobiomolecules.

Mycobacterium tuberculosis is a bacteria which causes a potentially serious chronic disease known as Tuberculosis (TB). It is infectious and easily transmits from one person to another through tiny droplets released into the air via coughs and sneeze that is called airborne. WHO announced a prediction. The metal complexes are used as therapeutic agents and as drugs for the treatment of several human diseases, due to the developments in inorganic chemistry. Because of their potential applications in pharmaceuticals, antibacterial, antifungal, anticancer and anti-inflammatory actions, synthesis of Schiff base metal complexes, particularly those of transition metal ions, with different molecular topologies and sets of donor atoms is becoming an emerging area of research. [3]

There has also been substantial interest in the rational design of novel transition metal complexes, which bind and cleave duplex DNA with high sequence and structure selectivity.

II. BIOLOGICAL IMPORTANCE OF SCHIFF BASE COMPLEXES

The field of bio-inorganic chemistry increases the interest in Schiff base complexes, and made it biologically important.

Antifungal Properties

Some of the Schiff base complexes with copper metal have been efficiently studied for their antifungal and antibacterial activities. Their antifungal activities have been assessed against the three phytopathogenic fugi, A.solani, F.equisetti and M.phaseolina. Then their antibacterial activities have also been studied against the two pathogenic bacteria, E.coli and S.aureus. M.E.Hossain et al. reported his study that copper(II) complexes are generally less fungitoxic towards A.solani, F.equisetti and M.phaseolina than either the free ligands or the commercially available antifungal agent nystatin. The copper(II) complexes of benzoylpyridine Schiff base ligands are found to be more active towards the organism F.equisetti. The study shows that the given complexes are active against the organism S.aureus but the presence of E.coli remains stable. [4]

Some Schiff base metal complexes of 2-Aminomethythiophenyl-4-bromosalicylaldehyde have been reported for their antimicrobial activities. Shaker and his collegue reported a series Fe(II) Schiff base complexes derived from the condensation of amino acid and sodium 2-hydroxybenzaldehyde-5-sulfonate. These complexes are characterized by different analysis and undergone the antibacterial activities with Bacillus cereus, P.aeruginosa and Micrococcus bacteria. Many literature survey shows that cobalt Schiff base complexes have amazing antibacterial activities. Because of their aqueous stability, availability and simplicity of synthesis are more studied for Co(II) complexes than Co(III) complexes. The stabilization of Co(III) ion due to the presence of some polydentate ligands with N,O

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and S donor atoms and in aqueous phase Co(III) shows kinetic inertness in water due to the presence of NH_3. The new hybrid amie-imine-oxime ligand of Co(III) complex shows antibacterial activity against Bacillius subtilis but, with Staphylococcus aureus or the Gram negative bacteria Escherichia coli ad Eterbacter fecalis has no activity.

Antiviral Activites

The pharmacological properties like antibacterial, anticonvulsant, anti-HIV, antifungal and antiviral activities are efficiently indentified in Schiff bases and Mannich bases of isatin. In 2007, A Jarrahpour et al. synthesized a series of Schiff bases having the combination of isatin and 5-flouroisatin with cobalt (III) and reported their antiviral activities. In general, Cobalt (III) ion is not stable in aqueous solution. So it is stabilized in presence of chelating N, O donor ligand atmosphere. [5]

K.S.Kumar reported a group of Schiff base complexes containing 3-(benzylideneamino)-2-phenylquinazoline-4(3H)-one and their anti viral activity against herpes simplex virus-1(KOS), herpes simplex virus-2(G), Vaccinia virus, Vesicular stomatitis virus, herpes simplex virus-1 TK-KOS ACVr, para influenza-3virus, reovirus-1. Sindbis virus, Coxsackod virus B4, Punta toro virus, feline coronavirus(FIPV) feline herpes virus, respiratory syncytial virus and influenza A H1N1 subtype, influenza A H3N2 subtype, influenza B. [6]

Anti-cancer activities

Cancer is a group of diseases that involves abnormal cell growth with the potential to attack or spend to other parts of the body. Chemotherapy is a drug treatment for both localized and metastasized cancer. The existing drugs have serious side effects, so many researches are going on to overcome these problems. Schiff base linkages present in the organic compounds have well anti cancer properties due to its structures. Not only in organic, but also in inorganic chemistry, are the Schiff base ligands with the metal complexes used as potent drugs or diagnostic agents. Metal complexes can offer unique mechanisms of drug action because of wide range of co-ordination numbers, geometries and kinetic properties, which are not possible with pure organic molecules.

Cell cytotoxicity (MTT assay)

Mosmann method was used to determine the cytotoxicity of sample on MG-63 cells. In cell viability assay, MG-63 visible cells are harvested and counted using hemocytometer and diluted in Dulbecco's Modified Eagle Media(DMEM) to a density of 1X10 4 cells/ml and was seeded in 96 well plates for every well and allowed for attachment. The samples at various concentrations (5,10,15,20,25,30,35 and 40 μg/well) are treated after 24 h incubation at 37 °C during a humidified 95% air and 5 % CO_2 incubator for 24h. After incubation, the drug containing cells are washed with a fresh culture medium and each cell was incubated for an additional 4h at 37 °C with 5 mg/ml MTT in PBS. MTT(bromide

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of 3-(4,5-dimethyl thiozol-2-yl)-2,5-diphenyltetrazolium) is reduced in living cells by mitochondrial dehydrogenase, generating a purple colour that may be seen. The precipitate was dissolved in 100ml DMSO and cell viability was followed at 540 nm with a multi-cell plate reader. The results are expressed as a percentage of stable cells relative to the control group. [7]

The MTT assay investigation carried out in human lung cancer cell line (A549) and normal mouse adipose cell line (3T3L1) with the complex [3-(4,5-dimethylthiazol-2-yl)- 2,5-diphenyltetrazoliumbromide] to assess the cytotoxicity of the compounds. The plates were incubated at 37 °C in a 5% CO_2 incubator for 24 hours. After the completion of the process, IC50 values were determined by plotting the percentage viability versus concentration on a logarithmic graph and reading off the concentration at which 50% of cells remained viable relative to the control. The experiment was repeated to obtain mean values for at least three times.

The Schiff base complexes such as Cu(II), Ni(II), Pd(II), and Pt(II) complexes of ortho-naphthaquinone thiosemicarbazone (NQTS) and elucidated their in vitro anti cancer activities against MCF7 human breastcancer cell lines. Ni(II) complex have most potent IC50 value of 2.25 µM. [8]

Mononuclear complexes of Cu(II), Mn(II), Co(II), Ni(II) with bis-schiff base ligand derived from 2,3-butadione and thiosemicarbazide are synthesized and reported for their better anti-cancer activities. The cytotoxicity assay was done against five different kinds of cell lines (HL-60, Spca-1, Tb, MGC, K562). Among these complexes, Cu(II) was found to have better anti-tumor activity.

III. DNA BINDING AND OTHER IMPORTANT ACTIVITIES

Cu(I) and Cu(II) complexes were synthesized with Isoniazid (INH) was estimated for their putative antiviral activity in vitro. These complexes hindered RT activity about 88% and 95% repectively at the same concentration. The Cu(II) complex exhibited to be more potent exhibitor than isoniazid against RNA tumor viruses which is known as Retroviruses. A series of six isoniazid-derived Schiff bases were synthesized by condensation of isoniazid and several aromatic aldehydes in methyl alcohol. Zn(II) and Cu(II) complexes were synthesized and investigated for anti onchocercal activity. It was reported that the ligands and Zn(II) complexes were inactive against microfilaria. Cu(II) complexes have high activity against both micro- and microfilaria with IC50 values of 5µg/ml and 10 µg/ml. [9]

Several Schiff bases possess anti-inflammatory, allergic inhibitors reducing activity radical scavenging, analgesic and anti-oxidative activity. Thiazole derived Schiff bases show analgesic and anti inflammatory activity. The Schiff base complex of chitosan and carboxymethy-chitosan shows an antioxidant activity such as superoxide and hydroxyl scavenging. Furan semicarbzone metal complexes exhibit significant anthelmintic and analgesic activities. [10]

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IV. CONCLUSION

Many numbers of drugs are developed for the treatment of Tuberculosis for the past 40 years. The antimycobacterial activities of various Schiff bases and complexes have been explored. Among the Schiff bases, oxadiazoles, substituted triazoles, hydrazides like isoniazid, pyrazinamide, benzhydrazide and nicotinohydrazide are of great importance in the discovery of effective antimycobacterial drugs. Schiff base can be studied invitro study to undergone the cancer treatment. Schiff bases find applications in medicine have multi-dimensional properties. In various reports, it shows that the metal complexes with isoniazid have excellent several biological activities such as antibacterial, antifungal, anti-tuberculosis, cytotoxitiy, DNA bindig, antioxidant, scavenging and antiviral activities.

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SERVICE AND EFFICIENCY OF CLOUD IN HIGH PERFORMANCE ENVIRONMENTS - A STUDY OF RESOURCES BASED QUALITY SCHEDULING

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ABSTRACT-

The fastest-growing technology of the twenty-first century is most probably cloud-computing. It's the new buzzword of the IT industry that is being increasingly relied upon for its offer of unique services and applications. Cloud computing has on offer the unique and much sought after experience of giving its customers access to scalable, sustainable, and virtualized resources. It is through improved resource utilization and throughput across large-scale processing issues, that cloud computing aims to accomplish these goals. Therefore, scheduling tends to have an impact on cloud efficiency and is crucial for the creation of high-performance cloud environments. Scheduled resources are determined by the Quality of Service (QoS) needs based user application. Various QoS - based scheduling strategies have been tried by several researchers to overcome these scheduling challenges. This study presents an in-depth examination of the resource scheduling methodology, comparing and contrasting several soft computing-based scheduling approaches and discussing their outcomes. The results of this study should aid researchers in selecting appropriate methods for scheduling user applications in accordance with their quality of service (QoS) criteria.

Keywords: Scheduling; Soft computing; Cloud Computing; Quality of Service, applications.

I. INTRODUCTION

The most recent developments in Cloud computing are significantly impacting commercial apps, making them significantly more aggregated and compact. Twitter and Facebook are two well-known consumer apps where this is evident. Business apps in cloud are rapidly moving towards satisfying the expectations of clients. The clients need the information tailor made to their needs and for this the information is evaluated and is continuously addressed to suit the contemporary needs of the client. Cloud computing models are constantly evolving. In the cloud/client architecture, the client is an Internet-connected device that runs a rich application, while the server is an aggressively flexible cloud computing platform that utilizes a usage strategy that support by organizations.

Cloud applications can be used on a variety of client devices and serve as the central control point, record, and structure. A local application or programme can be used to address the client's needs; the program's expanding vitality is compatible with a range of client devices and work environments.

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Cloud programmes are being increasingly compelled to request more server-side processing capacity and limit restraint due to the demonstrably sophisticated requests of adaptable customers.

II. CLOUD ARCHITECTURE AND RESOURCE ALLOCATION

Different cloud parts are incorporated into cloud computing designs. The cloud structure is divided into two sections:

1. Front End proposes the client component in the architecture of cloud computing. It has the apps and interfaces needed to get close to the cloud computing phases, including a web browser.
2. The cloud itself is suggested by Back End. It comprises a substantial amount of resources that must be provided to cloud computing companies. Massive data accumulation, virtual computers, security frameworks, associations, organisations, servers, and so forth are all included.

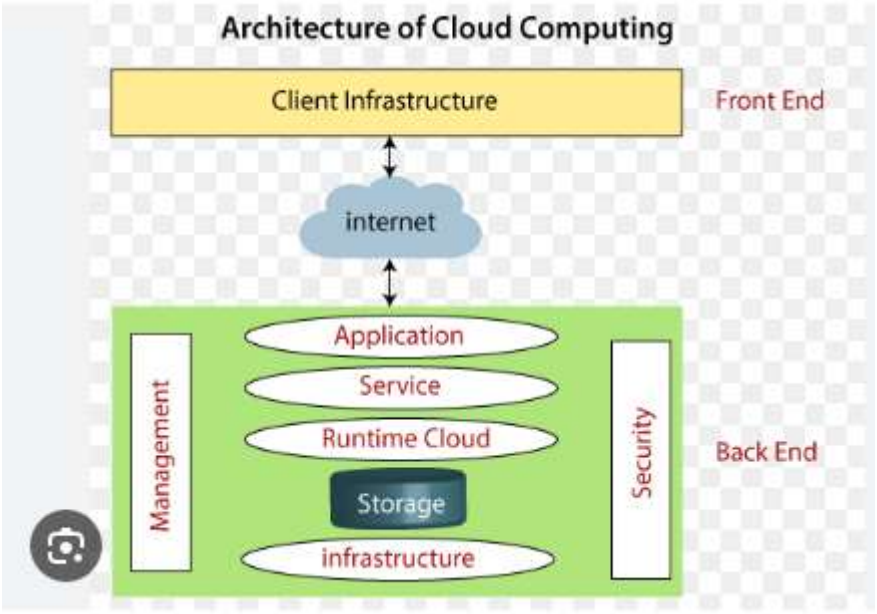

Fig-1: Cloud Computing Architecture

These new technologies, computing is now more or less treated as a commodity and delivered in the same way as traditional utilities. Users typically access services based on their needs, without giving much thought to the fundamentals of those services, such as their hosting location or delivery method. The cloud is an adaptable service provider because it taps into a vast pool of virtualized resources accessible through the internet. Resources are distributed among users in accordance with their needs in cloud computing data centres.

III. RESOURCE ALLOCATION

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Coordination of cloud provider exercises for using and allocating scarce resources inside the maximum cloud condition to resolve cloud application concerns is integral to resource allocation. Allocation requests and timestamps also contribute to optimal resource allocation. Many different types of administrations can be accommodated by a cloud. There are a lot of parameters that can be improved in allocating resources. For the resource allocation to be effective, the display and representation of the resources must take these requirements into account. Whether it is virtual or physical, any resource that engineers request from the Cloud is considered a resource in the cloud. Computational requirements, such as central processing unit (CPU), memory, and capacity, as well as data transmission and delay, can be planned by engineers.

All of these requirements must be satisfied for the resource allocation to be accurate when showing and depicting the resources. Cloud resources can be seen as any resource that engineers can request from the cloud, whether it's physical or virtual. Mostly the requirements can be engineered. Some of these requirements are transmission speed and latency besides computing requirements, like CPU, memory, and capacity. These requirements can be fulfilled using the cloud-based resources as a representation while constructing a framework for allocating resources. The allocating of resources should primarily focus on improving realistic models and depiction of those resources. Resource provision and treatment is a judicious action that resource allocation must overcome in order to meet the needs of applications. Just as dynamic and programmed allocation of resource needs is to be aware of the current state of cloud resources over time. Therefore, this framework is fundamentally built around components that allow for resource reveal and checking. Both systems contribute to making computation easier, because the resources and their state is crucial for making good decisions. The following challenges can occur during the process of resource allocation:

1. The virtual machine is experiencing performance issues due to being overcrowded.
2. Underutilization of resources occurs due to virtual machines being underloaded
3. Various applications have variable resource requirements [Chen, Zhu, Di, Feng 2016].

Task scheduling accuracy tends to be dependent various activities including a thorough analysis of applications before running them, analyzing the capabilities of the resources at the users' disposal, and providing a range of scheduling options to help users find the best configuration for running applications with the least amount of overhead. The problem of scheduling cannot be solved in polynomial time using any scheduling configuration that is currently accessible for all computer systems. However, taking into account features of the network environment, tasks, resources and such that are applicable to a certain setting can find the optimal scheduling approach to use. Some of the soft computing techniques might offer near-optimal answers to these NP-complete issues. In this

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paper, various soft computing techniques that can be used to identify the key quality of service attributes that impact on scheduling algorithm performance have been examined. These techniques include neural networks, fuzzy logic, genetic algorithms, support vector machines, Bayesian networks, and swarm optimization algorithms like Particle Swarm Optimization (PSO), Simulated Annealing (SA), BAT, and cuckoo search. To determine which quality of service (QoS) factors are most relevant when scheduling in cloud, a taxonomy and detailed evaluation of various methods is to be provided.

This paper explains the fundamentals of cloud computing, including the ideas behind resource scheduling and the criteria for quality of service. An analysis of different scheduling-based soft-computing approaches is presented, along with comparisons of these algorithms according to quality-of-service aspects. The benefits and drawbacks of soft computing methods are outlined in besides the provision of comprehensive definitions of quality-of-service elements. Using resource scheduling approaches, it offers its benefits. Major scientific findings and future work potential on the subject have also been included.

IV. RESOURCE SCHEDULING AS CENTRAL THEME OF CLOUD COMPUTING

Cloud computing revolves around the idea of resource scheduling, which significantly impacts the overall performance of cloud services [Chen, Zhu, Di, Feng 2016]. Finding the right resources and delivering them to clients based on their needs the focus.

The simplest form of scheduling can be detailed as follows:

When there are ‘n’ tasks with different processing times (J1, J2, ..., Jn) and a set of resources (R= {r1, r2……., rm}) with different processing powers. We need to discover a mapping function (M.F.) from J to R that specifies which resource (Rj) job ji is assigned to, where 1<= j >=n and 1<= I >=m.

Reducing complexity and overheads while optimizing for different quality of service factors is the primary goal of this mapping function. Figure-1 depicts the fundamental architecture of cloud computing resource scheduling. Task submissions are reviewed by admission control units, which possess comprehensive resource information and determine whether to approve or reject the task for rescheduling based on the necessary job resources. Jobs are scheduled to separate virtual machines when user requests are accepted.

To prevent resource over-utilization or underutilization, the second level of scheduling involves migrating virtual machines to different physical machines and taking into account user QoS demands at the first level of scheduling. A virtual machine (VM) with a lower failure rate has a higher percentage of successfully completing tasks assigned to it, the quality of the output is dependent on the type of VM that is assigned to the task but it results in higher expenses. There are a number of reasons why not all users opt for high-quality services to complete their tasks, one of which is the

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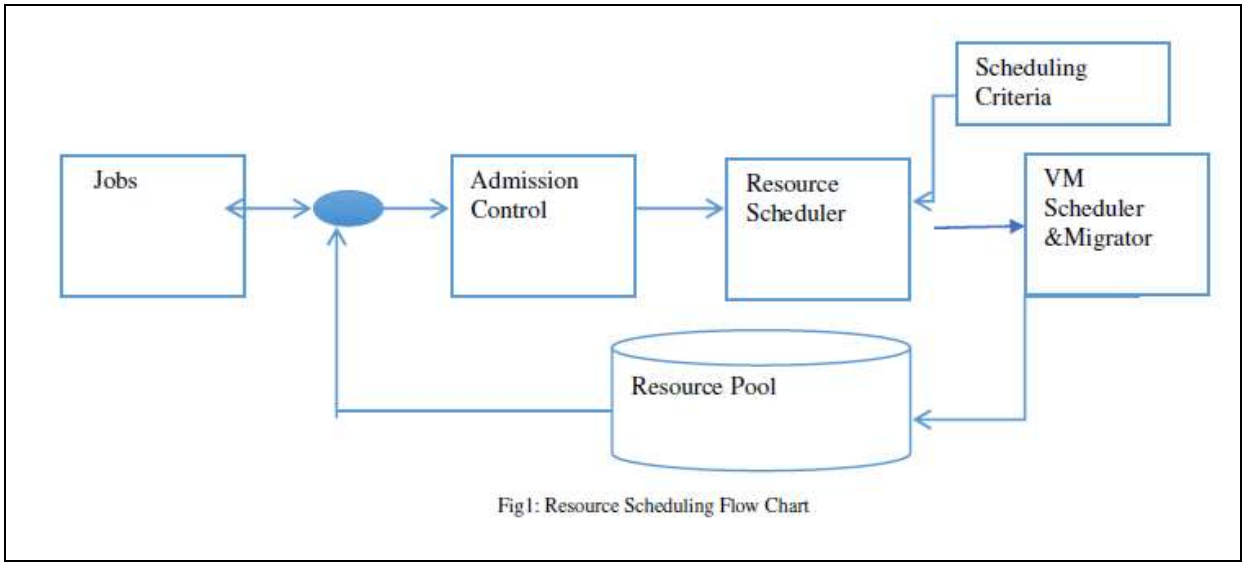
associated cost. According to Xing, Liu, and Ling (2015), the scheduling problem's most significant practical difficulty is that most suppliers offer varying service quality to meet different sorts of criteria. In a cloud computing context, numerous basic schedulers are possible. The problem is that these schedulers are not good at managing due dates, which can cause problems.



Source: Navimpour and Milani [2017]

Figure-2: Layout of Resource Scheduling in Cloud Computing

V. QUALITY OF SERVICE (QOS)

One area of study for cloud systems is the provision of high quality of service (QoS) to users including service users and suppliers. Low QoS diminishes customer loyalty and can cause service providers to go out of business and can result in the customers being dissatisfied or even loosing money on their investments. Therefore, in order to understand the concept of quality from a quantitative standpoint, measuring quality is a vital task. When dealing with cloud applications, one of the biggest problems is quality of service management, which arises from the inefficiency of resource allocation. In order to understand the relationship between quality of service (QoS) and cloud computing applications and the level of success in resolving QoS challenges, a number of researchers have examined different QoS strategies in cloud. Abdelmaboud, Jawawi, Ghani, Elsafi and Kitchenham [2015] aim to pinpoint the most important areas for future research. Since each user has unique quality of service (QoS) requirements, the cloud scheduler needs to be able to allocate resources such that cloud providers can reap the most value from meeting each user's QoS requirements.

VI. RESOURCE SCHEDULING USING SOFT COMPUTING TECHNIQUES

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Optimal scheduling, reduced execution time and cost, excellent dependability, and security are all requirements for cloud users to have their jobs completed. In order to meet the goals of cloud providers—which include optimizing resource utilization and load balancing—it is necessary to discover solutions that strike a good balance between these competing considerations [Rani and Kannan 2017]. This paper looks at a few of the many available soft computing techniques for addressing complicated issues, such as particle swarm optimization, neural networks, genetic algorithms, and more. These methods are employed to address many quality-of-service concerns pertaining to resource scheduling in a cloud computing setting.

A. Neural Network

Almeida et al. [2015] enhanced cloud computing scheduling using multilayer perceptions. The hidden layer of the network used hyperbolic tangent activation functions and the output layer used linear functions. When used in place of conventional scheduling methods, multiple ANN outperformed single ANNs in terms of performance, reduced error rates with less effort, and improved reaction times. Predicting resource demand by cloud users using static methodologies typically results in either under-provisioning or over-provisioning of resources because they fail to account for VM workload fluctuation. ANNs can automate the elastic scaling of resources in cloud systems, which makes them commonly employed for forecasting challenges. Therefore, [Uma and Chakraborty 2016] utilized ANN to achieve resource demand based on resource usage statistics obtained from the system static collector. They applied dynamic resource scheduling to consolidate the VM to enable it to handle variable workloads without violating SLAs, while considering the dynamic workload fluctuations of the virtual machine and accuracy of their predictions.

By monitoring each virtual machine's CPU, memory, bandwidth, and other metrics during runtime, Anitha N. and Anirban Basu [2015] were able to determine whether more or less resources should be allocated, and then fed this data into a feed-forward neural network. To decrease the execution time and power consumption VM, Karthikeyan and Chitra [2017] integrated ANN with a grey system for work scheduling. This system takes three important parameters into account: task duration, CPU intensiveness, and memory intensiveness. Uma and Chakraborty (2016) suggested a fuzzy neural network PID control-based task manager as a means to optimize the nonlinear and time-varying system's quality of service features. In order to feed the neural network, the suggested task manager uses the feedback from the previous round of QoS parameters measured by fuzzy max-min inference workload. To determine the workload degree, the output layer employs center-of-gravity defuzzification.

B. Fuzzy Logic

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To be able to comprehend the vague necessities of particular issues, like resource scheduling or virtual machine management, a fuzzy model is built. Various researchers have created fuzzy models, such as the rules-based system, to address scheduling issues and comprehend fuzzy user demands [Guo, Yu, Tianand Yu 2015; Li, Ma, Tang, Shen and Jin 2017; Shinde and Kadam 2015; Chen, Zhu, Di, and Feng 2015; P. V and C. Nelson 2017] and A. Ragmani et al. [2016] utilized the idea of a global performance indicator (GPI) based on fuzzy logic theory to rank the variation between potential configurations of physical and virtual computers with the goal of optimizing cloud performance and load balancing.

The writers tested out various GPI values while varying input parameters like the number of virtual machines and hosts per data center, processor speed, number of processes, data size, user requests and data requests. A dynamic scheduling method based on fuzzy logic controllers can investigate the impact of waiting time slots in queues and their priority, according to Mehranzadeh and Hashemi [2013]. This approach can reduce work completion times and assign virtual machines to hosts. Zavvar, Rezaei, Garavand, and Ramezani [2016] created a reliable resource scheduling system based on fuzzy logic to enhance the dependability of cloud computing. They utilized fuzzy metrics such as cost, trust, and length to achieve this. Fuzzy clustering techniques have been used by researchers to decrease the task waiting time of applications that are bound by precedence. Cloud computing CPU and fuzzy similarity matrices, as well as other resource attribute communication and processing capability, network location, number of links, etc., are considered by these methods. The work of Jian Li and colleagues. Li, Ma, Tang, Shen, and Jin [2017] used a fuzzy c-means clustering method based on radial basis functions to sort the possible resources into three categories and then decrease the pool. The inverse trig function can be used in the modified FIFO scheduling paradigm to allocate transmission, storage, and computation resources to jobs according to their predicted utilization. When it comes time to schedule the processing unit, knowing how well the resources are doing is vital for choosing the one that will accomplish the work best.

VII. ADVANTAGES OF RESOURCE SCHEDULING

Some of the benefits of resource scheduling can be listed as follows:

1. Increasing the rate of resource utilization is achieved by using underutilized servers by many virtual machines.
2. Less resource shuttering and clashing, over-provisioning, under-provisioning, etc. are handled by the efficient technique.
3. The scheduler benefits from the VM's performance when allocating new jobs to appropriate machines.
4. The typical rate of success enhances the effectiveness of scheduling in the face of competing demands for available resources Nelson, P. V., and C. [2017].

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5. By utilizing virtualization, one can enhance resource availability, simplify processes, and safeguard against dangers related to infrastructure.
6. Users are able to handle their dynamic requirements with ease thanks to its scalability and adaptability
7. Tasks in the workload queue spend less time waiting when resources are allocated and scheduled efficiently in the cloud.
8. Thanks to the optimal distribution of resources, there is a little likelihood of scheduling delays and resource failures.
9. Scheduling efficiently lowers energy consumption without compromising SLA.
10. The most efficient use of time and resources is achieved through scheduling decisions.

VIII. CONCLUSION

The efficiency of resource utilization and task performance can be greatly enhanced by using resource scheduling, which has found extensive application in cloud computing. Research on scheduling algorithms has shown that many different types of soft computing techniques —including neural networks, fuzzy logic, genetic algorithms, Bayesian networks, and meta heuristics—are commonly used to schedule resources according to various quality of service attributes. Additionally, the pros and cons of currently available resource scheduling approaches are carried in this paper. When working in cloud, no one method can guarantee optimal scheduling. Therefore, QoS qualities and resource scheduling approaches are both crucial to the success of a cloud computing system.

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A COMPREHENSIVE INVESTIGATION TO EXAMINE THE PREFERENCES AND SATISFACTION LEVELS OF OUTPATIENTS IN RELATION TO THE QUALITY OF SERVICES PROVIDED BY HOSPITALS IN THE VELLORE DISTRICT

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ABSTRACT

Customer satisfaction remains the most fascinating topic. The primary objective of organizations is to maximize profits while trying to reduce costs. Increasing sales with lower costs can increase profits. Customer satisfaction, which promotes customer loyalty, is part of sales growth. Patient satisfaction regarding health care is a multidimensional concept that now becomes a very crucial health care outcome. The behaviours of healthcare service providers have altered significantly in recent years as a result of technology innovation. Due to intense rivalry in the industry, the health care system is currently a challenge for all governments, states, political parties, and insurance companies. The private sector, previously dominated by non-profit/public hospitals, is now playing a larger role in health care delivery. This study the researcher has attempted to analyse the level of satisfaction of patients and their perceived quality of services provided by the hospitals. It is hoped that the health care providers would pay attention to quality in every aspect of patient care, both medical and non medical. As the patient satisfaction is the valuable asset of the health care providers, understanding the patient and believing that he is most important, goes a long way towards the success of every health care provider.

Key Words: Patients, Satisfaction, Hospital, Healthcare, Perspective, etc,

I. INTRODUCTION

For businesses and scientists alike, customer satisfaction remains the most fascinating topic. The primary objective of organizations is to maximize profits while trying to reduce costs. Increasing sales with lower costs can increase profits. Customer satisfaction, which promotes customer loyalty, is part of sales growth (Wilson et al., 2008, p. 79). Customers always want to get as much satisfaction as possible with the product or service they purchase. In order to succeed in today's economy, businesses must build close relationships with their customers in addition to creating quality goods. Delivering

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greater value to target customers than competitors means developing client relationships (Kotler et al., 2002, p. 391).

The importance of patient happiness as a health outcome has grown. According to popular belief, satisfaction is an attitude reaction to patients' value assessments of their therapeutic interaction (Kane et al., 1997, p. 714). A definition of satisfaction based on the achievement of expectations might be stated openly or implicitly (Williams, 1995, p. 559). From our vantage point, a consumer's expectations for satisfaction are what they judge and ultimately decide whether to accept or reject a product or service based on.

Patient satisfaction regarding health care is a multidimensional concept that now becomes a very crucial health care outcome. The following factors were found in a meta-analysis of patient satisfaction with medical care: overall quality, trust, reputation, continuity, competence, information, organisation, facilities, and attention to psychosocial problems, humaneness, and treatment outcome (Hall & Dorman, 1988, p. 935). All of these elements have a significant impact on the level of satisfaction as well as the level of service quality provided by healthcare institutions.

II. STATEMENT OF THE PROBLEM

Hospitals are essential to quality of life. Health is a prerequisite for labour productivity and human development. “All societies must remember that a high quality of life and, dare I say it, human well-being can only be achieved with an adequate level of health, is also a prerequisite for development. A range of health policies is therefore aimed at ensuring that individual health receives appropriate care, typically the kind of services available in hospitals. We have a system and a variety of programs: large numbers of technically qualified people seeking services in hospitals apply their knowledge and skills using sophisticated equipment to ensure quality patient care Built-and is working on human resource development every day with the aim of developing human resources and improving living standards. India has emerged as a major player in this industry due to its large population and current value of Rs 73,000 (around 4% of GDP).

Developing and implementing a system that provides high-quality hospital services while pursuing real quality is a major challenge for hospital administrators. In this regard, the researchers are interested in conducting a study on patient satisfaction and quality assessment of medical services in a multi-specialty private hospital in Vellore District, Tamilnadu. Importance and Scope of Research India's healthcare sector has made remarkable progress in recent years and people's expectations have risen dramatically. Service costs are also rising, with 4,444 patients expecting faster and better service from hospitals.

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There is a growing demand for quality hospital services to satisfy patients. Therefore, assessing patient satisfaction and patient perception has become a time-consuming task. This helps marketers identify similarities and gaps in hospitals, paving the way for innovation. Marketers not only understand and address unmet needs, they strive to identify unmet patient needs, educate patients about their needs, and address their needs more effectively compared to competitors. Competitive quality creates patient satisfaction. Disgruntled patients leaving services lead to negative public opinion about the quality of services provided. This will affect the growth rate and market share of hospitals. Better and more competitive service benefits dissatisfied and lost customers. Existing customers who are very satisfied with your service can be the best marketers for your service as they can generate positive word of mouth, which is a powerful promotional tool to attract new customers increase. It's more powerful than any promotional tool the company has created. The study focused on patient satisfaction with the performance of services in multispecialty private hospitals. Patient perceptions and expectations were also studied to assess the service quality of private hospitals.

III. NEED FOR THE STUDY

Patient satisfaction is the health care recipient's reaction to aspects of his or her service experience. Patient satisfaction belongs to the service dimension as opposed to the technical dimension of quality of care. Most patients report few problems related to technical quality of care in hospitals and more over do not feel qualified to judge technical quality and therefore assume technical competence. The study suggested that the management should put more effort in improving the facilities and cleanliness. As a health care institution, hygiene is very important to prevent any infection and worsen the patient's condition. Both government and private hospital are controlled by Ministry of Health (MOH). They are referring to the same standard but it depends on the management to implement it and to serve the patients. As revenue affects the survival of private hospital, the management must monitor the service quality continuously to ensure that the patients are satisfied and willing to revisit again. Customer loyalty is influenced by the satisfaction. Thus, identify the service quality that affecting the patients' satisfaction is helpful in planning the marketing strategy. The policy-makers are able to implement and provide better service to the patient so that they will visit the same health care institution again.

IV. OBJECTIVES OF THE STUDY

1. To review the growth and development of health care services in India in general and Vellore district in particular.
2. To study the awareness of patients towards health care services of the private hospitals.
3. To study the criteria used by the patients in choosing the hospital service providers.

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4. To examine the level of satisfaction of patients and the factors influencing their level of satisfaction.
5. To evaluate the quality of health care services provided by the private hospitals.
6. To offer suggestions in enhancing the quality of hospital services and patient satisfaction.

V. REVIEW OF LITERATURE

Mohammed Eid Mahfouz et al, (2021) a move-sectional on line survey changed into performed the use of a pre-examined and tested questionnaire. The Arabic model of the National Health Service (NHS) and Quality Hospital Solutions (QHS) changed into used to accumulate responses from sufferers. Inclusion standards covered sufferers handled in any health center, public or non-public and person sufferers (over 18 years of age). Exclusion standards covered seriously unwell sufferers (CCU and ICU sufferers) and illiterate sufferers. Satisfaction rankings in diverse subdomains associated with health center offerings have been measured and subjected to statistical evaluation the use of the Statistical Package for the Social Sciences ver.23 the use of appropriate importance tests.

Dr.K.Veeraraghavan (2021) Analyses the general public fitness coverage must be making sure the accessibility and affordability to number one fitness take care of all the humans. Health care is the essential proper of the humans then most effective the humans can stay with inside the international for a protracted time. In this look at the bulk of the sufferers happy with the fitness offerings supplied with the aid of using Private Hospitals in Thirualluvar District.

Babatola et al. (2022) This look at assessed affected person delight with fitness care offerings and identifies elements related to affected person delight in decided on fitness centres in Ondo State. Gender, degree of schooling and career are predictors of delight with fitness offerings. Health care vendors want to paintings on fitness care transport to enhance care recipients' delight with care.

Swarupa and Dr. Radhika M (2022) decide the great of affected person care rendered with inside the sanatorium. It is an essential factor on this competitive present day era, and usually used indicator for measuring the great. Patient delight is a subjective phenomenon. It is likewise a multidimensional aspect as, many elements make contributions immediately or in a roundabout way to affected person delight, which include accessibility and comfort of offerings, institutional structure, interpersonal relationships, the competence of fitness experts and an affected person's expectancies and preferences. More significance is now given to delight of sufferers and their caregivers with sanatorium care. Patient Satisfaction is diagnosed as an essential parameter for assessing the great of affected person care offerings. Research design-A descriptive go sectional look at changed into undertaken to evaluate the extent of delight amongst sufferers in decided on Hospital, the pattern length changed into 2 hundred in sufferers have been decided on with the aid of using the use of simple random method for the look at. Modified Mcclockey /Mueller delight scale changed into used to evaluate the extent of delight amongst inpatients closer to affected person care

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offerings. Revealed that amongst 2 hundred inpatients. 116(83.0%) are very much happy, 34(17.0%) are happy. 81% and 70% of them have been very much happy closer to nursing offerings and the doctor's offerings respectively.

VI. RESEARCH DESIGN

Descriptive research

A pilot study was conducted with 78 respondents to test for its reliability. For the study the final Questionnaire was framed checking the alpha (Cronbash) values. Respondents' were selected from different zones in Vellore district of Tamilnadu. The reliability for the pilot study was tested statistically using Cronbach's Alpha and it was found to be 0.795.

In the current research study the sampling technique, used is stratified convenient. In which Vellore district is stratified. In each of the zone in the Vellore district were considered as a strata, the samples were chosen from each strata using convenient sampling technique. The population is all the private hospital patients belong to Vellore district. Respondents were contacted personally and administered the questionnaire.

Table showing the factor loading values of various dimensions and its attributes

Dimensions/ Factors	Item	Factor Loading	Dimension Loading
Registration Service	Reception Services	0.89	0.77
	Availability of information	0.77	
	Waiting time for admission	0.81	
Physicians' competence and medical care	Professional competence of doctors	0.90	0.79
	Time spent by the doctor for diagnosis	0.89	
	Explanation about the health and treatment	0.75	
	Attitude and behaviour	0.69	
	Willingness to listen/answer patient's questions	0.75	
	Psychological support	0.84	
	Health education provided	0.91	
	Daily visit	0.71	
	Professional appearance	0.64	
Nursing care	Nursing skill	0.86	0.78
	Attitude and behaviour	0.79	
	Promptness in meeting needs	0.77	
	Medication at regular intervals is in time	0.69	
	Psychological support	0.75	
	Professional appearance	0.84	
Room environment	Calm and Quietness in room	0.91	0.86
	Bed size and quality	0.75	

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	Facilities (Fan, water, sanitation, etc)	0.90	
	Cleanliness	0.89	
	Appearance	0.82	
	Ventilation	0.79	
Dietary Services	Timeliness of food served	0.81	0.85
	Diet	0.79	
	Menu	0.92	
	Taste	0.84	
	Temperature of food served	0.88	
	Containers	0.89	
Discharge process and Billing	Presenting and explanation of the bill	0.75	0.77
	Discharge instructions	0.84	
	Discharge summary	0.91	
	Time taken for the patient to leave the hospital	0.75	
Supporting staff	Skill & knowledge of the supportive staff	0.90	0.80
	Promptness in meeting needs	0.79	
	Care & concern	0.81	
	Appearance	0.79	

The factors of current study identified are Registration Service, Physicians' competence and medical care, Nursing care, Room environment, Dietary Services, Discharge process and Billing, and supporting staff. The factor Registration Service has an overall loading of 0.77 and it ranges from 0.76 to 0.91. The factor Physicians' competence and medical care has an overall loading of 0.79 and it ranges from 0.64 to 0.9. The factor nursing care has an overall loading of 0.78 and it ranges from 0.75 to 0.86. The factor Room environment has an overall loading of 0.86 and it ranges from 0.75 to 0.91. The factor Dietary Services has an overall loading of 0.85 and it ranges from 0.81 to 0.92. The factor Discharge process and Billing has an overall loading of 0.77 and it ranges from 0.75 to 0.91. The factor supporting staff has an overall loading of 0.80 and it ranges from 0.79 to 0.90. The overall factor loading to all the 38 attributes is 0.78.

DATA COLLECTION

For the application of statistical tools data is required and the required data was collected by the researcher by the two means of primary and secondary data.

SAMPLING TECHNIQUES

The research study used stratified convenient sampling technique, in which each of the zone in the Vellore district were considered as a strata, the samples were chosen from each strata using convenient sampling technique. The population is all the private hospitals patients belong to Vellore district. Respondents were contacted personally and administered the questionnaire.

SAMPLE SIZE

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The sample size for the current study is 658

VII. FRAMEWORK OF ANALYSIS

The data collected were analysed using relevant statistical tools to make valid inferences based on the objectives of the study. Descriptive tables and percentages are used for analysis.

Intra-Test of Association (correlation) among the factors of patient's satisfaction towards hospital services

Null Hypothesis H_0**:** There is a significant relationship exists among the various factors of patient's satisfaction towards hospital services

Correlations

Dimensions		**Registration Service**	**Physicians' competence and medical care**	**Nursing care**	**Room environment**	**Dietary Services**	**Discharge process and Billing**	**Supporting staff**
Registration Service	Pearson Correlation	1	.721**	.578**	.565**	.711**	.654**	.517**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	658	658	658	658	658	658	658
Physicians' competence and medical care	Pearson Correlation	.721**	1	.582**	.612**	.624**	.549**	.401**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	658	658	658	658	658	658	658
Nursing care	Pearson Correlation	.578**	.582**	1	.613**	.644**	.387**	.411**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	658	658	658	658	658	658	658
Room environment	Pearson Correlation	.565**	.612**	.613**	1	.711**	.547**	.612**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	658	658	658	658	658	658	658
Dietary Services	Pearson Correlation	.711**	.624**	.644**	.711**	1	.519**	.442**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000

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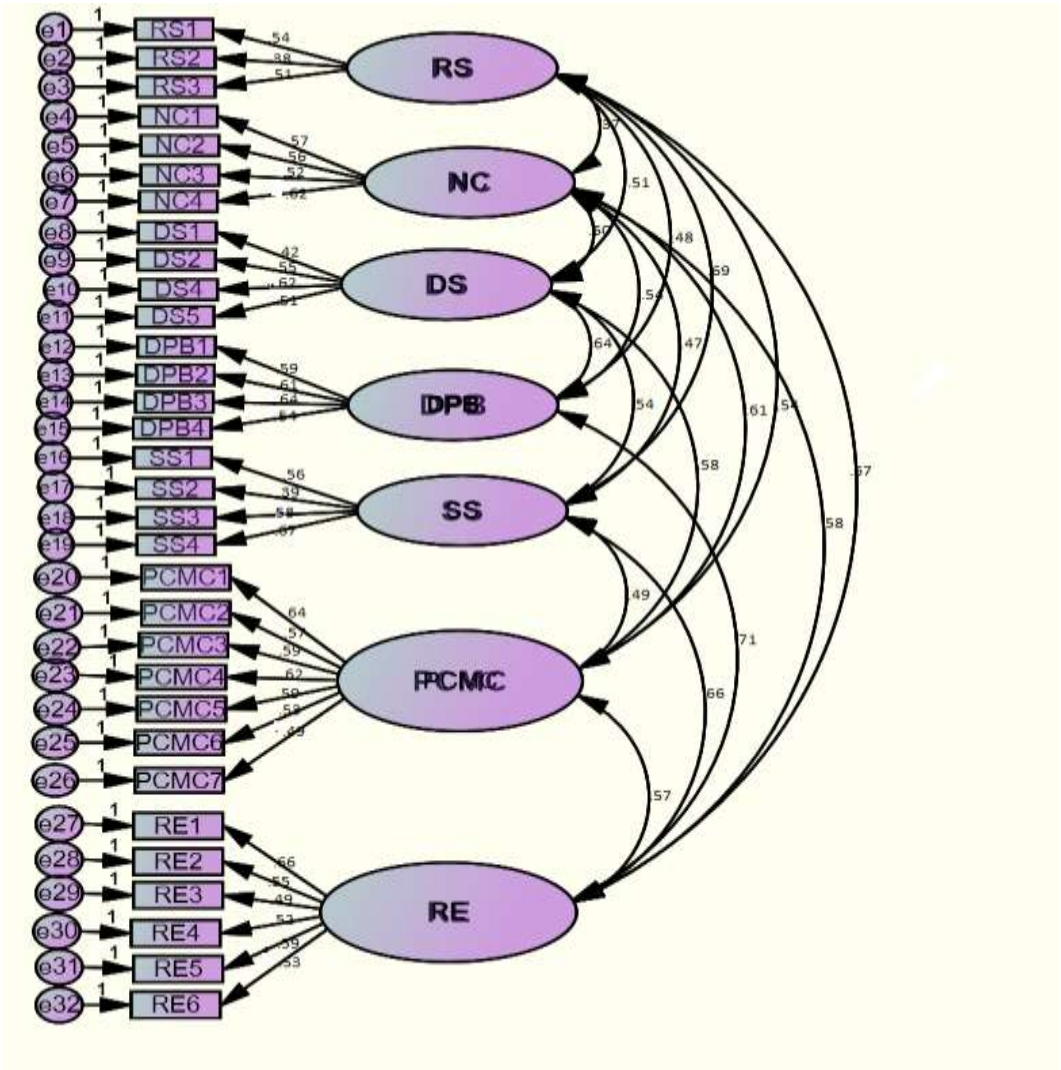
	N	658	658	658	658	658	658	658
Discharge process and Billing	Pearson Correlation	.654**	.549**	.387**	.547**	.519**	1	.404**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	658	658	658	658	658	658	658
Supporting staff	Pearson Correlation	.517**	.401**	.411**	.612**	.442**	.404**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	658	658	658	658	658	658	658

**. Correlation is significant at the 0.01 level (2-tailed).



CFA Model and Evaluation of the patient's satisfaction model

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Table showing the values of SEM model fitness indices

S. No	Model Fitness Index	Value
1.	Chi-square / Degrees of Freedom	1.018
2.	Significance Value	0.214
3.	Goodness of Fitness index (GFI)	0.901
4.	Goodness of Fitness index (AGFI)	0.906
5.	Comparative Fit Index (CFI)	0.942
6.	Root Mean Square Residuals (RMR)	0.009
7.	Root Mean Square Error of Approximation (RMSEA)	0.011

VIII. CONCLUSION

This study the researcher has attempted to analyse the level of satisfaction of patients and their perceived quality of services provided by the hospitals. It is hoped that the health care providers would pay attention to quality in every aspect of patient care, both medical and non medical. In the present situation where the globe is facing the crises of Covid-19 and trying to overcome from it and India takes a better step towards the field of medical care and overcame the challenges and manage it in a better way. The services provided by the hospital are tremendous and the way of tackling the crises is also appreciated. In terms of patients satisfaction it is out of the services rendered by the hospital keeping the various factors which leads to the helping the patients in their tough time and leads to create the trust and faith of the patients. As the patient satisfaction is the valuable asset of the health care providers, understanding the patient and believing that he is most important, goes a long way towards the success of every health care provider.

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EMPOWERING DIFFERENTLY ABLED INDIVIDUALS THROUGH DIGITAL INNOVATION IN SERVICE DELIVERY

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ABSTRACT

This study explores the relationship between innovation and the needs of people with disabilities, highlighting four ground-breaking advancements in online services. Voice-activated interfaces enable people with mobility challenges to interact without using their fingers. Apps for augmented fact navigation provide real-time guidance to blind individuals, enhancing their sense of self and ability to move around. Tailorable technology for show analysis accommodates different customer needs, guaranteeing personalized online reports. Furthermore, real-time signal language translation applications enable more fluid spoken communication. Even while these improvements greatly enhance freedom and equality, issues with affordability and privacy still exist. While wearable augmented reality and natural language processing hold great potential for the future, pricing, customer awareness, and privacy remain crucial concerns. In the end, this paper emphasizes how generation has the revolutionary power to break down barriers and promote inclusivity.

I. INTRODUCTION

In a world characterized by relentless technological advancement, the notion of service has undergone a profound transformation. As societies become increasingly reliant on services spanning from healthcare and transportation to education and e-commerce, the imperative of equitable accessibility cannot be overstated. However, a segment of our population continues to encounter persistent challenges in availing these services, a segment that we, in the realm of this research work, refer to as "differently abled users."

According to the findings of Sweta Pattnaik, Jogesh Murmu, Ritik Agarwal, Tanveer Rehaman, Srikanta Kanugo and Sanghamitra Pati, the overall prevalence of disability was 4.52 % [(95% CI: 4.48–4.55), *n* = 1,28,528] across all age groups in India. The prevalence was highest in the age group of 75 years and above at 6.07%[6]. This research work is poised at the intersection of innovation, service, and inclusivity, focusing unwaveringly on the needs of differently-abled individuals. The service industry stands at a crossroads, much like a gardener deciding which seeds to plant for the most bountiful harvest. It cannot afford to ignore or undervalue the importance of serving differently abled individuals effectively. Their experiences are woven into both the progress and limitations of

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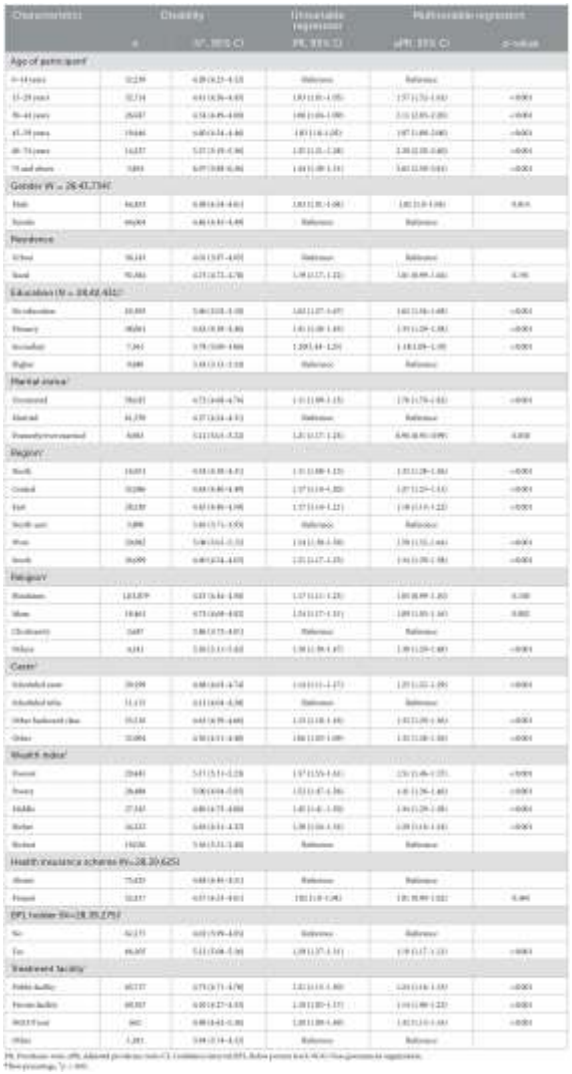
service delivery. By embracing innovative solutions and technologies, we strive to close this gap, improving accessibility, independence, and overall quality of life. This research paper delves deeply into innovations in services tailored for differently-abled users—examining their impact on this group while envisioning future paths toward inclusivity. This study is more than scholarly work; it's akin to laying down bricks for building an inclusive society where services are accessible to everyone regardless of their unique abilities or challenges. Historically speaking, such shifts have been monumental—not unlike when electricity first illuminated homes once bound by candlelight—transforming how societies functioned overnight. Innovations in assistive technology have similarly revolutionized opportunities for differently abled persons: from wheelchairs that climb stairs autonomously to apps translating text-to-speech instantly enhancing daily interactions. These changes also ripple through workforce dynamics as new roles emerge specifically catering towards inclusion—a tapestry being rewoven with threads more colorful and varied than before—and societal perceptions shift gradually but irrevocably towards understanding diversity not as hindrance but richness.



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II. LITERATURE REVIEW

While existing literature provides valuable insights into the challenges and innovates in services for differently abled, there remain certain gaps:

A. Cross Sector Inegration: Numerous studies concentrate on particular industries alone. Examining how accessibility and inclusivity might be integrated across sectors is necessary, given that people with disabilities engage with several service sectors on a regular basis.

B. User Experience and Satisfaction: While some studies offer thorough analysis of user experiences and satisfaction with these changes, even though some focus on the development of creative solutions. It's critical to comprehend how these technologies will actually be used.

C. Emerging Trends and Future Directions: The literature frequently fails to offer a thorough analysis of new developments in innovation. By providing insight into how services will be accessible in the future to people with disabilities, this research aims to close this gap.

III. METHODOLOGY

The research strategy, data gathering procedures, and analysis methodologies employed in this investigation of innovation in the service industry for people with disabilities are described in the methodology section. This section offers an overview of the research methodology, allowing the reader to assess the level of investigational rigor. Using a mixed-methods approach, this study thoroughly examines developments in the service industry for people with disabilities by integrating quantitative and qualitative research techniques. Combining these approaches provides a more comprehensive grasp of the material.

A. Data Sources: Survey Questionnaires: A standardized survey questionnaire encompassing a range of age groups and disabilities was given to a representative sample of people with differing abilities. The influence of creative solutions, accessibility, and user satisfaction were all evaluated in the questionnaire based on their experiences using the services.

In-Depth Review: To gather information, semi-structured interviews were held with service providers, organizations that specialize in creating creative solutions for users with disabilities, and specialists in accessibility and inclusivity. Qualitative insights into the difficulties and innovations in service delivery were obtained from these interviews.

Secondary Data: To bolster the research's conclusions and discussion, pertinent data from scholarly works, official documents, and trade journals was gathered.

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IV. EXPERIMENTAL RESULT

Services for people with disabilities that are innovative employ a variety of tools and methods. Several notable areas of innovation have been found by this review of the literature:

Assistive Technologies: Numerous studies have examined the creation and uptake of assistive technology, including communication devices, mobility aids, and screen readers. With the help of these technologies, people with disabilities can move more freely across both digital and real-world contexts.

User-Centered Design: In the service industry, user-centered design approaches have gained popularity since they emphasize the active participation of diverse Numerous studies have examined the creation and uptake of assistive technology, including communication devices, mobility aids, and screen readers. Through the design and testing of services, these technologies enable more independently abled individuals to navigate both digital and physical settings. By using this strategy, services are guaranteed to be customized to the target demographic's unique needs and interests.

Education and E-Learning: Research on accessible e-learning systems and material has increased with the emergence of online education, increasing the accessibility of education for people with disabilities. Digital textbooks and easily available LMSs are examples of creative solutions.

A. Solutions and Recommendations:

Voice-Controlled Interfaces: Provide voice-activated user interfaces so that people can utilize natural language to control digital services. With the help of this invention, people with limited mobility can interact with technology hands-free.

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Augmented Reality Wayfinding: Create augmented reality (AR) apps that help differently abled users navigate public spaces. A low cost and easy adoption method developed by M Anandan, M Manikandan, and T Karthick gives higher adoptability to such technologies [5]. These apps can provide real-time guidance, highlighting accessible routes and offering location-based information for visually impaired users.

Work produced by Padma Priya Mahalingam, Periyasamy J.K, Jeyaselvi P develops a system that captures image from the camera and then detects the object region and extracts text pattern [2] combined with the work of Aswath Suresh, Chetan Arora, Debrup Laha, Dhruv Gaba, and Siddhant Bhambri which proposes smart glass as a representation of a potential aid for people who are visually impaired that might lead to improvements in the quality of life[3] can be used as a foundation for Augmented Reality Wayfinding

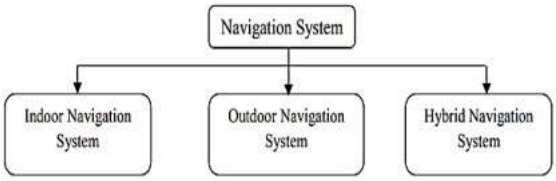
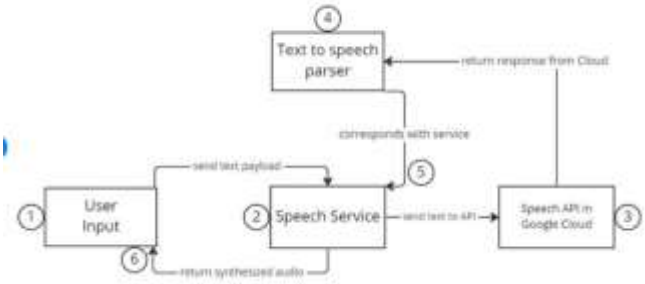


Figure 1. Types of navigation system

Customizable Screen Reading: Develop advanced screen readers that are highly customizable, allowing users to adjust the reading speed, voice, and other settings to cater to individual preferences and needs.



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Realtime Language Translation: Develop real-time language translation apps for sign language. These apps can facilitate communication between differently abled individuals who use different sign languages and those who don't understand sign language. A study on the same by Anjali Kanvinde, Abhishek Revadekar. Kalbande and Nida Bakereywala yielded an accuracy of 97% using Inception V3 and a recurrent neural network, with 20 classes taken into consideration from the Argentinian Sign Language Dataset. [1] Work done by Song, N., Yang, H., and Wu, P. also provides a pathway for not only integrating gesture recognition but integrates facial recognition[4] to further enhance the context of translated message.

V. DISCUSSION

Voice-Controlled Interfaces: For users who are differently abled and have mobility issues, voice-activated user interfaces can be life-changing. Through the ability to interact with digital services hands-free, these interfaces offer a renewed sense of autonomy. Without requiring physical input, users can access technology, operate gadgets, and complete tasks.

The elimination of physical barriers in interacting with technology is empowering for those with limited mobility. With just their voice, people with disabilities can interact with a broad range of services, from internet browsing to home automation, and traverse digital surroundings and information.

.**Augmented Reality Wayfinding**: Applications for augmented reality navigating are revolutionary for those with visual impairments. Through real-time navigation and location-based data, these applications improve mobility and lessen the stress of navigating public areas. Users with different abilities become more self-assured and daring to explore new places, leading to increased independence.

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The improvement in accessibility of public areas is substantial. It is easy for users to find accessible routes, find necessary facilities, and get up-to-date information about their surroundings. This invention could completely change how people with disabilities interact with their surroundings.

Customizable Screen Reading: Differently abled individuals can enjoy a comfortable and tailored reading experience with customizable screen readers. Readers can customize various options, such as voice type and reading speed, to suit their individual requirements and tastes. Those with visual or cognitive limitations particularly benefit from this level of customisation.

A more inclusive digital environment is ensured by screen readers that accommodate individual preferences. Equal access to information and services is promoted by allowing users of all abilities to interact with websites, applications, and content on their own terms.

Real-Time Language Translation: For people with disabilities who use sign language as a means of communication, real-time language translation apps have a significant influence. This breakthrough enables smooth and instantaneous communication between users who use various sign languages and non-sign language users.

The population at large as well as individuals with disabilities are impacted by real-time sign language translation. It fosters inclusivity and bridges communication gaps, enabling individuals with varying abilities to communicate effectively.

VI. CONCLUSION:

The past, present, Innovations for people with disabilities in the digital service sector have progressed, changed, and have the potential to become more inclusive in the past, present, and future. People with restricted mobility now enjoy a sense of freedom and a hands-free way to connect with technology thanks to voice-activated interfaces. The way the blind may navigate has dramatically changed with the adoption of augmented reality wayfinding gadgets, which offer them real-time guidance and greater freedom to explore public spaces. Thanks to customized screen reading technologies, users with varying needs and preferences may now access and enjoy tailored digital experiences. Applications for instantaneous sign language translation have removed obstacles to communication and promoted inclusivity between non-sign language speakers and users of other sign languages. The lives of people with impairments are significantly impacted by these improvements in a number of ways. They have improved accessibility and promoted independence while also making homes, businesses, public spaces, and educational institutions more inclusive. These advancements also show how technology has the revolutionary potential to advance social justice and erase barriers that have long kept individuals with disabilities from participating fully in all parts of society.

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It seems that upcoming trends could build upon past successes. Natural language processing will enable more fluid and user-friendly voice-activated interfaces. Augmented reality navigation will become more precise with the use of wearable technology. Customizable screen reading adapts in real time to the choices of the user. Real-time language translation will support a wider range of sign languages and cultural differences. In conclusion, improvements in the digital service sector for users with disabilities reflect both societal shifts toward more inclusivity and technology advancements. They serve as excellent illustrations of how innovation can bring people together, empower them, and improve everyone's access to and equality in the world. The persistent conviction that every person is different and has obstacles to overcome is what keeps the pursuit of accessibility and inclusivity alive and well. Therefore, the journey does not end here.

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