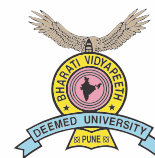




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Prof Dr. Vivek Saoji
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Vice Chancellor speaks

I am honored to welcome the latest edition of the JOURNAL OF MANAGEMENT AND SOCIAL RESEARCH (JMSR). Educational institutions have a crucial role in nurturing bright minds and fostering a culture of ongoing learning, innovation, and research. Bharati Vidyapeeth's dedication to global recognition, especially through research endeavors, is emphasized as a significant step towards this objective. The journal is highly relevant for both academics and practitioners, offering a diverse range of theoretical and empirical research papers and articles. Research not only facilitates learning but also boosts confidence and increases public awareness, leading to a comprehensive transformation of scholars in various aspects of their lives.

I commend IMED for launching JMSR, recognizing it as a platform for disseminating valuable research, ideas, and insights. I am confident in IMED's continuous pursuit of excellence in teaching, research, and extension activities, anticipating further accomplishments in the future.

My congratulations and best wishes to the editorial board, authors, and the entire team involved in JMSR, acknowledging their steadfast efforts and dedication.

Prof Dr. Vivek Saoji

Director's Message



Dr Ajit More
I/C Director-IMED

I extend my sincere wishes for good health and safety to everyone. May the year 2024 bring prosperity and happiness to all.

In recent years, we've experienced various challenges and opportunities, including economic fluctuations, conflicts, and globalization. Despite crises like COVID-19 leading some nations towards recession, they've also presented new avenues for global collaboration. In such times, it's essential for management education to be comprehensive and inclusive. That's why we prioritize both technical expertise and research through our Journal of Management Science and Research (JMSR).

JMSR serves as a platform for publishing theoretical and empirical research across all management-related domains. We welcome submissions covering a wide range of topics including business trends, advancements in science and technology, company/industry analysis, HRM strategies, digital harvest, Big Data Security, and more.

Research skills play a crucial role in understanding and influencing individual and societal behavior. Hence, IMED strongly advocates for research and provides ample opportunities for scholars to showcase their work. Through decades of dedication, we've nurtured students into ethical corporate leaders, emphasizing the importance of research in their development.

Research not only enhances knowledge but also fosters confidence and raises awareness, contributing to a scholar's academic, social, and personal growth. Our exceptional faculty and talented students collaborate to promote excellence in management, innovation, and entrepreneurship.

I extend my heartfelt congratulations to all the researchers, faculty members, and professionals whose contributions have enriched this issue.

Best wishes and warm regards to you and your families.

Dr. Ajit More
I/C Director-IMED

From the Editor's Desk

Greetings Readers,

Welcome to the latest edition of IMED journal "JMSR", where we showcase an array of thought-provoking research articles spanning various domains. This edition has been intentionally crafted to capture the attention of readers and provide them with an engaging platform to explore and showcase researchers' endeavors on various related topics like HRM Strategies for Employee Retention in a Competitive Environment, Digital Harvest, Colon Targeted Drug Delivery Systems, Enhancing Efficiency in Indian banking sector for saving and Salary Package Accounts, Web 3.0 Era of new Marketing Strategies, Big Data Security and financial performance of Oil and Natural Gas Corporation (ONGC).

This issue encompasses a diverse range of topics that address the most current issues and concerns within economies and companies. Amidst a competitive environment, organizations are increasingly focusing on HRM strategies to retain talent. Similarly, the digital landscape is transforming agricultural commerce through platforms like e-NAM, while advancements in drug delivery systems are revolutionizing healthcare. Moreover, the banking sector in India faces challenges in enhancing efficiency in savings account opening and elevating corporate salary package accounts. Similarly, the advent of Web 3.0 heralds' new marketing strategies, while big data security remains a paramount concern in the era of data-driven decision-making. Lastly, financial performance analysis of companies like Oil and Natural Gas Corporation (ONGC) offers valuable insights into their operations and potential areas for improvement.

We extend our gratitude to the authors for their valuable contributions and invite readers to explore the wealth of knowledge presented in this issue.

Happy reading!

Warm regards,

Editors

Dr. Ranpreet Kaur

Dr. Deepali Kadam

Research at IMED

BVDU IMED acknowledges the increasing significance of research within the realms of Management, technology and Social Sciences. To facilitate and direct research endeavors, the institution has formulated a comprehensive research policy to inspire faculty members and students alike to embark on research projects of societal, national, and industrial relevance.

One of our primary objectives is to encourage interdisciplinary collaboration and the exchange of knowledge. By fostering an environment conducive to research, innovation, and implementation, we aim to contribute positively to societal progress.

In line with this vision, IMED actively promotes a research culture among students. We motivate them to publish their research findings in collaboration with faculty members through our journals, "Reflections and JMSR". Our institution ensures effective coordination of research activities across different departments with the aid of internal and external experts.

Furthermore, we prioritize research capacity building and adopt a systematic approach to promote research excellence. This involves organizing workshops on research methodology and grant writing, as well as seminars on research ethics and intellectual property rights.

Through research collaborations, we engage in joint research projects, facilitate faculty exchanges, and develop collaborative research protocols. These partnerships enhance our research output and contribute to the advancement of knowledge in Management and Computer Applications.

Faculty members at IMED are actively engaged in writing research papers that are published in reputable databases such as Scopus, Web of Science, and UGC CARE. Additionally, they are diligently pursuing research funding opportunities. Moreover, many of them have successfully registered and obtained patents for their innovative work.

IMED's holistic approach to research encompasses support, coordination, ethical oversight, capacity building, and collaborations. This underscores our commitment to fostering a dynamic research environment and driving innovation in the fields of Management and Computer Applications.

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HRM Strategies for Employee Retention in a Competitive Environment

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ABSTRACT

Employee retention is a crucial aspect of organizational success, particularly in competitive environments where companies need to maintain their top talent to have an edge over their contenders. In such environments, employees are more likely to be tempted by offers from rival firms, making retention a significant challenge. Employee retention as a fundamental company strategy is critical in a competitive world where employees have many options and are regularly approached by recruiters. Employers may lower turnover expenses, boost productivity, and gain a long-term competitive edge by investing in employee retention. To retain employees in a competitive environment, companies must focus on creating a positive work culture, offering competitive compensation and benefits packages, providing opportunities for growth and development, and ensuring a healthy work-life balance. By prioritizing employee satisfaction and well-being, organizations can create a work environment that nurtures loyalty and dedication among employees. Effective communication and regular feedback are also critical in retaining employees. By providing employees with clear expectations, constructive feedback, and opportunities to raise their concerns and opinions, companies can create an open and supportive work environment that fosters employee engagement and commitment. Finally, companies must recognize the importance of recognizing and rewarding their top performers. Recognizing employees' hard work and achievements through promotions, bonuses, and other incentives can help in fostering a strong sense of allegiance and dedication among team members

Introduction

Employee retention is the need of the day and many of the organisations face challenges for the same in competitive environments. Retaining employees is critical for the success of any organization as losing talented employees can lead to a significant loss of productivity, knowledge, and expertise. In this research paper, we will examine the factors that impact employee retention in a competitive environment for the manufacturing companies and discuss strategies that organizations can employ to ensure talent retention.

Retaining employees in a competitive environment requires a strategic approach that goes beyond just offering competitive salaries and benefits. To foster employee retention, organizations need to establish a workplace environment that promotes both satisfaction and engagement. Achieving this involves implementing diverse initiatives, including creating avenues for career advancement and development, ensuring a healthy work-life balance, acknowledging, and rewarding employees for their contributions, and cultivating a positive and supportive work culture.

In addition, it is important to understand the needs and expectations of employees, as well as their motivations and goals. This can be done through frequent communication and feedback, employee surveys, and focus groups. By understanding employee needs and expectations, organizations can tailor their retention strategies to meet those needs and create a more engaged and committed workforce.

In a competitive environment, where employees have many options and are constantly being approached by recruiters, prioritizing employee retention is crucial for organizations as a core business strategy. By dedicating resources to this aspect, companies can mitigate turnover costs, enhance productivity, and establish a lasting competitive advantage.

Through the implementation of strategies emphasizing a positive employee experience, the cultivation of a supportive and inclusive culture, and the provision of ample opportunities for growth and development, organizations can elevate their capacity to retain top talent and sustain a competitive edge in the market.

Literature review

Employee retention is a key concern for organizations operating in competitive environments. As competition for top talent increases, organizations are faced with the challenge of developing effective human resource management (HRM) strategies to retain their employees. In this literature review, we will examine the existing literature on HRM strategies for employee retention in a competitive environment.

Albdour & Altarawneh, 2018; Namasisivayam & Denizci Guillet, 2018 This paper studies that one

of the most effective HRM strategies for employee retention is the development of a positive organizational culture. A positive organizational culture is characterized by open communication, a supportive work environment, and a focus on employee development and growth. Research has shown that a positive organizational culture is positively related to employee job satisfaction and retention.

As per the studies by Gao & Greenberg, 2016; Saks, 2016, another HRM strategy for employee retention is providing employees with opportunities for career development and growth. Employees who are provided with avenues for career development are inclined to find greater satisfaction in their roles and are less prone to consider leaving the organization. In addition, providing employees with opportunities for career development can also increase their skills and knowledge, making them more valuable to the organization.

Golden & Veiga, 2008; Pera & Boella, 2018 mentioned in the research that Flexible work arrangements are another HRM strategy that can be effective for employee retention in a competitive environment. Flexible work arrangements, such as telecommuting and flexible schedules, have been shown to be positively related to job satisfaction and retention. Flexible work arrangements can also improve work-life balance, which is a key factor in employee retention.

Lau, Shaffer, & Kleiner, 2017; Menguc, Auh, & Katsikeas, 2019 Research has shown that employees are more likely to stay with an organization if they feel that they are being fairly compensated. In addition to salary, offering benefits such as health insurance and retirement plans can also improve employee retention. Finally, offering competitive compensation and

benefits is another important HRM strategy for employee retention in a competitive environment.

Factors that influence employee retention in competitive environment in companies are summarised as below:

1. **Compensation and Benefits:** Salary and benefits are the most critical factors that influence employee retention in a competitive environment. Organizations that offer competitive compensation packages and benefits have a better chance of retaining their employees. Employees often compare their salaries and benefits with those offered by their competitors, and organizations that do not offer competitive compensation packages are always at a risk losing their top talent.
2. **Insufficient prospects for Career advancement:** - Employees are looking for growth and development in their careers. Organizations that offer career development opportunities like training, mentorship programs, and job rotations have a higher chance of retaining their employees. Employees who see a clear career path within the organization are more likely to stay with the organization for the long term.
3. **Work-Life Balance:** Maintaining a strong work-life balance is vital for employee satisfaction and retention. Organizations that provide flexible work arrangements like telecommuting, part-time work, and job-sharing have a better chance of retaining their employees. Employees who feel that their work-life balance is not

respected are more likely to leave the organization.

4. **Sense of belonging:** Poor coordination organization of resources can result in delays in the production process, which can lead to missed deadlines and frustrated employees. When employees are unable to work efficiently due to lack of coordination, they lose their sense of belonging towards the organization and may start to look for work elsewhere.
5. **Leadership challenges:** Employees want leaders who are transparent, supportive, and inspiring. Leaders who provide clear expectations, feedback, and recognition can help increase employee engagement and loyalty. Employees who feel that their leaders are not supportive, or inspiring are more likely to leave the organization.
6. **Recognition and Rewards:** When employees sense that they are undervalued and unappreciated, they are more likely to become detached and look for employment elsewhere. Employees who believe that their hard work and contributions go unnoticed or unrewarded may become demotivated and lose their enthusiasm for their job, leading to decreased productivity and job satisfaction.

HRM Framework strategies

1. **Competitive Compensation and Benefits:** Recognizing and rewarding employee achievements can help to retain employees by demonstrating that their

work is valued and appreciated. Companies can offer incentives such as bonuses, promotions, and awards to motivate and retain their employees. Providing competitive salaries and benefit packages can help attract and retain employees. This includes healthcare, retirement plans, and other benefits that employees value.

2. Career Development Opportunities:

Offering opportunities for career advancement, such as training programs and skill development, can help employees feel invested in the company and motivated to stay. For this, start by identifying the skill gaps and development needs of employees through a training needs analysis. The analysis will help to determine the specific requirement for the career development of employees.

3. Flexible Working Schedule:

Defining the flexible working hour policy, outlining the types of flexible working arrangements that are available, such as flexitime, compressed work weeks, and telecommuting. Ensure that the policy is communicated to all employees and that they understand the guidelines and expectations. Employees should be held to the same performance standards as those who work traditional hours, and they should be available during core business hours. By implementing a flexible working hour strategy, organizations can promote work-life balance, reduce turnover rates, and increase productivity.

4. Strengthening Company Culture:

The pivotal role of company culture in employee retention cannot be overstated. A positive work environment that nurtures teamwork, respect, and open communication significantly contributes to heightened employee satisfaction and retention rates. Clearly defining your company's mission and values and transparently communicating them to employees establishes a shared sense of purpose and identity. This shared identity creates a sense of pride and connection among employees, making them more likely to remain committed to the organization. When employees feel valued and respected, the likelihood of their lasting commitment to the organization increases.

5. Leadership Excellence and Employee Retention (LEER) Strategy:

Develop a comprehensive leadership development program that addresses the identified problems with leaders. The program should include training and mentoring, a company can develop a comprehensive strategy for addressing problems with leaders and create a positive leadership environment that promotes employee retention and organizational success.

6. Performance Excellence:

Employee retention centres significantly on the implementation of effective recognition and rewards systems. It is crucial for employees to feel appreciated and valued for their contributions. When employees perceive their efforts as unrecognized or undervalued, the likelihood of them seeking opportunities elsewhere increases. Companies should prioritise the

recognition and appreciation of employee contributions, thus nurturing a culture of excellence. Organizations that consistently acknowledge and reward employee achievements are better positioned to retain their valuable talent.

Benefits of implementing effective HRM strategies for employee retention:

- 1. Reducing Recruitment and Training Costs:** High employee turnover can be costly for organizations due to the need to constantly recruit and train new employees. Effective HRM strategies can help retain employees, reducing the need for frequent recruitment and training, which can save the organization money and resources.
- 2. Increasing Employee Productivity:** Employees who feel valued and supported by their organization are more likely to be motivated and engaged in their work, leading to increased productivity. Effective HRM strategies, such as providing opportunities for career development, recognition of employee achievements, and a positive work culture, can help increase employee motivation and productivity.
- 3. Enhanced employer brand:** Effective HRM strategies can also enhance an organization's employer brand, making it more attractive to potential candidates. By creating a positive work environment and fostering a supportive culture, organizations can build a reputation as a desirable employer, which can attract top talent.
- 4. Establishing Employee Loyalty:** Effective HRM strategies can help create a sense of

loyalty among employees, encouraging them to remain with the organization for the long-term. This can help reduce employee turnover, increase productivity, and foster a sense of stability within the organization.

- 5. Improving Employee Satisfaction:** When employees feel valued and supported by their organization, they are more likely to be satisfied with their job and the organization overall.

Challenges to implementing HRM strategies for employee retention in a competitive environment:

- 1. High turnover rate:** Manufacturing companies often experience a high turnover rate due to the nature of the work, low pay, and lack of career growth opportunities. This can make it difficult to retain employees and requires a strong retention strategy to address.
- 2. Budget constraints:** Manufacturing companies often have limited budgets for employee retention initiatives, which can make it challenging to implement effective strategies.
- 3. Resistance to change:** Implementing new employee retention strategies may be met with resistance from employees and managers who are comfortable with the status quo.
- 4. Limited resources:** Manufacturing companies may have limited resources, including staff, time, and technology, to devote to employee retention initiatives.
- 5. Lack of leadership support:** Lack of backing from senior leaders can hinder the success of retention strategies, as they may not prioritize or invest in these initiatives.

6. **Competition for talent:** Manufacturing companies may face competition from other companies in the industry for skilled and talented employees, making it challenging to retain top performers.
7. **Lack of data and analytics:** Manufacturing companies may struggle to collect and analyse data on employee turnover and engagement, which can make it difficult to recognize the root causes of retention issues and implement effective solutions.

Organizations that have successfully implemented HRM strategies to retain their top talent:

1. **PwC:** PwC is a professional services firm that has implemented several HRM strategies to retain its top talent. One such strategy is the "Flexible Talent Network," which allows employees to work on short-term assignments and take time off between projects. PwC also offers a variety of training and development programs, including leadership development programs and opportunities for international assignments. As a result of these strategies, PwC has been able to retain top talent and maintain a high level of employee engagement.
2. **Microsoft:** Microsoft is a technology company that has implemented several HRM strategies to retain its top talent. One such strategy is the "One Microsoft" initiative, which aims to create a more collaborative and innovative work culture. Microsoft also offers a variety of benefits and perks, such as gymnasiums, free food, and flexibility in work schedules. As a result of these strategies, in a fiercely competitive industry, Microsoft has successfully drawn in and retained top-notch talent
3. **Marriott International:** Marriott International is a hospitality company that has implemented several HRM strategies to retain its top talent. One such strategy is the "Marriott Leadership Development Program," which provides employees with opportunities for career advancement and development. Marriott also offers a variety of benefits and perks, such as discounted hotel rates and flexible work arrangements. As a result of these strategies, Marriott has been able to retain top talent and maintain a high level of employee engagement.
4. **Salesforce:** Salesforce is a cloud-based software company that has implemented several HRM strategies to retain its top talent. One such strategy is the "Salesforce Ohana Culture," which fosters a positive work culture that values diversity, equality, and inclusivity. By providing an array of benefits and perks, including on-site gyms, complimentary meals, and adaptable work schedules, Salesforce has effectively drawn and retained premier talent in a fiercely competitive industry.
5. **Starbucks:** Starbucks is a coffee house chain that has implemented several HRM strategies to retain its top talent. One such strategy is the "Starbucks College Achievement Plan," which provides employees with opportunities to earn a bachelor's degree online through Starbucks, in conjunction with Arizona State University, provides a range of benefits and perks like healthcare benefits and stock options. These strategic initiatives have enabled Starbucks to successfully attract and retain premier

talent within a fiercely competitive industry.

Implementing HRM strategies for employee retention in a competitive environment can be challenging and may have certain limitations.

Limitations of implementing HRM strategies for employee retention in a competitive environment:

1. **Cost:** Implementing HRM strategies requires significant investment, which may not be feasible for all organizations, especially small businesses.
2. **Lack of Alignment:** HRM strategies must be aligned with the organization's overall goals and values to be effective. If the strategies are not aligned with the organization's values, employees may not be motivated to stay with the organization.
3. **Competitor Pressure:** Competitors may offer more attractive salary and benefits packages, making it challenging for an organization to retain top talent.
4. **Changing Employee Expectations:** Employee expectations are constantly changing, and organizations must be able to adapt to these changes to retain top talent. For example, younger generations may prioritize work-life balance over salary and benefits.
5. **Employee Turnover:** HRM strategies may not be effective in highly competitive industries with high employee turnover rates, such as retail and hospitality.

Recommendations

1. Identify the root cause of turnover: Companies should identify the

underlying reasons for high turnover rates before implementing any retention strategies. Conduct exit interviews, employee surveys, and review HR data to gain insight into the reasons why employees are switching companies.

2. **Evaluate the company's culture and work environment:** Companies should evaluate their organizational culture and work environment to identify areas of improvement. This can include reviewing company policies, communication processes, and employee engagement levels.
3. **Develop a comprehensive retention strategy:** Once the root causes of turnover are identified, companies should develop a comprehensive retention strategy that addresses the identified issues. The strategy should be allied with the company's overall goals and values.
4. **Obtain buy-in from senior leadership:** It is important to obtain buy-in from senior leadership to ensure that the retention strategy is fully supported and has the necessary resources to be successful.
5. **Communicate the strategy to employees:** Communicate the retention strategy to employees and make sure that they understand the objectives and their role in the implementation process.
6. **Monitor progress and adjust as needed:** Companies should regularly monitor the progress of the retention strategy and adjust it as needed. Use metrics such as turnover rates and employee satisfaction levels to assess the effectiveness of the strategy and identify areas for improvement.

Conclusion

In conclusion, employee retention is a critical issue for organizations in competitive environments. Implementing effective HRM strategies for employee retention can lead to numerous benefits for the organization, including reduced turnover costs, increased employee engagement, and improved productivity. The factors influencing employee retention include career development opportunities, work-life balance, company culture, leadership, and reward and recognition. However, there are also challenges that organizations face when implementing retention strategies, such as the need for buy-in from senior leadership, limited resources, and difficulties in measuring the effectiveness of retention strategies.

Despite these challenges, organizations can overcome them by conducting an employee engagement survey, providing career growth opportunities, offering compensation and benefits that are at par within the industry, improving work-life balance, fostering a positive company culture, providing regular feedback, developing strong leaders, and using technology to streamline HR processes.

Overall, it is important for organizations to prioritize employee retention and develop comprehensive retention strategies that address

the root causes of turnover. By doing so, organizations can create a positive work environment that fosters employee engagement, development, and retention, even in a competitive environment.

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Digital Harvest: e-NAM and the Future of Agricultural Commerce in India

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ABSTRACT

The e-NAM (National Agriculture Market) initiative by the Government of India is a landmark agricultural reform aimed at creating a unified national market for agricultural commodities. Launched in April 2016, e-NAM is designed to promote a transparent and efficient system of trading agricultural produce through an online platform. The benefits of e-NAM, such as improved price discovery, reduced middlemen, and increased market access for farmers. However, we also should also acknowledge challenges, including limited awareness, infrastructure issues, and the need for ongoing reforms.

The Paper concludes with suggestions for enhancing the effectiveness of the e-NAM initiative, such as improving infrastructure, conducting awareness campaigns, ensuring mobile accessibility, and addressing implementation challenges. The overall tone recognizes e-NAM's significance in modernizing agricultural markets but underscores the importance of continuous efforts and collaboration for its sustained success.

Keywords- challenges, e-NAM, Government of India, agricultural commodities

Introduction:

The Government of India's e-NAM (National Agriculture Market) initiative is an agribusiness reform aimed at creating a single national market for agricultural commodities. Launched in April 2016, e-NAM aims to promote a transparent and efficient agricultural trading system through an online platform. Benefits of e-NAM like better price clearing, reduction of middlemen and better market access for farmers.

Objectives:

1. Investigating key features of the e-NAM initiative.

2. To make readers understand the Role of e-NAM in Agricultural Reforms.
3. Proposing Strategies for Addressing Implementation Challenges by viewing progress and challenges.

Research methodology:

The research methodology employed for this article involves a comprehensive literature review and synthesis of findings from various high-impact journals and research articles. A systematic approach was taken to identify and select relevant scholarly works that have contributed significantly to the understanding of the chosen topic. The process included an extensive search of reputable databases, such as

PubMed, IEEE Xplore, and Google Scholar, utilizing a combination of keywords and Boolean operators to ensure a thorough exploration of the existing literature.

The selection criteria prioritized articles from high-impact journals, conference proceedings, and seminal works recognized for their scholarly contributions. The chosen articles underwent careful scrutiny to ensure relevance, credibility, and methodological rigor. The gathered information from these sources was then synthesized to cumulate key insights and critical points. This synthesis aims at creating a cohesive narrative that not only reflects the current state of knowledge on the subject but also integrates diverse perspectives and findings from the selected literature. The cumulative approach, drawing from a multitude of high-impact sources, enhances the robustness and validity of the arguments presented in this article. The methodological design is intended to provide a comprehensive and informed analysis, offering valuable insights into the intricacies of the topic under investigation.

Key features of the e-NAM initiative:

1) Unified Market Platform:

e-NAM provides a unified online market platform that connects existing APMC (Agricultural Produce Market Committee) mandis across the country. The platform enables farmers to sell their produce to buyers beyond their local mandis, thereby expanding market access.

2) Online Trading:

The e-NAM platform facilitates online trading of agricultural commodities, allowing farmers to list their produce, and traders/buyers to bid for it electronically.

3) Transparency and Price Discovery:

The initiative aims to bring transparency to the agricultural marketing system by providing real-time information on prices prevailing in various mandis. Farmers can make informed decisions about when and where to sell their produce, leading to better price discovery.

4) Reduced Intermediaries:

e-NAM helps in reducing the number of intermediaries in the agricultural supply chain, allowing farmers to get better prices for their produce.

5) Quality Assurance:

The platform encourages the trading of quality agricultural produce. It includes facilities for online payment and quality testing, assuring both buyers and sellers of fair transactions.

6) Promotion of Electronic Negotiable Warehouse Receipts (eNWRs):

e-NAM integrates with the Warehousing Development and Regulatory Authority (WDRA) platform, enabling farmers to use electronic negotiable warehouse receipts to avail credit facilities.

7) Expansion of e-NAM to Other Commodities:

While initially focused on fruits and vegetables, the scope of e-NAM has been expanded to include commodities like cereals, pulses, oilseeds, and spices.

8) Integration with Technology:

The platform leverages technology to provide farmers with a user-friendly interface for listing their produce, checking market prices, and tracking transactions.

9) Promotion of Farmer Producer Organizations (FPOs):

e-NAM encourages the participation of Farmer Producer Organizations, empowering them to collectively sell their produce and negotiate better prices.

The e-NAM initiative is part of the broader agenda to modernize India's agricultural marketing system and improve farmers' income by providing them with a more efficient and transparent market. However, it has also faced some challenges, including issues related to infrastructure, awareness, and the need for further reforms in the agricultural marketing ecosystem.

Progress, Achievements & Challenges for the e-NAM platform:

Progress and Achievements:

1) Expansion of Coverage:

The e-NAM platform has been gradually expanding its coverage to include more Agricultural Produce Market Committees (APMCs) across states.

2) Increased Farmer Registration:

There has been an increase in the number of farmers registering on the platform, indicating a growing acceptance of the online trading system.

3) Price Discovery:

The platform has contributed to improved price discovery by providing real-time information on commodity prices in various markets, helping farmers make more informed selling decisions.

4) Reduction in Middlemen:

The initiative aims to reduce the role of intermediaries in the agricultural supply

chain, allowing farmers to get better prices for their produce.

5) Promotion of Farmer Producer Organizations (FPOs):

The e-NAM platform encourages the participation of Farmer Producer Organizations, enabling them to collectively sell their produce.

6) Integration with Electronic Negotiable Warehouse Receipts (eNWRs):

The integration with eNWRs facilitates electronic transactions and helps farmers access credit facilities.

Challenges and Concerns:

1) Limited Awareness:

Many farmers and traders, especially in remote areas, may not be fully aware of the e-NAM platform and its benefits.

2) Infrastructure Challenges:

In some regions, there are challenges related to the availability of necessary infrastructure, including internet connectivity and electronic weighing facilities.

3) Resistance to Change:

Traditional practices and established systems in local mandis may face resistance to adopting the online trading system.

4) Implementation Issues:

Implementation issues, including technical glitches and delays in payments, have been reported in certain cases.

5) Market Reforms:

The success of e-NAM is closely tied to broader agricultural market reforms, and

progress in this area has been incremental.

6) Need for Institutional Support:

Farmer education and institutional support To enhance the effectiveness of the e-NAM (National Agriculture Market) initiative in India, several measures can be considered. These measures involve addressing both technological and operational aspects, as well as providing support to the key stakeholders involved. Here are some suggestions:

7) Infrastructure Development:

Improve internet connectivity in rural areas to ensure seamless access to the e-NAM platform. Upgrade and maintain necessary infrastructure such as electronic weighing machines, storage facilities, and transportation networks.

8) Awareness Campaigns:

Conduct extensive awareness campaigns to educate farmers, traders, and other stakeholders about the benefits of the e-NAM platform. Provide training programs to familiarize users with the online trading system and address any concerns or misconceptions.

9) Mobile Accessibility:

Develop user-friendly mobile applications to make the e-NAM platform more accessible to farmers and traders who may not have regular access to computers.

10) Capacity Building:

Provide training and capacity-building programs for APMC officials, traders, and farmers to ensure smooth onboarding and effective utilization of the platform.

11) Real-Time Information:

Enhance the real-time information

features on the platform, including market prices, demand trends, and transaction history, to empower farmers to make informed decisions.

12) Payment Security:

Implement secure and timely payment mechanisms to build trust among farmers and traders. The assurance of prompt payment is crucial for the success of online transactions.

13) Integration with Financial Institutions:

Facilitate seamless integration with financial institutions to enable farmers to access credit facilities based on their transactions on the e-NAM platform.

14) Feedback Mechanism:

Establish a feedback mechanism to gather input from users, including farmers, traders, and APMC officials, to identify areas for improvement and address any issues promptly.

15) Standardization of Processes:

Standardize processes across different APMCs to ensure uniformity and streamline operations. This includes standardizing procedures for quality testing, grading, and settlement of payments.

16) Incentives for Farmer Participation:

Introduce incentives for farmers to encourage increased participation on the e-NAM platform. This could include recognition for quality produce, bonuses for early transactions, or loyalty programs.

17) Regular Monitoring and Evaluation:

Establish a robust monitoring and evaluation system to regularly assess the performance of the e-NAM initiative,

identify bottlenecks, and implement corrective measures.

18) Collaboration with Private Sector:

Collaborate with the private sector to leverage their expertise and resources in technology and logistics, enhancing the overall efficiency of the e-NAM ecosystem.

19) Policy Reforms:

Continue to implement broader agricultural market reforms to create an enabling environment for the success of the e-NAM initiative.

These measures, when implemented collectively, can contribute to the growth and sustainability of the e-NAM initiative, fostering a more efficient and transparent agricultural marketing system in India.

Conclusion:

It's important to note that the success of the e-NAM initiative depends not only on the technology platform but also on addressing these on-the-ground challenges and fostering a supportive ecosystem for farmers and traders. Reforms and improvements are ongoing, and the government continues to work on enhancing the effectiveness of the e-NAM platform.

In conclusion, the e-NAM initiative in India represents a significant leap toward modernizing the agricultural marketing landscape. Its aim to create a unified national market for agricultural commodities through a digital platform holds great promise for fostering transparency, efficiency, and fair trade practices. As evidenced by its expansion and increased farmer registrations, the initiative has made notable strides in connecting markets and empowering farmers.

However, challenges such as limited awareness, infrastructure constraints, and resistance to change must be acknowledged and addressed to unlock the full potential of e-NAM. Continued efforts to enhance accessibility, provide comprehensive training programs, and ensure the reliability of payment mechanisms are imperative.

The success of e-NAM extends beyond economic considerations; it embodies the government's commitment to leveraging technology for the welfare of farmers. Its impact on rural development, economic empowerment, and the overall transformation of agricultural practices could potentially shape positive perceptions among the electorate.

As the initiative evolves, it calls for ongoing monitoring, evaluation, and adaptation to align with the diverse needs of farmers across regions. A collaborative approach involving public and private sectors, along with proactive policy adjustments, will be instrumental in ensuring the sustained success of e-NAM.

In navigating the dynamic landscape of Indian agriculture, the e-NAM initiative stands as a testament to the government's vision for a more inclusive, efficient, and digitally-driven agricultural sector. It is a crucial step toward realizing the broader goal of doubling farmers' income and ensuring the long-term sustainability of India's agrarian economy.

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Colon Targeted Drug Delivery Systems: An Overview of Conventional and Innovative Approaches

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ABSTRACT

Inflammatory bowel disease (IBD) is a chronic intestinal inflammation from genetic susceptibility and host-microbial interactions. This autoimmune condition affects both the small and large intestines, leading to the immune system attacking digestive system elements. Crohn's disease and ulcerative colitis are the primary forms of IBD, manifesting with symptoms like diarrhoea, abdominal pain, bloody stools, and vomiting. This study aims to evaluate the impact of colon-targeted drug delivery on patients, improving therapeutic efficacy and yielding superior therapeutic outcomes. Several novel approaches are employed, including alginate-coated microparticles, carbon nanotubes, dendrimers, delayed-release dosage forms, and conventional techniques for drug delivery to the colon. The colon is a complex organ that can be divided into three parts: a colon, a gastrointestinal tract, and a small intestine. A colon-specific formulation has been subjected to dissolution studies in a variety of media that mimic different pH levels and timeframes that are likely to be experienced at different points in the gastrointestinal system. Because of their size and complexity, biologics and macromolecules provide particular obstacles for colon-targeted drug delivery. This approach holds the potential to transform the way gastrointestinal illnesses are treated and to lead to more effective and individualized therapeutic approaches. In this review, we will focus on the development of novel carriers and delivery systems that can securely deliver these medicinal substances to the colon.

Introduction

For the treatment of conditions affecting the colon, such as colon cancer, amoebiasis, irritable bowel syndrome, and inflammatory bowel disease, colon-specific medication administration is essential. By evaluating the precise administration of the medication to a particular illness location, This study looks at how patients respond to tailored oral

medication distribution, which increases therapeutic efficacy and produces better therapeutic results. Medication administration to the colon that is medically tailored reduces the systemic harmful effects of the drug and has a local impact on the condition. Even if there are some challenges and issues, administering medications directly to the colon's sick portion provides advantages over administering drugs

systemically. Drug administration via the colon can produce both local and systemic effects. Numerous novel approaches are employed, including alginate-coated microparticles, carbon nanotubes, dendrimers, delayed-release dosage forms, and conventional techniques for drug delivery to the colon.

1. Physiology of colon

The colon performs several physiological tasks, including as absorbing water and electrolytes and storing, moving, and expelling waste products from earlier digestive stages (faeces) into the surrounding environment. These functions are regulated by both intrinsic and extrinsic nerve supply and depend on biochemical and physical routes. These physiological processes will be addressed, particularly those involving motility and secretion/absorption. (Figure 1).

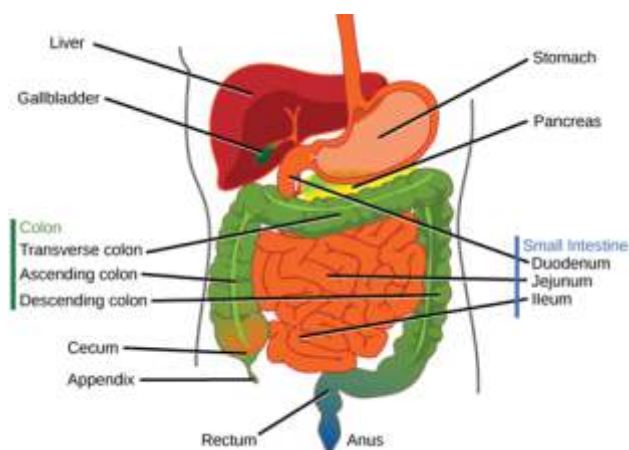


Figure 1 Physiology of Colon

The majority of stomach organisms are transitory, and acidity keeps their populations low (10³ to 10⁶/g of contents). One possible stomach pathogen that may contribute to the development of some forms of ulcers is *Helicobacter pylori*. The duodenal flora in healthy hosts is scant (0 to 10³/g of contents). The flora in the ileum is quite heterogeneous (10⁶–10⁸/g of contents). The vast bowel's flora is

thick (10⁹ to 10¹¹/g of contents), primarily made up of anaerobes. These microorganisms are involved in the large bowel's synthesis of ammonia, vitamin K, and bile acid conversion. They may also result in peritonitis and intestinal abscesses.

Colon focused drug transport systems are intended to release a medication selectively in the colonic environment, as opposed to releasing it prematurely in the upper GI tract. Examining the physiological properties of the colon and the surroundings of the illness sites is essential in determining. From the middle to the intestine, the GI tract undergoes dynamic variations in pH, fluid levels, enzyme activity, and motility [1]. Additionally, colon's illness site's surrounding microenvironment is very different from that of typical, healthy parts. As indicated by the table [2], patients with colonic disorders have mucosal deterioration, an imbalance in antioxidants, and an increase in reactive oxygen species (ROS) and inflammatory cytokines. The development of formulations must consider pathophysiological variations in the microenvironment surrounding disease sites. Several method approaches, such as pH-sensitive structures, enzyme-triggered structures, and magnetically-driven structures, have been investigated to maximize colonic drug transport. Studies on receptor-mediated structures have also been conducted to increase specificity at disease locations. These structures link preferentially with some overexpressed receptors on the impacted site or sites.

2. Conditions related to colon

Colon cancer

Cancer that originates in the colon is referred to as colon cancer, whereas cancer that originates in the rectum is known as rectal cancer. Cancers

affecting either of these organs are collectively referred to as colorectal cancer. The majority of colorectal malignancies typically start off as adenomatous (precancerous) polyps over time, yet this is not always the case. After several mutations (abnormalities) occur in their cellular DNA, polyps (growths) might undergo changes. Some of the risk factors for colorectal cancer include poor nutrition, smoking, alcoholism, inflammatory bowel disease, and a family history of colon or rectal cancer.

Irritable bowel syndrome (IBS)

Irritable bowel syndrome, or IBS, is a group of symptoms that affect the digestive tract. It's a common yet bothersome gastrointestinal disease. IBS symptoms include cramping in the abdomen, increased gas, and discomfort.

Inflammatory bowel disease

A collection of conditions known as inflammatory bowel disease (IBD) result in persistent inflammation (pain and swelling) of the intestines. Crohn's disease and ulcerative colitis are included under IBD. The digestive system is impacted by both kinds.

Diarrhea

Diarrhoea is watery, loose stools that happen more often than usual.

A virus is typically the cause of diarrhoea, though tainted food can sometimes be the culprit. Less frequently, it may indicate the presence of another illness, including irritable bowel syndrome or inflammatory bowel disease.

3. Criteria for selection of drugs for CDDS

Drug Carrier is an additional element that affects CDDS. The most suitable carrier for a particular combination of medications depends on the physiochemical composition of the medicine and the disease for which the system is

intended to be used. The choice of carrier is influenced by various factors, including the drug's chemical makeup, stability, and partition coefficient, as well as the type of absorption enhancer selected. Furthermore, the drug molecule's functional groups influence the drug carrier selection. For instance, an azo bond can be formed between a Drug and another benzene group by using the aniline or nitro groups on the drug. The carriers might have an impact on the release characteristics and system performance since they comprise additives like polymers, which can be utilised as matrices, hydrogels, or coating agents.

4. Approaches used for Controlled Drug Delivery System (CDDS)

There are various methods for delivering drugs to specific sites as follows:

Drug Delivery to the Colon via pH-Sensitive Polymer Coating

When fasting, the pH in the stomach is between 1 and 2, but it rises after food is consumed. The small intestine's pH values in the proximal and distal regions are respectively 6.5 and 7.5.¹⁹ pH dramatically decreases from the ileum to the colon. The pH of caecum is roughly 6.4. pH levels in the ascending colon of healthy individuals, however, have been measured as low as 5.7.²⁰ The descending colon has a pH of 7.0, while the transverse colon has a pH of 6.6. Based on these pH level variations, pH dependent polymers are used. The colon-specific medication delivery polymers that are characterized by pH dependence become insoluble at low pH values.

But as pH increases, they become more soluble [3]. In the lower small intestine, a pH-dependent polymer may start to dissolve while still protecting the formulation in the stomach and proximal small intestine, indicating limited site-

specificity in formulations [4]. The pH fall from the end of the small intestine to the colon can present problems for enteric-coated single-unit formulations, such as extended lag times at the ileo-cecal junction or fast transit through the ascending colon, which can lead to poor site-specificity.

Delayed (Time Controlled Release System) Release Drug Delivery to Colon

Time-controlled release (TCRS) drug release systems, including sustained or delayed release dosage forms, have a lot of potential. However, due to the possibly significant variability in the dosage forms' stomach emptying time in humans, these methodologies are unable to estimate the colon arrival time of dose forms with any degree of reliability, which results in poor colonic availability [5]. The dosage forms can also be employed as colon targeted dosage forms by increasing the lag period by about 5 to 6.5 hours. On the other hand, this system's drawbacks are:

- i. The amount and form of food consumed affects how long it takes the stomach to empty, and this variation can be significant across participants.
- ii. The drug's gastrointestinal transit would alter because of gastrointestinal movement, particularly peristalsis, or the contraction of the stomach.²⁴
- iii. Prolonged passage through various colonic regions has been noted in individuals with inflammatory bowel disease (IBD), carcinoid syndrome, diarrhoea, and ulcerative colitis.^{9,25, 26,}

Time-dependent methods are therefore not the ideal technique to provide medicine to the colon for treating illnesses connected to the colon. When time release and pH-sensitive activities are combined in the right way into a single dosage form, the site specificity of medicine

delivery to the colon may be improved. Considering that the time it takes for the dosage form to transit through the small intestine is fairly constant—roughly 3 ± 1 hours—²⁷ The time-release (or timer) function of the small intestine should operate better than that of the stomach. At a certain period after gastric emptying, a drug carrier will be given to the targeted side of the small intestine, and drug release will begin. The drug release in the stomach should be suppressed by a pH detecting function (acid resistance) in the dose form, which would lessen fluctuation in the gastric residence duration.²⁴ Enteric coating (acid resistance function), press-coated swellable hydrophobic polymer layer (hydroxy propyl cellulose layer, or HPC), and drug-containing core tablet (rapid release function) are the three components that make up enteric coated time-release press coated (ETP) tablets [6]. The enteric coating of the tablet prevents the drug from dissolving in the stomach because its outer layer resists acids. The intestinal fluid begins to progressively erode the press coated polymer (HPC) layer when the stomach is empty, whereas the enteric coating layer dissolves rapidly. (Figure 2). Rapid medication release occurs when the erosion front reaches the core tablet since there is no lag phase (drug release interval) after stomach emptying. This is due to the prolonged erosion process. The duration of the lag phase is dependent on the weight or composition of the polymer (HPC) layer.

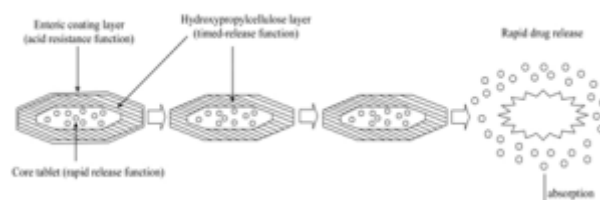


Figure 2 Design of enteric coated timed-release press coated tablet (ETP Tablet)

Microbially Triggered Drug Delivery to Colon

The colon's microflora, which ranges from 10^{11} to 10^{12} CFU/mL, is mostly made up of anaerobic bacteria such as ruminococcus, Bacteroides, bifidobacteria, eubacteria, clostridia, enterococci, and enterobacteria.[7] By fermenting different kinds of substrates that have been left undigested in the small intestine, such as polysaccharides, di- and tri-saccharides, etc., this enormous microflora meets its energy needs. [8] Numerous enzymes, including glucuronidase, xylosidase, arabinosidase, galactosidase, nitro reductase, azareducatase, deaminase, and urea dehydroxylase, are produced by the microflora in order to aid in this fermentation.[76] The fact that the biodegradable enzymes are exclusive to the colon suggests that the use of biodegradable polymers for colon-specific drug delivery is a more site-specific approach than prior methods. These polymers can carry the drug to the colon while protecting it from the conditions seen in the stomach and small intestines. By the time they reach the colon, their molecular weight and mechanical strength have decreased because to the breakdown of the polymer backbone, enzymes, or microorganisms assimilating them. [9] At that point, they are no longer able to contain the drug substance.[10]

Combination systems activated by pH and colonic microbiota.

Phloral:

This is a single-layer coating system comprising a uniform blend of Eudragit S and resistant starch (consisting of amylose and amylopectin)

-Because each trigger mechanism works independently, the two parts complement one another and can make up for one another's inactivity if one does not activate.

OPTICORE:

The innovative combination approach known as Optimised Colonic Release, or OPTICORE for short, aims to release drugs more quickly in the ileocolonic area, which has larger fluid volumes than the mid-to distal colon.

Prodrug Approach for Drug Delivery to Colon

The colon's microflora, which ranges from 10^{11} to 10^{12} CFU/mL, is mostly made up of anaerobic bacteria such as ruminococcus, Bacteroides, bifidobacteria, eubacteria, clostridia, enterococci, and enterobacteria.[7] By fermenting different kinds of substrates that have been left undigested in the small intestine, such as polysaccharides, di- and tri-saccharides, etc., this enormous microflora meets its energy needs.[11] Numerous enzymes, including glucuronidase, xylosidase, arabinosidase, galactosidase, nitro reductase, azareducatase, deaminase, and urea dehydroxylase, are produced by the microflora in order to aid in this fermentation.[76] The fact that the biodegradable enzymes are exclusive to the colon suggests that the use of biodegradable polymers for colon-specific drug delivery is a more site-specific approach than prior methods. These polymers can carry the drug to the colon while protecting it from the conditions seen in the stomach and small intestines. By the time they reach the colon, their molecular weight and mechanical strength have decreased because to the breakdown of the polymer backbone, enzymes, or microorganisms assimilating them. [9] At that point, they are no longer able to contain the drug substance[10].(Table 1).[12]

Table 1 Prodrugs evaluated for colon specific drug delivery

Carrier	Drug investigated	Linkage hydrolyzed	Performance of the Prodrug/conjugates
Azo conjugates Suphapyridine (SP) 5-ASA	5-ASA 5-ASA	Azo linkage Azo linkage	Site specific with a lot of side effects [13] associated with SP Delivers 2 molecules of 5-ASA as compared to suphasalazine[14]
Amino acid conjugates glycine	Salicylic acid	Amide linkage	Absorbed from upper GIT, though metabolized by microflora of large intestine[15]
Tyrosine/methionine	Salicylic acid	Amide linkage	Absorbed from upper GIT, though metabolized by microflora of large intestine[16]
L – Alanin/D- Alanine	Salicylic acid	Amid linkage	Salicylic acid-l-alanine was hydrolysed to salicylic acid by intestinal microorganism but salicylic acid-D-alanine showed negligible hydrolysis thereby showing enantiospecific hydrolysis[17]
Glycine	5-ASA	Amid linkage	Prodrug was stable in upper GIT and was hydrolysed by cecal content to release 5-ASA[18]
Saccharide carriers	Dexamethasone/ prednisolone	Glycosidic linkage	Dexamethasone prodrug was site specific and 60% of oral dose reached the cecum. Only 15% of prednisolone prodrug reached the cecum[19]
Giucose/galactose / cellobioside	Dexamethasone; prednisolone hydrocortisone, fludrocortisone	Glycosidic linkage	Less hydrolysis of the prodrug was seen in contents of stomach and proximal small intestine (PSI).hydrolysis increased in contents of distal small intestine (DSI) and was maximum in cecal content homogenates. galactosides hydrolyzed faster than glucosides which hydrolyzed faster than the corresponding cellobioside [20]
Glucuronide conjugates glucuronic acid	Naloxone/nalme fene	Glucuronide linkage	When given to morphine dependent rats, these reversed the GIT side effects caused by morphine without causing CNS withdrawal symptom because of activation in large intestine followed by a resultant diarrheas which excreted the prodrug 7 drug[21]
	Budesonide	Glucuronide linkage	Was found to be superior than budesonide itself for treatment of colitis[22]

(ii) Azo-Polymeric Prodrugs

More recent techniques focus on using polymers as drug delivery systems to provide colon medication. For this reason, polymers that exist naturally and artificially have both been employed. Polymeric prodrugs having an azo connection between the drug moiety and the polymer have been created using sub synthetic polymers [23]. For CDDS, these have been assessed. A variety of azo polymers have also been proposed as covering materials for

pharmaceutical cores. It has been discovered that the large bowel azo-reductase might break them. Peptide capsules are covered with polymers cross-linked with azo-aromatic groups to protect the medication from small intestine and stomach digestion. The medication is released in the intestines when the azo linkages degrade.28 Table 2

Azo polymer-based drug delivery techniques for colon-specific drug delivery.

Azo polymer	Dosage from prepared	Drug investigated	Summary of the results obtained
Copolymers of styrene with 2-hydroxyethyl methacrylate	Coating over capsules	Vasopressin insulin	These capsules showed biological responses characteristics of these peptide hormones in dog though it varied quantitatively [24]
Hydrogels prepared by copolymerization of 2-hydroxyethyl methacrylate with 4-methacryloyloxy) azobenzene	Hydrogen	5-fluorouracil	Drug release was faster and greater in human fecal media compared to simulated gastric and intestinal fluids [25]
Segmented polynurethanes	Coating over pellets	Budesonide	These azopolymer-coated pellets were useful for colon-specific delivery of budesonide to bring healing in induced colites[26]
Aromatic azo bond containing urethane analogues	Degradable films	5-ASA	These films were degraded by azoreductase. The permeability of 5-ASA from lactobacillus treated films was significantly higher than that of control [27]

Ligand-Mediated Drug Delivery System

Peptide-

Peptides are becoming more and more popular as a possible ligand for the delivery of tailored medications. Peptides provide several benefits, such as chemical diversity, biocompatibility, affordability, and stimuli responsiveness [28]. The fact that peptide ligands can be easily synthesized using automated solid-phase peptide synthesis equipment and are available for high-throughput screening makes them even more beneficial. Peptide ligands are increasingly employed in targeted drug delivery systems because they may also be used to change peptide sequences and prevent the metabolic instability brought on by proteases. In these situations, the TK peptide was used as a targeting ligand in conjunction with PEG-PLA micelles that were loaded with doxorubicin. Tumor spheroids were more readily penetrated and TK-conjugated micelles exhibited much more cytotoxicity, suggesting that the TK peptide is a viable targeting ligand for colon-targeted treatment.

Antibody -

The distribution of liposomes conjugated with an anti-transferrin receptor antibody was seen to be preferentially distributed towards inflamed mucosa as opposed to normal mucosa. This led to an enhanced accumulation at the site of inflammation, which was more than four times greater than that of normal mucosa. Single-chain CD98 antibodies have been added to the surface of nanoparticles designed for IBD treatment (scCD98-functionalized). In animals prone to colitis, intestinal macrophages and colonic epithelial cells overexpress the heterodimeric neutral amino acid transporter CD98. [29]

Polysaccharide Based Delivery Systems

The utilization of these naturally occurring

monosaccharide polymers in colon-focused medications has gained a lot of attention due to their accessibility, affordability, and range of forms and properties. They can be easily modified chemically and biochemically as well as they are hydrophilic, safe, nontoxic, gel-forming, and biodegradable. Some of the natural polysaccharides from plants (guar gum, inulin), animals (chitosan, chondroitin sulfate), algae (alginates), and microorganisms (dextran). Polysaccharides can be changed into simple saccharides by the gut flora.²¹ Their classification is "generally regarded as safe" as a result. (GRAS).).

a. Minitablets approach

Hadi et al, 2014 reported For the treatment of rheumatoid arthritis, colon-targeted minitables containing hydroxy propyl methyl cellulose capsule shell, lornoxicam, and naproxen, offered a consistent medication release and good patient compliance.[30] Numerous formulation techniques are used in the production of these mini-tablets, including the use of polymers that release drugs in a time-dependent manner as core mini-tablets filled with pulsifacil and microsomal enzyme-dependent and pH-dependent polymers, which are known as capsules filled with matrix mini-tablets or coated mini-tablets made of pH-dependent polymers. [31]

b. Microspheres

There are several benefits that biodegradable polymers or protein-based microspheres with a particle size of 5200 nm and free-flowing characteristics have over traditional drug delivery methods. The sensitive medicine can be stabilised, delivered locally, and sustained release in situations where the environmental conditions vary greatly between patients

and between diseases.[31] Various types of matrices are detected in these microspheres; Zhang et al. introduced polysaccharide-based microspheres as one type. Vaidya et al. described using prodrug method and multiparticulate system to explain how pectin metronidazole microspheres were produced for the treatment of amoebiasis.[32] Tang et al. created a microemulsion loaded with 5-ASA silicon dioxide Nanoparticles for UC that was more effective and had less cytotoxicity.[10]

c. Mucoadhesive approach

Zhang et al. (2016) reported on the preparation of valdecoxib mucoadhesive matrix using sodium alginate and coated inside Eudragit S 100 as an anti-inflammatory drug in micro and nanocarriers for colonic drug delivery.[33] Chawla et al. (2012) prepared Naproxen sodium mucoadhesive polymer using sodium alginate and Eudragit S 100 for the treatment of colitis.[34] Chuah et al. (2013) reported on the development of NPs with improved mucoadhesive properties. The production of NPs made of curcumin and chitosan has a mucoadhesive drug delivery potential, increasing the residence time of the drug and bioavailability.[12] Ullah et al. 2019 reported the preparation of gelatin-based oxaliplatin hydrogels solution was pH-responsive and biocompatible; its tolerated dose of 4000 mg/kg was reported to be free of any cytotoxicity in rabbits. The hydrogel was intended to treat colon cancer.[35]

d. Multimatrix systems

In order to improve patient compliance

and therapy efficacy, multi-matrix systems have been developed to offer single-dose therapy. Fiorino et al. (2010) reported using mesalamine in a multi-matrix system as a single dosage for UC and IBD treatment.[36] According to Maroni et al. (2009), the time-dependent delivery system was utilised in the formulation of the dosage form for insulin delivery to the colon. In this system, insulin was incorporated into cores and coated with hydroxypropyl methylcellulose using a spray-dried technique, with the effectiveness and stability over an extended period of time being evaluated.[37]

e. Nanoparticles

A brief discussion of NPs, which come in a variety of forms and are used to target medication delivery to the colon, is given. These include metallic NPs, CNTs, biodegradable polymers, and dendrimers. Because of their unique qualities, NPs have changed the medical companies. Tian et al. (2017) showed, for example, that doxorubicin was loaded into polyacrylic acid, a pH-sensitive polymer, with mesoporous silica SBA-15 through a grafting technique to improve the efficacy and safety of the medication with good bioavailability, high drug loading of 785.7 mg/g, and fantastic pH-susceptibility. A coating of guar gum was used to create enzyme-responsive mesoporous silica nanoparticles containing 5-fluorouracil, which exhibited a great drug release when enzymes were present.[9] By creating nanospheres using a layer-by-layer method of cysteamine-based disulfide cross-linked sodium alginate, Ayub et al. (2019) reported an improvement in the

delivery of paclitaxel to colon malignant cells, with over 70% of cell internalisation.[9] According to Theiss et al. (2011), NPs are given in hydrogel that is created by the electrostatic interactions of calcium or sulphate ions with alginate and chitosan to form crosslinks. These crosslinks are then broken down by colonic enzymes, which increases the drug's bioavailability. Dextran sodium sulfate-induced mouse colitis was treated with an alginate/chitosan hydrogel that included the anti-inflammatory peptide Lysine-Proline-Valine encapsulated inside nanoparticles (NPs).[38] Surface-modified paclitaxel-loaded nanoparticles (NPs) were created by precipitating PLGA-polyethylene glycol (PEG) polymers at the nanoscale with the carcinoembryonic antigen on the surface of CRC cells. This process ultimately produced the formulation needed to interact with the diseased cells.[12] Because of their special surface chemistry and size, NPs are useful for targeted colon drug delivery. Their increased permeability allows them to embed and penetrate inflammatory areas through the gut wall, which will eventually improve tissue uptake. Particle residence times rise as size decreases; particles smaller than 10 μm tend to collect in inflammatory areas, although the size range of nanoparticles reduces medication clearance.[39] Additionally, NPs' adaptable physicochemical characteristics can be used to minimise systemic side effects and maximise medication concentration in the colon. Some of the research on polysaccharide-based micro/nano carriers is provided in Polysaccharide-based micro/nano-carriers.

f. Metal nanoparticles

The majority of metal nanoparticles (NPs) are colloidal systems made possible by reductive technology. Some, like NPs of porous silica, are created using seed-based technology. Colloidal suspensions can be used in medicine because of their fluidity and capacity to interact with external magnetic fields when they are magnetised in a liquid carrier. The cytotoxicity of synthetic nickel oxide nanoparticles (NPs) with a size range of 20–25 nm has been assessed in a recent study by Khan et al. 2019, and the results suggest decreased cytotoxicity; still, most metallic NPs have been shown to be hazardous when they accumulate in the body.[40]

g. Liposomes

According to Garg et al., liposomes are nanosized phospholipid bilayer vesicles that are used for targeted colon medication administration. Alberto Gabizon reported on PEGylated Doxorubicin liposomes in 2001, which demonstrated improved half-life, improved biocompatibility, and decreased macrophage recognition.[41] In order to target colon cells, 5-fluorouracil loaded liposomes with folic acid as a ligand were created. When the in vivo efficacy of the liposomes was examined, 5-FU liposomes demonstrated superior activity in destroying cancer cells.[42] Neuberger et al. (2018) created and evaluated doxorubicin-loaded liposomes on Caco 2 colon malignant cells, and the results demonstrated improved drug internalisation, improved circulation time, and significantly reduced cytotoxicity.[43]

h. Magnetic nanoparticles

The alternating magnetic field (AMF) in magnetic nanoparticles (MNPs) produces heating power. MNPs have been widely used in the biomedical area, especially as a cutting-edge approach to treating cancer and other tumours.[44] According to Mannucci et al. (2014), the MSR-1 strain of *Magnetospirillum gryphiswaldense* is the source of the naturally occurring MNPs made by magnetotactic bacteria. Its anti-neoplastic efficacy was evaluated on human colon cancer HT-29 cell cultures, and when its interaction with cells in vivo was evaluated, it demonstrated improved absorption without exhibiting any harmful effects.[45]

Conversely, thermotherapy is a powerful technique for treating a variety of tumour forms, but its specificity is lacking. Several strategies are put out and applied in order to improve the technique's effectiveness. By increasing tissue temperature using AMFs, magnetic fluid hyperthermia maximises the effectiveness of the procedure by improving the intratumoral delivery of MNPs. According to Creixell et al. (2010), encapsulated iron oxide MNPs with improved internalisation in cells exhibit monodisperse and stable production of epidermal growth factor (EGF) in comparison to nontargeted NPs.[46]

Biomimetic Nano Delivery Systems

Apart from the ligand-receptor binding approach, bionic technology, which primarily coats nanoparticles with biofilms, enables the nanoparticles to actively target the tumor. This tactic can use membrane proteins, glycoproteins, and homologous adhesion to cause

nanoparticles to selectively collect in the tumor in addition to preventing the immune system from identifying the particles.[47] The bionic cell membranes that have been utilized in the reported nanoparticles lately primarily consist of leukocyte membranes, cancer cell membranes, and erythrocyte membranes.[2] Moreover, it is preferable to conceal the nanoparticles with hybrid cell membranes in order to provide them with additional features.

j. Dendrimers

The drug delivery agents with the best conjugation and encapsulation capacities are called dendrimers. Different kinds of dendrimers have recently been developed and employed for targeted medication delivery in cancer research. Dendrimer molecules are those that are covalently bound to biologic molecules at the cellular level, as well as to DNAs, folic acid, antibodies, chemotherapy drugs, and contrast chemicals used in magnetic resonance imaging.[48] More sensitive and widely applicable in the detection of cancer, dendrimers coupled to particular antibodies can identify circulating tumour cells. Dendrimer conjugates of water-soluble polyamidoamine, which were reported to exhibit strong resistance to drug release prior to colonization, were used to give 5-ASA to the colon. In [49]

Carbon nanotubes

According to Liu et al. (2008), poly-ethylated single-walled carbon nanotubes (SWNTs) are associated with the synthesis of paclitaxel single-walled CNTs (SWNTs), which exhibit strong suppressive activity on tumours where the drug is soluble in water. As a result, it

makes normal cells more soluble in water and less hazardous.[47] According to a 2013 study by Lee et al., C225 antibody was produced inside of SWNTs for targeted therapy of the EGF receptor, which is primarily overexpressed in colon cancer. Topoisomerase I inhibitor SN38 (7-ethyl-10-hydroxycamptothecin) regulates release treatment, which includes colon in colorectal cancer. Chemotherapeutic drug carriers that show promise are SWNT.[50] Colon cancer was the target of gemcitabine multi-walled CNTs loaded with hyaluronic acid conjugated with polyethylene glycol. These CNTs were

assessed for in vitro and in vivo investigations that demonstrated the efficacious use of CNTs in colon cancer treatment.[51] It is evident from the discussion of this work, which has been published in several international publications, that focused medication administration to the colon is required. It can also minimise drug cytotoxicity, minimise the therapeutic target, and lessen adverse medication effects. The use of polymers and other newer techniques like NPs has improved therapeutic effects (Table3).

Table 3 Polysaccharides investigated for colon specific drug delivery with their dosages forms and summary of results obtained

Polysaccharide investigated	Drug moiety used	Dosage form prepared	Performance of the system
Chitosan	5-(6) carboxy fluorescein (CF)	Enteric-coated chitosan capsules	Little release of CF in upper GIT conditions and 100% drug release in 33% cecal contents within 4 h of dissolution [52]
Derivatives Chitson succinate Chitosan phthalate.	Sodium diclofenac	As matrices	Reduced drug release was seen in acidic conditions and improved dissolutions under basic conditions[53]
Pectin (used as calcium salt)	Idomethacin	Matrices	In the presence of rat cecal content drug release was 60.8±15.7% as compared to 4.9±1.1% in control[54]
Amidated pectin	Paracetamol	Matrix tablets	These matrices were not suitable for drug delivery colon[55]
Amidated pectin / calcium pectinate	Ropivacaine	matrix tablet with ethyl cellulose as drug matrix additive	Amidated pectin were more susceptible to pectinolytic enzymes as compare to calcium pectinate. Addition of ethyle cellulose increased the tablets strength and dissolution rate coating this formulation with Eudragit L100 reduced drug release in upper GIT conditions without effecting enzyme degradability[56]

Chondroitin sulphate, Cross linked chondroitin Alginates As calcium salt	Indomethacin 5-ASA	Matrix tablet Double coated swellable beads	Drug release increases in presence of rat cecal content. Also it was observed that as crosslinking increased, drug release decreased [57] In basic media enteric coating dissolves and beads swell to exceed the strength of aquacoat film, which then burst releasing the drug[58]
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5. Recent developments in colon targeted drug delivery system (CDDS)

a. Pressure Controlled Drug-Delivery Systems

The colon experiences greater pressures than the small intestine due to peristalsis. Takaya et al. created water-insoluble ethyl cellulose-based pressure-controlled colon-delivery capsules. In these systems, pressure within the colon's lumen causes medication release to happen when a water-insoluble polymer capsule dissolves. The primary factor that determines how easily the formulation dissolves is the thickness of the ethyl cellulose membrane.[59] The capsule's density and size seemed to have an impact on the system as well. The colon has a higher viscosity of luminal material than the small intestine due to the reabsorption of water from the colon. Thus, it has been determined that colon-specific oral medication delivery systems may encounter issues due to drug disintegration in the colon.[60] The medication is in a liquid state in pressure-controlled ethyl cellulose single unit capsules. Pressure-controlled capsules were shown to have lag durations of three to five hours when it came to medication absorption in humans.

b. Novel Colon Targeted Delivery System (CODESTM)

Developed to circumvent the inherent issues with pH or time-dependent systems, CODESTM is a novel CDDS technology.[61] A combination of pH-dependent and microbially driven CDDS is called CODESTM. It was created by employing a special mechanism involving lactulose, which serves as a catalyst for the release of medication at certain colonic sites (Figure 3). The system is made up of a conventional tablet core with lactulose on it. Eudragit E, an acid-soluble material, is then applied on top of it, followed by Eudragit L, an enteric material. The idea behind the technique is that the tablet is shielded by the enteric coating while it is in the stomach, and it dissolves fast after the stomach is emptied.[62] The preparation is subsequently shielded from the alkaline pH of the small intestine by the acid soluble material covering. The bacteria in the colon use enzymes to break down the polysaccharide (lactulose) in the tablet and produce organic acid. This sufficiently lowers the pH of the surrounding environment to cause the acid soluble coating to dissolve and for the medicine to release as a result.[63]

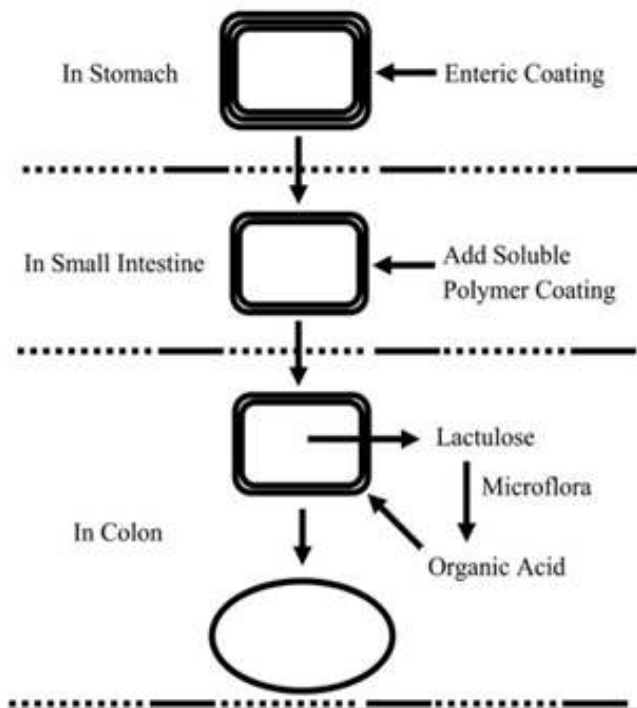


Figure 3 Schematics of the conceptual design of CODESTM

c. Osmotic Controlled Drug Delivery (ORDS-CT)

When treating a condition, the OROS-CT (Alza corporation) can be utilised to target the medicine locally to the colon or to accomplish otherwise impossible systemic absorption. The OROS-CT system consists of one osmotic unit or up to six push-pull units, each measuring 4 mm in diameter and enclosed in a hard gelatin capsule.[64] A semipermeable membrane encloses the drug layer and the osmotic push layer in each bilayer push pull unit. Beside the drug layer, a hole is

punched through the membrane. The push-pull units in the OROS-CT disintegrate in the gelatin capsule as soon as it is ingested. Each push-pull unit is unable to absorb water in the stomach's acidic aqueous environment due to its drug-impermeable enteric coating, which prevents medication delivery. The coating dissolves in the small intestine's higher pH environment (pH > 7) when the unit passes through it. Water also enters the unit, causing the osmotic push compartment to expand and simultaneously forming a flowable gel in the drug compartment. Drug gel is forced out of the aperture by swelling of the osmotic push compartment at a pace that is precisely regulated by the rate at which water is transported through the semipermeable membrane. Each push pull unit for the treatment of ulcerative colitis is made with a 3-4 hour post-gastric delay to avoid medication distribution in the small intestine. When the unit enters the colon, the drug starts to release. In the colon, OROS-CT units can give medication over as little as four hours or sustain a consistent release rate for up to 24 hours.[65] Phase-transfer technologies have emerged recently and show promise as a useful technique for directing medication towards the colon. A number of in vitro and in vivo assessment methods have been created and put forth to evaluate the effectiveness and stability of CDDS.

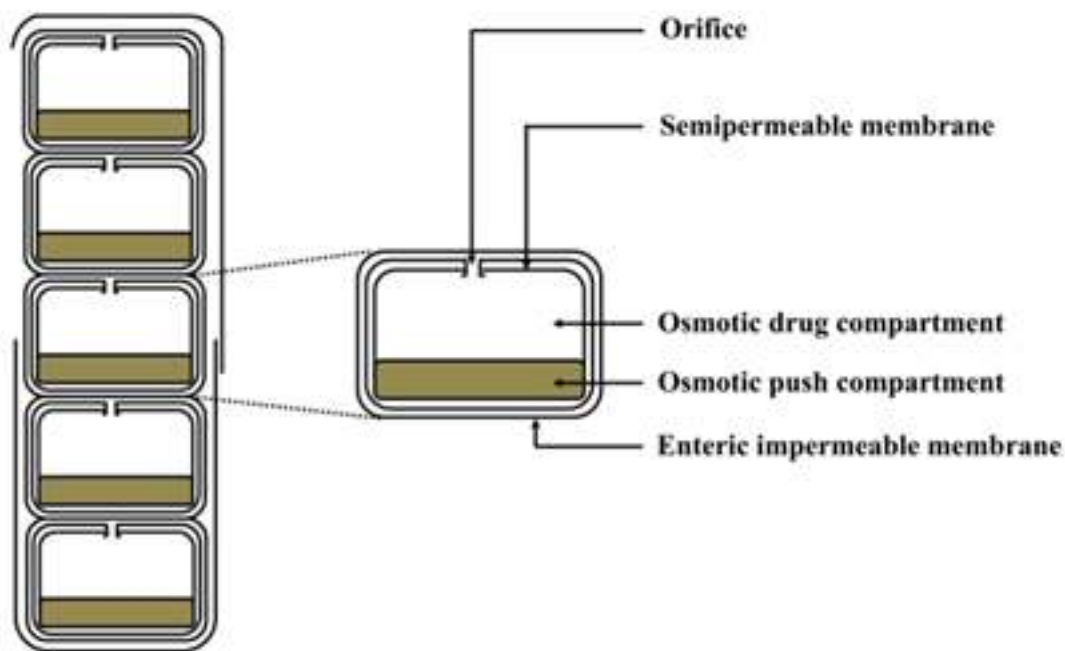


Figure 4 Cross-Section of the OROS-CT colon targeted drug delivery system

Advantages of CDDS over Conventional Drug Delivery

Glucocorticoids and other anti-inflammatory medications are currently used to treat Crohn's disease and ulcerative colitis, two types of chronic colitis.[64] Systemic side effects from the oral and intravenous administration of glucocorticoids, including methyl prednisolone and dexamethasone, include immunosuppression, adenosuppression, cushinoid symptoms, and bone resorption [66]. Hence, targeted drug delivery to the colon may help to minimise systemic negative effects from

high dosages as well as the necessary dosage [31].

Criteria for Selection of Drug for CDDS

The best candidates for CDDS are medications, particularly peptides, that exhibit limited absorption from the stomach or intestine. The best choices for local colon administration are medications used to treat diarrhoea, ulcerative colitis, IBD, and colon cancer as given in Table 3.

Table 4 Criteria for selection of drugs for CDDS

Criteria	Pharmacological class	Non-peptide drugs	Peptide drugs
Drugs used for local effects in colon against GIT diseases	Anti-inflammatory drugs	Oxyprenolol, Metoprolol, Nifedipine	Amylin, Antisense oligonucleotide
Drugs poorly absorbed from upper GIT	Antihypertensive and antianginal drugs	Ibuprofen, Isosorbides, Theophylline	Cyclosporine, Desmopressin

Drugs for colon cancer	Antineoplastic drugs	Pseudoephedrine	Epoetin, Glucagon
Drugs that degrade in stomach and small intestine	Peptides and proteins	Bromophenaramine, 5-Flourouracil, Doxorubicin	Gonadoreline, Insulin, Interferons
Drugs that undergo extensive first pass metabolism	Nitroglycerin and corticosteroids	Bleomycin, Nicotine	Protirelin,sermorelin, Saloatonin
Drugs for targeting	Antiarthritic and antiasthamatic drugs	Prednisolone, hydrocortisone, 5-Amino-salicylic acid	Somatropin,Urotoilitin

6. Pharmacokinetic Evaluation of Controlled Drug Delivery System Formulations:[67]

Controlled drug delivery system (CDDS) formulations can be evaluated using several in vitro, in vivo, cell line, and enzymatic study approaches. In vitro evaluation presents some challenges as there is no standardized technique that can fully replicate the in vivo conditions of the gastrointestinal tract (GIT). An ideal in vitro model would account for the varying pH levels, volumes, mixing/agitation, bacterial presence, enzymatic activity, and other components within the GIT. However, these conditions are influenced by diet, physical activity, and other individual factors, making it difficult to design a standardized in vitro model. Some in vitro models that have been used to evaluate CDDS formulations include:

a) In Vitro Dissolution Testing

Controlled-release formulations used for colon-specific drug delivery typically have complex dissolution processes that the United States Pharmacopeia's dissolution procedures are unable to accurately mimic in vivo conditions such

as pH, bacterial flora, and mechanical mixing pressures. The traditional basket method can be used to conduct dissolution studies related to chronologically-dependent drug delivery systems. It is possible to conduct parallel dissolution tests in various buffers to examine how formulations behave at different pH values. A colon-specific formulation was subjected to dissolution studies in a variety of media designed to mimic the different pH levels and timeframes likely to be experienced at different points in the gastrointestinal tract. For instance, pH 1.2 was used to represent gastric fluid, pH 6.8 to represent the jejunal area of the small intestine, and pH 7.2 to represent the ileum section. Three buffers were used in a gradient dissolution study to examine enteric-coated chronologically-dependent drug delivery system capsules. The pH of the capsules was evaluated for two hours at 1.2, one hour at 6.8, and then at 7.4.

b) In Vitro Enzymatic Testing [67]

Polymer-based drug delivery carriers

should be incubated in fermentation vessels containing relevant bacterial growth media, such as *Bifidobacterium ovatus* and *Streptococcus faecium*. Release experiments are performed to establish the quantity of medication released at designated time intervals. Drug release experiments are conducted using buffer solutions containing enzymes (pectinase, dextranase) or cecal contents from rats, guinea pigs or rabbits. The degradation rate of the polymer carrier directly impacts the amount of medicine delivered over a specified period of time.

c) Cell Line Research

The development of in vitro systems has been necessitated by these limitations. Due to their numerous advantages over animal models – such as enabling direct observation, focused experimentation, and continual evaluation – cell-based systems are currently receiving significant consideration. Variations and inconsistencies in experimental outcomes can be decreased for general in vitro studies.

The Caco-2 cell line

The Caco-2 cells, also known as human colorectal adenocarcinoma cells, are an immortalized line of human epithelial colorectal adenocarcinoma cells. Developed by Fogh at the Sloan-Kettering Institute for Cancer Research in 1977, these cells spontaneously differentiate into various intestinal epithelial cell types in vitro. In the late 1980s, Hidalgo et al discovered that Caco-2 cells could be used for research studies. Though originally derived from colon cancer tissue, the cells mimic the enterocytes that line the small intestine. Developed Caco-2 cells exhibit traits similar to small intestinal enterocytes such as

microvilli and the production of digestive enzymes including lactase, aminopeptidase N, sucrase-isomaltase, and peptidases. The Caco-2 cells are also capable of producing cytokines like tumor necrosis factor- α , thymic stromal lymphopoietin, and interleukins 6-8 and 15, enabling their use in inflammation research areas such as inflammatory bowel disease. Numerous studies have found a strong correlation between Caco-2 cell permeability coefficients and drug absorption data, particularly for passively transported drugs. Dulbecco's Modified Eagle Medium is commonly used to maintain Caco-2 cell lines.

Organoids

Organoids are three-dimensional cell structures created from adult or pluripotent tissue stem cells. A type of cell called an organoid can transform into various cell types to carry out the tasks of the corresponding organs. Since 1992, researchers have worked to keep tissue explants alive in vitro. In 2008 and 2009, Eiraku et al. and Sato et al. developed the first effective method for creating structures produced from stem cells, now called "organoids".

Sato et al. utilized Lgr5+ adult stem cells, first obtained from rodents and subsequently from human intestinal crypts, to create them. Good organoid cultures have been obtained from several anatomical areas, including the colon, esophagus, and stomach tissues. Organoids derived from colonic tissue are called colonoids. Organoids derived from small intestine tissue are known as enteroids, or small bowel organoids. They can develop into mature enterocytes, tuft cells, goblet cells, and paneth cells from a small volume of tissue, such as biopsies. Gut organoids also carry out several functions of the parent tissue, including contraction, filtration, endocrine and paracrine secretion, molecular transport, and absorption.

T84 cell line

One cell line frequently used in intestinal research studies is the T84 cell line. Developed in 1980 by Murakami et al., this line was created to investigate hormonal control of human colon cancer. T84 cells display microvilli on their surfaces and can adopt a crypt-like phenotype when activated by transforming growth factors. They demonstrate similar rapid differentiation potential as Caco-2 cells to form an absorptive epithelial cell layer. T84 cells also have the ability to differentiate into crypt-like cells when influenced by mesenchymal factors and human transforming growth factors. The T84 cell line is valuable for host-microbe research generally as it is widely accepted to accurately represent the colon environment. Additionally, T84 cell lines are among the most commonly used models in the study of inflammatory bowel disease due to past use investigating electrolyte transport mechanisms, intestinal permeability, and signaling pathways involved in the inflammatory response of the intestines.

The T84 cell line is one model utilized in colon research. However, it can also be applied more broadly in studies of inflammatory bowel disease. Similar to Caco-2 and HT29 cell lines, the T84 cell line has limitations owing to its malignant origin and lack of epithelium-specific functions demonstrated *in vivo*.

HT29 cell line [67]

The HT29 cell line, like Caco-2, was generated from human colon cancer. It was extracted from the main tumor of a 44-year-old Caucasian female in 1964 by Fogh and Trempe [68]. These cell lines were initially used to study aspects of human cancer biology as multiple cell lines have been established for colon cancer. The ability of these cells to express mature intestinal cell

properties such as enterocytes or mucus-generating cells garnered attention [69]. HT29 and Caco-2 cell lines share several traits. Like Caco-2 cells, HT29 cells undergo differentiation. Similar to Caco-2 cell lines, HT29 cells also secrete digestive enzymes [70]. Prior studies have demonstrated that HT29 cell lines emit cytokines that are similar to those released by Caco-2 cell lines [71]. A noteworthy difference between HT29 and Caco-2 cells is that the latter were able to produce mucin at a respectably high level [72]. A unique feature of HT29 cells is their high rate of glucose consumption. Thus, a high glucose concentration in the medium is required. When exposed to high glucose concentrations, these HT29 cells did not exhibit traits of intestinal epithelial cells. They formed as an undifferentiated, unpolarized layer of cells [73]. Consequently, substituting galactose for glucose was discovered. Pinto et al. [74] found that enterocytic differentiation was initiated by substituting galactose for glucose in the media containing HT29 cells.

C. In vivo evaluation

Dogs, guinea pigs, rats, and pigs are among the animals used to assess drug transport to the colon because their anatomical and physiological characteristics are like those of the human gastrointestinal tract, as well as its bacteria. The relative model for colonic disorders should be considered while selecting a model for Controlled drug delivery systems testing. For experimental inflammatory bowel disorders models, guinea pigs are frequently utilized. Rat and rabbit GIT azoreductase and glucouronidase activity distributions are like human GIT distributions.[75] A unique paradigm for the quick evaluation of Controlled drug delivery systems has been proposed. In this paradigm, a subcutaneous tunnel on the back

of thymic nude mice is transplanted with human foetal intestine, therefore bascularizing the host.

7. Future perspectives of colon targeted drug delivery system

The future of colon-targeted drug delivery lies in personalized medicine, tailoring treatments based on individual patient characteristics. Advancements in diagnostics, including genetic and microbial profiling, will enable the development of patient-specific drug delivery systems. This approach holds the potential to optimize therapeutic outcomes while minimizing adverse effects.

Individualized Medical Care

With colon-targeted Drug Delivery systems in the future, tailored medicine offers a revolutionary approach to healthcare. Through acknowledging the multiplicity of patient traits, genetic compositions, and illness patterns, scientists can create customized approaches that maximize therapeutic efficacy while reducing side effects. This patient-centred approach has the potential to transform the way gastrointestinal illnesses are treated and to lead to more effective and individualized therapeutic approaches.

Macromolecules and Biologics

Because of their size and complexity, biologics and macromolecules provide particular obstacles for colon-specific medication delivery. Subsequent investigations ought to concentrate on the creation of novel carriers and delivery systems that can securely and efficiently deliver these medicinal substances to the colon. This might result in the development of novel techniques for treating inflammatory bowel diseases and colon cancers. Recent advances in biomaterials and nanotechnology offer

promising strategies for the targeted colon distribution of biologics and macromolecules. These big molecules can be encapsulated by nanocarriers like liposomes, micelles, and nanoparticles, which will shield them from deterioration and allow for regulated release in the colon. Additionally, accurate and on-demand release of biologics in the colon can be achieved by smart polymers that react to particular stimuli, including pH changes or enzyme activity changes[72].

One approach is to use pH-sensitive nanoparticles, which release their cargo in the colon's higher pH settings but stay stable in the acidic environment of the stomach and small intestine. Another approach uses the unique microbial composition of the colon to trigger the release of biologics. Specific polymers were engineered to degrade in response to specific enzymes produced by colonic bacteria, allowing for the targeted release of the therapeutic drug. [73].

To achieve effective encapsulation, controlled release, and therapeutic efficacy, these nanocarriers and smart polymers must be optimized for colon-targeted drug delivery of biologics and macromolecules in the future. These systems will function even better if they are customized using personalized medicine techniques to fit the unique patient profiles. Furthermore, resolving immunogenicity concerns and other adverse effects related to the usage of macromolecules is essential to the effective transition of these technologies from the lab to clinical settings [74].

In conclusion, resolving the issues posed by the size and complexity of biologics and macromolecules will be critical to the success of colon-targeted medication administration in the future.

Featuring Smart Technologies:

For the pharmaceutical business, innovative technological advancement into colon-targeted medication delivery devices is revolutionary. This technology enables real-time monitoring, wireless communication, and customized treatment programs. Healthcare providers can collect useful data, modify treatment regimens, and improve patient adherence by adding responsive components to medication formulations. As a result, drug administration is now more accurate, flexible, and successful, and we are getting closer to the goal of personalized medicine when it comes to colon-specific treatments [74].

Colon-targeted drug delivery systems will work better when smart technologies like wireless communication and remote monitoring are integrated. Drug release, patient response, and adherence can all be tracked in real time with smart tablets that are fitted with sensors and communication components.

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Enhancing Efficiency in Savings Account Opening and Elevating Corporate Salary Package Accounts of Indian banking sector: Strategies and Challenges

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ABSTRACT

The study analyzes the processes and benefits of two key banking services: savings account opening and corporate salary package account opening. The aim is to understand the significance of these services for both customers and banks in India.

For saving account opening the paper looks into the fundamental aspect including the documentation required, eligibility criteria, and the account opening process. It highlights the ease of access to savings accounts, which serves as a secure and convenient tool for individuals to store their money and earn interest. The research work emphasizes the ease of account opening procedure and how it can become faster and hassle free. How can the business of Indian banks grow? Regarding corporate salary account opening, the report explores how businesses can provide this service to their employees. The study outlines the advantages of corporate salary accounts which include facilitating salary transfers, streamlining payroll management and enhancing employee satisfaction by offering exclusive banking benefits such as home loans, car loans and various other benefits. It also analyzes how such arrangement can foster stronger relationships between the customers and banks.

Keywords- benefit, challenges, strategies, saving account, corporate salary account

Introduction

Over the past ten years, the banking sector has undergone constant change, which has increased industry efficiency and increased competition. The history of the banking sector in India is vast and spans from the traditional banking methods used by the British to the reforms era, nationalization to bank privatization, and the current trend of growing numbers of foreign banks operating in India. As a result, Indian banking has a lengthy history.

Indian banks can expand and become more competitive with the help of microfinance and rural banking.

The use of technology has drastically changed every aspect of human life and brought about a revolution in the way banks operate. The advent of technology adoption has made anytime, anywhere banking possible. Due to the ease of access provided by gadgets, life has drastically changed.

The goal of this study is to make opening a

savings bank account easier for customers. It explains how to open an account easily and outlines the necessary adjustments to make the process less complicated. Since opening an account is the first step in becoming a bank customer, there should be no difficulties or inconveniences for the customer during this procedure.

Overview of the Industry

Twelve public sector banks, twenty-two private sector banks, forty-six foreign banks, fifty-six regional banks, and fourteen hundred and eighty-five urban cooperative banks make up India's banking industry. The banks manage the flow of money in any economy; their primary responsibilities are to accept deposits and make loans. Banks play a crucial role in controlling a nation's economy. It inculcates in people the habit of saving money.

Governments have introduced various schemes to significantly improve India's financial position. The Indian banking system has recently witnessed major innovative banking models like payments and small finance banks. The banking sector is a massive industry that supports many aspects of the economy and controls many other national rates, including inflation. The banking sector is heavily involved in business and financial transactions because it is a significant and well-liked method of borrowing, investing, and storing money. Worldwide, there are banks, and most of them are subject to strict regulations set by international governments to guard against corruption and safeguard public funds.

With the aid of the Unified Payments Interface (UPI) and digitization, the banking sectors have reached new heights and the digital payments system has simplified banking procedures and expanded its global reach.

Review of literature.

The literature review is an essential component of this article as it encompasses the entire spectrum of previous research conducted on the chosen topic, which forms the foundation for the study's research design. A literature review provides additional context for the subject. Here is a review of the literature on the subject of improving account opening. Improving account opening is a crucial aspect of businesses in the financial industry as it directly impacts customers acquisition and satisfaction.

"The Impact of Digitalisation on Account Opening Processes in Banking Institutions " (Jones M. 2018) This study explores how the integration of digital technologies has transformed traditional account opening processes in banking institutions, it analyses the benefits of digitalisation, such as reduced paperwork, increased efficiency and enhanced customer experience. The research also highlights challenges like data security and customer trust in adopting digital account opening methods. "Customer On boarding Strategies, A comprehensive review" (Smith J. 2019) This review paper provides a comprehensive analysis of various customer onboarding strategies used by finance institutions. It gives different techniques for identifying KYC compliance, risk assessment during the account opening process." Mobile Account Opening: Trends and opportunities" (Wong A. 2019) this paper explains the growing Trends of mobile account opening in the financial industry. It analyzes the advantages of mobile platforms, such as accessibility and convenience, and investigates the challenges faced for ensuring data security and regulatory compliance on mobile devices.

Objectives of the study

1. To understand the needs of the customers, challenges faced by them while opening an account and to know their suggestions to enhance the quality of the products and services.
2. The main aim of the study is to understand the account opening process of the bank and provide best possible ways to increase the savings account opening.
3. To suggest measures to increase the corporate salary account opening and saving bank account opening of the bank.
4. To understand major challenges in opening a savings account and corporate salary account.

Research Methodology

Research is descriptive in nature. Researchers have collected data from primary as well as secondary sources. Major primary and secondary data sources used in study are mentioned below.

1. Surveys

Survey was conducted to understand the preferences of the people, and their expectations from the bank. Surveys are the best method to understand the trends and changes required by the people. While the survey was conducted for the users and the employees at several banks many facts we found and it helped in understanding the major challenges.

2. Questionnaires

The questionnaire for the research was designed to find out the experience of the users of different banks. There were a set of questions for the respondents to answer which gave a brief knowledge about the

recent trends and the requirements of the generation.

3. Interview

An interview is the interaction between the interviewer and the interviewee, for the collection of more facts and data for this research, interviews were conducted with the branch managers of various branches of different banks.

4. Journals and Website

For the purpose of understanding the current position, financial records and various factors about the banks. The information gathered from journals and websites, comprising the secondary data for the research purpose.

Secondary data collection

The secondary data is collected from websites, journals and existing research articles. Generic process followed by the banks for opening a savings bank account and a corporate salary account is mentioned below.

There are two ways that a customer can open a savings bank account and a corporate salary account which are; a) online mode; b) offline mode.

The process of opening a savings bank account is as follows:

- **Step 1:** Comparison of interest rates offered by various banks to see which one best fits the needs of the customer. Selecting the savings account type they want to open at the bank of their choice.
- **Step 2:** Visiting the bank's official website to open an account, or, if preferred to do it offline, visit the nearest bank branch along with, proof of age, address proof, evidence of income, employment verification, and,

if needed, photographs.

- **Step 3:** Completing the application for a savings account of their choice. Along with a digital copy of identity documents, some banks may request to submit physical copies of documents, in which case they will send an executive to pick them up. In offline mode, the customer submits the form and the supporting documentation in person at the branch.
- **Step 4:** Upon verification of the information submitted, the application form is finally sent for processing. The account can then be opened and used at any time within a maximum of 12 working days.

One of the first things an employee receives from their employer when they start work there is a salary account. It's frequently not required. The following is how to open it:

- 1) Complete an application that the bank receives from the employer.
- 2) The employee must give the linked bank their information in order to open an online or offline salary account.
- 3) Check the identity and address proof on all of your documents.

Eligibility criteria for corporate salary account: The employee has to meet certain qualifying requirements in order to open a salary account. Upon joining an organization, they will likely have to meet all eligibility requirements while opening a salary account. They need to submit the necessary documents along with a completed application form.

Certain banks request that applicants submit an introduction from the company in the format that the bank specifies (signed and stamped by an authorized signatory). Additionally, each bank has a different minimum net salary band

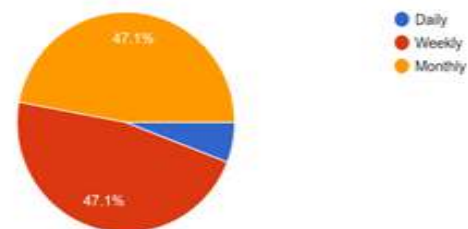
each month. Additionally, this varies based on the kind of salary account that the relevant bank offers.

As per RBI guidelines the Indian banks have to follow these steps with respect to opening of bank accounts and corporate salary accounts.

Details of Primary data collection from customers

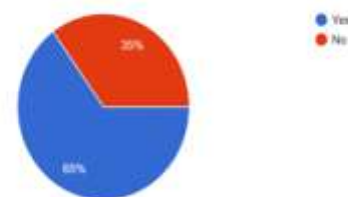
Research approach	Survey
Research Instrument	Questionnaire, Interview
Method of contact	Personal, Google form
Sample size	100 respondents

1. How frequently do you use personal banking service excluding UPI payments?



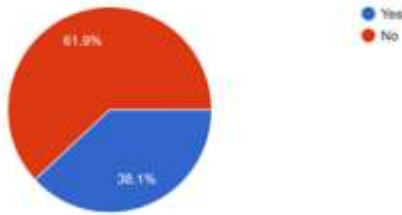
Interpretation: Majority of the respondent use personal banking service weekly that is 47% where UPI payments are not included.

2. Do you use services related to savings bank accounts such as internet banking or specific applications launched by the concerned banks?



Interpretation: 65% of the respondents use savings bank account related services launched by the banks.

3. Are you aware of the benefits provided by the savings bank account, such as complimentary insurance covers on debit cards.



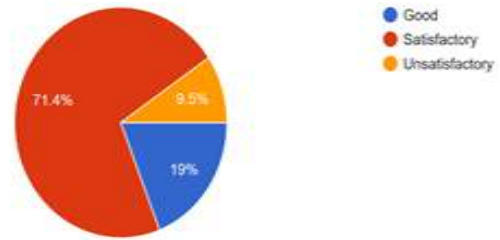
Interpretation: According to the study most of the respondents were unaware of the fact that banks along with its core banking facility provides additional benefits such as complimentary insurance cover, easy credit via apps, etc.

4. Is there anything Indian banks could do to improve your experience with the personal banking products/services

- o Should focus on providing better online services
- o Improve the UPI payments by reducing payment failures.
- o Fixing bugs in the bank App.
- o Improvement of customer support and response.
- o Should provide personal assistance
- o Should increase the number of ATM's and CDM's
- o Training should be conducted for the staff for better service.

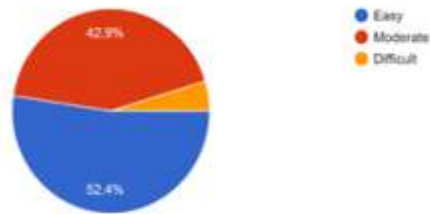
Interpretation: These were the most frequently faced issues by the current account users who wanted assistance for the above-mentioned issues raised by them. Fixing bugs in the app was mentioned by most of the respondents.

5. Are you satisfied with the offers of a savings bank account with your partner bank?



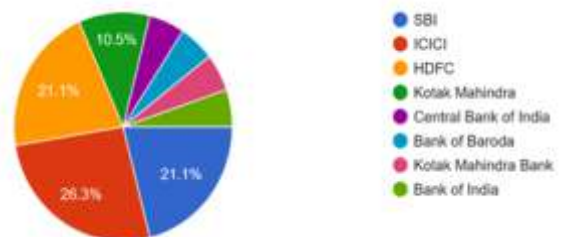
Interpretation: The overall performance was good of all the banks as users are satisfied by the offers provided by them, although there is scope for improvement in many aspects.

6. How was the process of opening a savings account in your partner bank?



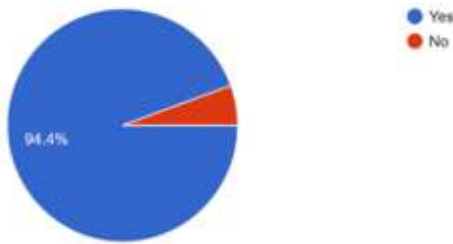
Interpretation: 52% respondent stated that account opening procedure was easy and hassle free but the fact cannot be neglected that 42% found it to be moderate where banks specially public sector banks can work and help resolve problems and gaps.

7. Which bank do you use for your corporate salary account?



Interpretation: The market leaders for savings bank account and corporate salary accounts are ICICI, HDFC and SBI who manage to compete with them with maximum savings bank accounts, and fairly enough salary accounts under its name.

8. Are you satisfied with the salary account handled by your bank?



Interpretation: 94% of the respondents are satisfied with the handling of their accounts by the bank.

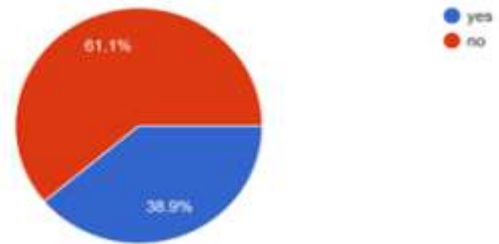
9. Any specific reason for choosing this bank for your salary account

- Provided by the employer
- Easy and simple procedure of account opening
- Customer friendly good customer support
- The operation is done through online mode with no need of visiting the bank.
- Usage is convenient and hassle free
- Good FD rates for salary account

Interpretation: The reasons were different for all respondents to choose those particular bank partners, although the key reason for most of them was who provided proper assistance when they switched to those banks. The relationship building and customer friendly approach plays a vital role in attracting more customers towards

a bank, where there are many substitutes in this sector.

10. Would you like to switch to other banks for banking solutions?



Interpretation: In the study it was found that the majority , 61% of the respondents, did not want to change their existing bank accounts with the respective banks above mentioned, contrary to this there are 38% of respondents who would switch to other banks for their banking solutions.

Analysis of Data Collected from different bank branch managers.

A questionnaire was prepared for the bank officials and employees to get an overview of the banks and what are the challenges these banks are facing and what are the changes required for increasing the number of accounts opening and corporate salary packages in the banks. This was a structured interview conducted with 6 branch managers of 6 different banks. As a researcher conveying the essence of the conversation, which involves the condensed information into a concise and cohesive summary mentioned below, guiding the readers through the wide range of ideas discussed.

1. Number of accounts opened on an average in a year

The accounts opened on an average in a

year at any banks are close to 500-800 depending on the offers provided by the banks and their branch locations, residential areas do not have a steep increase in numbers, compared to industrial areas.

2. Any problems faced by the customers during opening of accounts

The major problems faced by the customers during opening was filling the lengthy accounts opening form. Visiting banks and not getting at-home assistance from several banks, excluding a few banks who work very hard to give their customer the best experience of account opening.

3. Any specific problem during online account opening?

Online account opening is only possible if the person is a new customer who does not have data with the bank, an existing customer cannot switch their account to any other type of account, this is a very general problem with many banks, there should be continuous evaluation and upgradation of the data at banks, the customer has to visit the nearest branch for further operations in such cases.

4. Number of account closure in a month?

On an average the closure remains between 5-10 accounts, depending on the banks, not all banks have the same ratio.

5. Reason for closure of accounts?

The major reasons for closure of accounts are migrating to other cities, better offers

by other banks, no proper assistance, and time taking resolutions.

6. Which mode is more preferred for opening an account?

Online being hassle free and less time taking people still opt for offline account opening more than online mode at many banks.

7. What is the target for CSP accounts per month?

The targets are different for different banks, some have 2 companies a month whereas some aim at 5-6 companies a month.

8. Where few banks are lacking in terms of CSP accounts as the products and offers provided are almost similar to all banks?

In terms of attracting new CSP accounts it is very important to focus on marketing of products, which is reduced from the past few years at several banks. At the same time existing accounts cannot be switched through online mode and branch visit is compulsory. This also creates a barrier: customers end up having savings accounts at one bank and salary accounts in another.

9. Any specific problem that the banks are facing in order of opening new accounts?

Technical issues, such as a pre-existing database of any customers does not help in switching of accounts, less manpower in the banks. Technical issues are faced by many banks.

Major Findings and observations

- Existing databases make it difficult to open an account online.
- Extensive account opening forms are an issue for every branch.
- Consumers who require banking solutions must receive door-to-door services.
- Significant account closures are occurring as a result of people moving to different nations and cities.
- Product marketing is crucial to attracting new clients, particularly when it comes to corporate compensation packages.
- Customers and employees are less aware of things and should be given more attention.
- Minors under the age of eighteen are not permitted to open accounts online.
- Because mutual funds offer higher interest rates than deposits, branches are advising customers to invest in them, which is why deposit rates in the personal banking sector are declining.
- Due to the government senior citizen scheme, which offers an interest rate of 8.2% and a limit increase from 15 lakhs to 30 lakhs, customers have withdrawn their regular deposits and invested in it, which is the main cause of the decline in savings deposits.
- Additionally, customers are investing more in stocks and mutual funds, which has decreased their savings habits.
- Before a customer can apply for any type of bank loan, they must have a salary account.

Suggestions/Strategies

- **Streamlined digital onboarding:** By removing the need for customers to visit physical branches and implementing a digital onboarding system for all customers, including those who already have accounts and past databases, the time and effort needed to open a new account can be greatly reduced, making it convenient and accessible for both individuals and corporate employees.
- **Customer experience enhancement:** Nearly all clients want to improve their customer experience. A better overall customer experience will come from implementing user-friendly interfaces and offering interactive support during the account opening process. With clear and concise instructions, customers will feel more confident navigating the process, which will increase the satisfaction rate.
- **Shorter reaction times:** The expeditious verification and approval of account applications through automation and integration of internal processes results in a significant decrease in customer turnaround times.
- **Customization and individualization:** Understanding the value of customization and its advantages for corporate salary accounts as well as savings accounts, this strategy caters to a wide range of consumer demands and preferences while increasing customer loyalty.
- **Increased account opening:** will result from the project's marketing and outrage campaign, which uses a strategic market to raise awareness of the improved account opening procedure. At times of intense competition, awareness is essential.

Conclusion

Following investigation and examination, the study aimed at streamlining the corporate salary package account opening and savings account opening procedures by producing important findings and suggestions. The main goals were to transfer valuable experience to the customers, optimize internal processes, and spur business expansion. The study's findings are as follows.

- Product marketing;
- Lead generation and customer conversion for CSP accounts;
- Enhanced customer support.

In conclusion, the project seeks to transform the corporate salary package account opening procedures as well as the savings account opening process by embracing technology, streamlining processes, and placing a high priority on the customer experience. Adopting the previously mentioned suggestions will help the business grow and succeed overall by bringing in new clients and fostering enduring loyalty.

Web 3.0 - Era of new Marketing Strategies

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ABSTRACT

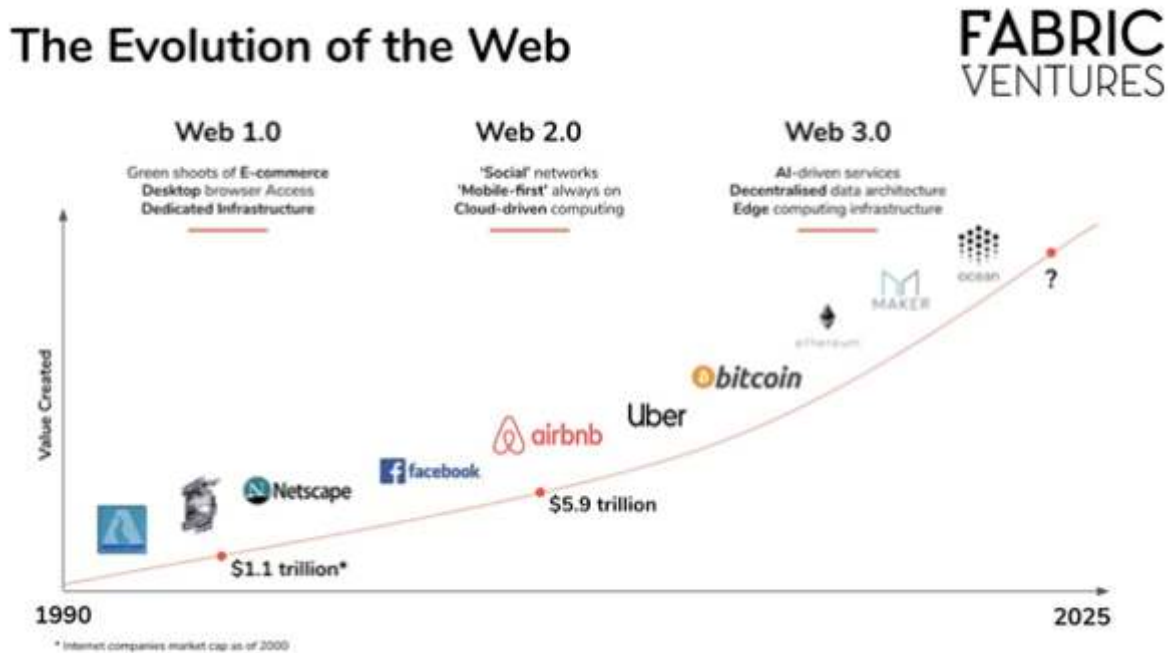
The term "Web 3.0" refers to the subsequent iteration of the internet, which incorporates cutting-edge innovations like blockchain, artificial intelligence, and decentralized systems. It alludes to a more sophisticated, distributed, and interconnected online environment where data and knowledge can be shared and processed by computers. New marketing opportunities are presented by the move toward a more intelligent, secure, and user-centric web environment. Web 3.0 aims to give users a more customized, automated, and seamless web experience. Web 3.0 marketing strategies concentrate on leveraging these new technologies to provide users with personalized and engaging experiences. This might entail using decentralized identity systems to gather and manage customer data, integrating chatbots and recommendation engines powered by AI to improve customer interactions, and using blockchain-based reward systems to encourage customer engagement. The ethical ramifications of using these new technologies will also need to be taken into account by marketers, along with consumer privacy and security concerns. Finally, Web 3.0 mandates that marketers change their emphasis from mass marketing to more individualized and customized marketing initiatives. This calls for a deeper comprehension of the unique needs and preferences of each customer as well as a willingness to modify marketing strategies to suit these needs. Overall, web 3.0 provides fresh possibilities for interaction, customization, and connection with customers, creating a new landscape for marketers. Marketers can design more meaningful and effective marketing campaigns and foster greater brand loyalty and engagement by adopting such new technologies and approaches. This research work is an attempt to study the concept of web 3.0, difference between Web 2.0 and Web 3.0, the key focus of web 3.0 marketing, Main pillars of web 3.0 marketing strategies, Use case of Web 3.0 adoptions

Keywords: Web 3.0, Semantic web, Decentralized internet, AI marketing, Machine learning, Chatbots, Blockchain.

Introduction

The decentralized web, also known as Web 3.0, represents the next phase in the evolution of the internet and gives individuals more control over their data, privacy, and online visibility. Web 3.0 is a network of decentralized, interconnected applications that uses blockchain technology to

enable direct user-to-user communication and do away with the need for middlemen. By reducing power concentration by businesses and empowering internet users, Web 3.0 intends to create a more user-driven, secure, and equitable internet.



Source: Fabric Ventures

Because it provides businesses with a new channel for communication and engagement with clients, Web 3.0 presents substantial marketing prospects. Web 3.0 offers businesses a singular opportunity to connect with customers through individualized and pertinent content, in contrast to the existing Web 2.0, where consumers are inundated with adverts. Because Web 3.0 is decentralized and avoids conventional intermediaries and censorship, businesses can now reach new clients in areas in which they were formerly unable to do so..

Businesses can reward clients for their engagement in Web 3.0 by using tokenized

incentives to enhance the customer experience. For instance, a company might provide tokens as a prize for writing reviews, taking surveys, or completing sales. A positive feedback loop of interaction and benefits would be created if these tokens were then utilized to access special content or promotions. Businesses can also manage their marketing initiatives using decentralized autonomous organizations (DAOs), which enables them to tap into the strength of the community to spur growth.

Businesses must adopt new marketing tactics that align with the decentralized structure of Web 3.0 if they want to flourish. Some corporate success tactics for Web 3.0 include the ones listed below:

- **Content Marketing:** In Web 3.0, content marketing will focus on producing useful and pertinent content for users. Prioritizing quality above quantity and producing content that is customized to the user's interests will be crucial for success.
- **Influencer Marketing:** In Web 3.0, influencer marketing will be crucial in helping firms reach out to new audiences by using reliable sources. Influencer marketing will appear more transparent on the decentralized web since there will be a closer connection between both the influencers and the brand.
- **Community building:** In Web 3.0, it is more crucial than ever to create a strong community around a brand. Decentralized communities can be used by businesses to strengthen consumer relationships and brand loyalty.
- **Tokenized Incentives:** Companies can use blockchain-enabled incentives to recognize customers for their participation and make the experience more personalized. Tokens may also be used to gain access to restricted offers or material, which encourages users to interact with the business.
- **Decentralized Autonomous**

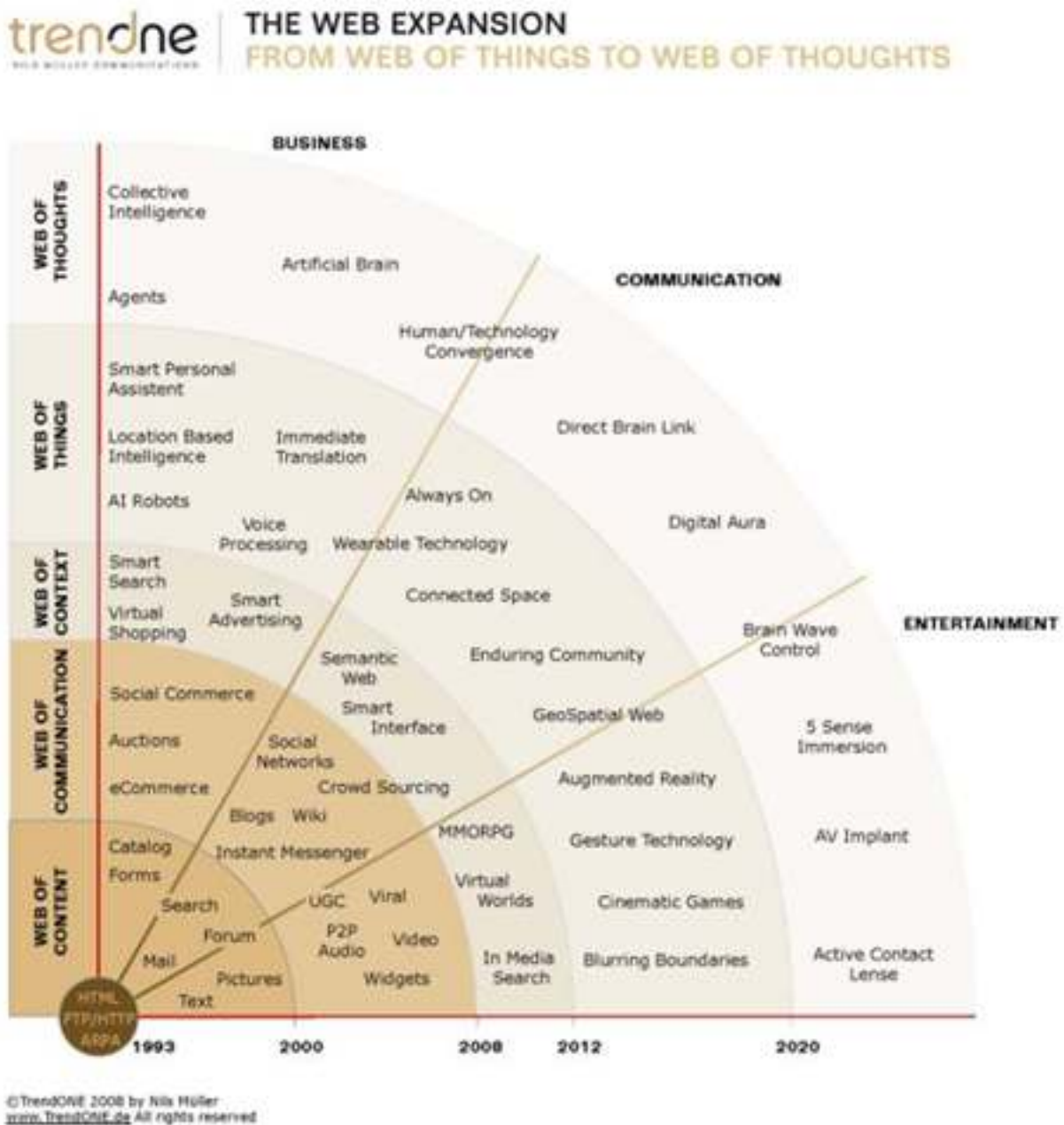
Organizations (DAOs): DAOs give companies the ability to tap into the strength of the community to spur growth. Businesses can strengthen their relationships with their clients and boost client loyalty by letting users take part in decision-making.

Web 3.0, in other words, offers businesses a fresh and exciting opportunity to connect with and interact with their clients. Businesses can access new markets, improve relationships with their clients, and spur growth by adopting innovative marketing techniques that are in line with the platform's decentralized structure. Businesses have a new frontier to explore with the decentralized web, and those who take advantage of it will gain from this exciting new era.

Objectives of the study

- To study and understand the concept of web 3.0.
- To comprehend the difference between Web 2.0 and Web 3.0.
- To understand the key focus of web 3.0 marketing.
- To acknowledge the main pillars of web 3.0 marketing strategies.

Difference between Web 2.0 and Web 3.0



Source: Trendone

The internet has evolved through two distinct phases known as Web 2.0 and Web 3.0. Social media, blogs, and user-generated content (UGC) growth were hallmarks of Web 2.0, which first appeared in the late 1990s and early 2000s. The emphasis on user participation, cooperation,

and the sharing of knowledge and ideas marked this period of internet history.

Contrarily, Web 3.0 is the subsequent iteration of the internet and is distinguished by a concentration on decentralized technologies like blockchain, the semantic web, and artificial intelligence. Information and data are

anticipated to be more connected and readily available in this new era, and the internet is developing more intelligence and responsiveness to human needs. Due to the distinctive characteristics and features of this brand-new internet era, new marketing approaches and strategies are beneficial in Web 3.0. For instance, Web 3.0 technologies like blockchain present fresh chances for companies to boost transparency and customer confidence. Artificial intelligence technologies can also be utilized to customize marketing communications and develop more specialized campaigns (PEYRAVI et al.).

The degree of control individuals have over their data is one of the main distinctions between Web 2.0 and Web 3.0. In Web 2.0, consumers frequently had to give up ownership of their data to gain access to various online services (Geeksforgeeks, 2022). However, Web 3.0 gives users greater control and transparency over how they manage their data, creating new chances for businesses to win over customers' trust.

The degree of decentralization is another significant distinction between Web 2.0 and Web 3.0. The internet was primarily controlled by a small number of powerful businesses in Web 2.0, but in Web 3.0, the internet has become more decentralized, giving people more control over their personal information and the opportunity to use decentralized networks and platforms.

In conclusion, the shift from Web 2.0 to Web 3.0 represents a significant step forward in the development of the internet and offers marketers both new chances and difficulties. Businesses may develop more specialized, individualized marketing campaigns and forge better connections with clients by utilizing the distinctive characteristics and possibilities of Web 3.0 technology.

Research Methodology

The investigation of Web 3.0 marketing techniques and the advantages that firms can reap from moving from Web 2.0 to Web 3.0 will be conducted using only secondary data as the basis for the research approach. This research will be performed using the following procedures:

Secondary data is gathered from a range of sources, including scholarly journals, business reports, web articles, and blogs. Keywords like "Web 3.0," "marketing tactics," "benefits of transitioning from Web 2.0 to Web 3.0," and other related terms will be used in an online search to gather the data.

Conceptual understanding of Web 3.0 marketing

Several firms have experienced a significant change in their marketing approaches and strategies as a result of the internet's progression from Web 1.0 to Web 3.0. Web 3.0 is centered on interaction and teamwork between people and technology, giving pertinent customer data that aids digital marketers in improving their targeting and creating individualized experiences. Gartner reports that 63% of digital marketing leaders have difficulty providing tailored experiences, which can be enhanced by utilizing Web 3.0. ("What Is Web 3.0, and How Does It Impact Digital Marketers?")

Web 3.0 is characterized by semantics and is based on three essential components: Web 2.0 apps, artificial intelligence, and the semantic web. It enables users to enjoy a more beneficial experience on an intelligent web. While Web 2.0 apps provide user-generated information and social networking, the semantic web offers structured data that is simple for machines to process. Machines can learn from user behavior

and offer individualized recommendations thanks to artificial intelligence. E-marketing is quickly changing how businesses interact with their clients. In the era of Web 3.0, marketing tactics enable businesses to better understand their customers, engage with them and advertise their goods, services, businesses, and brands. Using A.I. technology in marketing enables organizations to employ predictive analytics to foresee the requirements and preferences of their customers.

In essence, Web 3.0 has ushered in a new era of marketing tactics that emphasize communication and cooperation between users and technology. It offers pertinent client data that aids digital marketers in fine-tuning their targeting and delivering individualized experiences. Using A.I. technology in marketing enables organizations to employ predictive analytics to foresee the requirements and preferences of their customers. With the emergence of Web 3.0, marketing techniques are shifting in tandem with the fast-moving technological environment. To take advantage of the prospects presented by this new Internet era, we will examine the focus of marketing in Web 3.0.

The key focus of web 3.0 marketing

- **Technological Advancements:** Web 3.0 is the next stage in the development of the internet, and it is fueled by several novel technologies that are revolutionizing how we use the internet. The Internet of Things (IoT), blockchain, and artificial intelligence (AI) are three of the major technologies advancing Web 3.0 (Guide and Jha). Blockchain technology is a decentralized ledger system that makes it possible to distribute and verify data and information anonymously and securely.

Blockchain makes it possible to build decentralized systems, like cryptocurrency exchanges, which removes the middlemen and boosts trust and transparency in online transactions. Web 3.0 is being developed as a result of AI and machine learning, which give users a more customized and automated web experience. Websites and applications may evaluate user behavior and target marketing campaigns using AI and machine learning technologies, resulting in more relevant and individualized suggestions. The Internet of Things (IoT) is the term used to describe the expanding network of interconnected gadgets and sensors that are increasingly incorporated into our daily life. By enabling a more connected and seamless web experience, wherein devices and sensors can communicate with each other and with people in real-time, IoT is driving the development of Web 3.0.

- **Decentralized Web:** The decentralized web is a radical concept in web architecture that seeks to give users a more private, dependable, and secure web experience. The decentralized web is based on a decentralized network of nodes, where data is stored and processed by various nodes in a dispersed way, in contrast to traditional web platforms, which are centralized and controlled by a small number of organizations and institutions. A major advantage of the decentralized web is that it is more private and secure (Shou). Due to the fact that all data is held on centralized servers that are simple targets for malicious hackers, traditional web platforms are susceptible to cyberattacks and data breaches. In contrast, the decentralized web uses

distributed ledger technology (such as blockchain) and encryption to ensure that data is secure and difficult to steal or hack. The lack of the necessity for middlemen, such as social media platforms and search engines, to handle and control user data is another benefit of the decentralized web. Users can now decide when and how to disclose their personal information, giving them greater control over it.

- **Data Privacy and Security:** Web 3.0's heightened emphasis on data security and privacy has important ramifications for marketing plans. Customers are increasingly looking for platforms and services that prioritize privacy and security as they become more conscious of how their data is used and shared. In the Web 3.0 era, marketers must be open and honest about how they gather and use customer data. They also need to offer crystal-clear opt-in and opt-out mechanisms. This necessitates a change away from conventional data-driven marketing techniques, which depend on the gathering and analysis of enormous amounts of consumer data, and towards more privacy-focused tactics that put the trust and participation of customers first. Prioritizing the usage of first-party data—information gathered directly from customers—is one method for privacy-focused marketing. Because customers willingly gave information, this type of data is typically regarded as being more secure and trustworthy. It can also be more accurate and relevant because it reflects the consumer's actual habits and preferences. Another strategy is to concentrate on creating marketing technologies, such as chatbots and AI-powered marketing platforms, that put

privacy and security first. The requirement for storing and processing huge volumes of data can be decreased by using these technologies to engage with customers in a more personalized and secure way.

- **Consumer Behaviour:** Consumers' demands and complexity in their online interactions are increasing as a result of Web 3.0, which is causing substantial changes in consumer behavior. Marketers must be aware of these changes to effectively connect and engage with consumers in the Web 3.0 era and adjust their strategies accordingly. Web 3.0 has also resulted in a trend toward experiences that are more relevant and individualized. Customers are looking for platforms and services that provide these personalized experiences because they want to receive content and recommendations that are catered to their unique tastes and behaviors. By utilizing tools like AI and machine learning to give customers more relevant and individualized experiences, marketers can profit from this trend.
- **Personalization:** Web 3.0 places a strong emphasis on personalization since users want more tailored and relevant online experiences (Canorea). Content, experiences, and recommendations are personalized to reflect each individual's distinct interests and habits. Delivering the appropriate message to the appropriate individual at the appropriate time allows for more targeted and successful marketing campaigns. Marketing professionals can create tailored marketing strategies that are more likely to connect with their target audience and result in conversions by leveraging

data and technology to understand customer preferences and behaviors. Using AI and machine learning algorithms is one method that personalization can be incorporated into Web 3.0. With the help of these technologies, marketing information and experiences may be personalized in real-time by looking for patterns and preferences in customer data. An e-commerce site, for instance, can utilize AI algorithms to tailor product recommendations based on a user's previous purchases and browsing patterns. Using chatbots and other conversational interfaces is another option to incorporate personalization in Web 3.0. By offering suggestions and responses based on each customer's unique tastes and behaviors, chatbots can communicate with customers in a more personalized and relevant way. In comparison to conventional marketing strategies, this kind of contact has the potential to be more successful in reaching and converting consumers. It may also be utilized to increase consumer involvement and trust.

- **Customer Engagement:** Technologies like virtual reality and augmented reality are becoming major characters in the Web 3.0 era and have a lot of potentials to boost client engagement. With the use of these technologies, marketers can produce immersive, engaging, and cutting-edge customer engagement experiences. A fully immersive digital environment is created by virtual reality (VR), allowing users to interact with goods and services in a fun and realistic way. Customers can use virtual reality (VR) to try on garments and see how they fit or to browse a car's virtual showroom before making a purchase, for

instance. Marketing professionals may use virtual reality (VR) to design experiences that are more captivating and memorable, which can boost client satisfaction and brand loyalty. Similar to virtual reality (VR), augmented reality (AR) adds digital components to the real world rather than building an entirely virtual one. Customers can use augmented reality (AR) to examine how things will seem in their actual surroundings, such as how furniture will fit in their living room or how makeup will look on them. Marketers may use augmented reality (AR) to build experiences that are more relevant and individualized, which can boost customer engagement and enhance conversions. In addition to VR and AR, other Web 3.0 technologies like blockchain, artificial intelligence (AI), and the Internet of Things (IoT) also have a great deal of potential for boosting user engagement. Blockchain, for instance, may be used to design safe, transparent, and secure consumer reward schemes, while AI can be utilized to offer clients individualized guidance and assistance.

Main pillars of web 3.0 marketing strategies

- **Influencer Marketing:** As customers increasingly rely on social media and online communities for recommendations and information, influencer marketing is expanding quickly in the Web 3.0 era. Influencer marketing entails collaborating with people who have a sizable and active online following in order to market goods and services to their subscribers. Influencer marketing differs significantly from conventional types of advertising in

several important ways. First of all, because the influencer's followers trust their advice and ideas, influencer marketing is more natural and real. (Danise, 2022.) Because traditional types of advertising are frequently regarded as being more impersonal and unreliable, influencer marketing is a more efficient way to reach and interact with consumers. Furthermore, because influencers frequently specialize in a certain field or industry, influencer marketing enables a more focused and pertinent reach. A travel influencer might have a huge fan base of people interested in adventure and travel, as opposed to a beauty influencer, who might have a large fan base of people interested in skincare and cosmetics. Marketers may connect with a highly relevant and engaged audience that is more likely to convert by collaborating with the appropriate influencer. Finally, because collaborating with influencers is often less expensive than other forms of advertising, influencer marketing can be more cost-effective than traditional advertising. Influencer marketing is also frequently associated with increased engagement and conversion rates, making it a more economical method of reaching and engaging consumers.

- **Virtual and Augmented Reality:** Web 3.0 marketing tactics can make use of the potent technologies of virtual reality (VR) and augmented reality (AR) to provide customers with immersive and engaging experiences. Businesses may develop virtual product demos that let buyers experience things before they buy using VR and AR. (“Augmented Reality Marketing: A Technology-Enabled Approach to Situated Customer

Experience”) Customers may be more satisfied as a result and can make more educated purchases. Businesses may employ VR and AR to develop immersive advertising experiences that draw in customers and raise awareness of their brands. A fashion firm might employ AR to let customers virtually try on clothing, or a car manufacturer would use VR to provide a virtual test drive experience. Businesses may build virtual events that attendees can join from any location using VR and AR. This may be a useful strategy for expanding your audience and increasing brand recognition. Businesses may also develop virtual brand experiences with VR and AR that let people interact with a brand in fresh and original ways. A gaming company could employ VR to create a virtual gaming experience, or a beauty brand could use AR to let clients virtually experiment with makeup. Lastly, VR and AR can be used by businesses to teach clients how to use their goods or services. This can lower the price of customer support while improving customer satisfaction.

- **Tokenized Marketing:** Tokenized marketing is a cutting-edge marketing strategy that uses blockchain technology to reward and motivate people for engaging with a business. Companies can rely upon tokenized marketing because they can design token-based incentive schemes to encourage patrons to interact with their brands. Customers might get tokens, for instance, by making purchases, sharing content, or offering comments. Businesses can design referral programs that offer rewards to clients who recommend their friends and family to the company. By doing this, businesses can increase brand

recognition and reach new audiences. Companies can design programs that reward customers for sticking with their brand (Heines et al.). This can aid businesses in retaining clients and boosting client lifetime value. Tokenized marketing can help businesses gamify

their marketing initiatives. For instance, businesses may design games that offer prizes to users who complete tasks or interact with the brand in specific ways.

Use case of Web 3.0 adoptions

Industry	Parameters		
Fashion & Beauty	<p>Try-On Experiences: Companies like <i>Sephora</i> (“Sephora Virtual Artist: Try On Makeup Instantly”) and <i>MAC Cosmetics</i> (“Try Makeup Online + Virtual Try-On M·A·C Cosmetics”) are adopting virtual reality (VR) technology to let shoppers virtually try on clothing and accessories. This not only gives a level of personalization and relevance that is not feasible with conventional marketing techniques, but it also makes purchasing more immersive and participatory.</p>	<p>Personalized Product Recommendations: Artificial intelligence (AI) and machine learning are being used by businesses like Birchbox and Sephora to generate personalized product suggestions based on consumer interests and behavior. Due to its transparency and security, this not only improves the user experience but also fosters brand loyalty.</p>	<p>Decentralized Supply Chain Management: Blockchain technology is being used by businesses like <i>VeChain</i> (“Web3 for Better”) and Provenance (“Blockchain: the solution for supply chain transparency”) to build an open and secure supply chain management system. Being transparent and secure, not only improves productivity and lowers expenses, but also fosters brand loyalty and trust.</p>
Gaming	<p>Virtual Reality (VR) Gaming: Virtual reality (VR) technology is being used by businesses like Oculus and PlayStation to offer incredibly immersive and interactive gaming experiences. This not only improves the game experience and adds a level of relevance and personalization that is not feasible with conventional gaming techniques.</p>	<p>Decentralized Gaming Platforms: Blockchain technology is being used by businesses like Enjin (“Enjin Whitepaper”) and The Sandbox (“The Sandbox SAND whitepapers”) to build decentralized gaming platforms that let users own and exchange virtual goods. In addition to making the game experience more dynamic and entertaining, this also offers a level of security and transparency.</p>	<p>In-Game Advertising: Artificial intelligence (AI) and machine learning are being used by businesses like Unity and AdColony to make in-game advertising more relevant and tailored.</p>

<p>Decentralized content platforms</p>	<p>Decentralized Social Media Platforms: Decentralized social media platforms are being developed by businesses like Steemit (“Steem Whitepaper — Steemit”) and Minds (“THE CRYPTO SOCIAL NETWORK minds.com minds.org”) that enable users to own and manage their content and data.</p>	<p>Decentralized Content-Sharing Platforms: Decentralized content-sharing platforms are being developed by businesses like Filecoin (“A Decentralized Storage Network”) and IPFS (“Content Addressed, Versioned, P2P File System (DRAFT 3)”) that enable users to share and access content in a secure and open manner. Users benefit from increased privacy and security, and a more effective and affordable content distribution network is also made possible by it.</p>	<p>Decentralized Marketplaces: Decentralized marketplaces are being developed by organizations like Cryptopunks to enable users to trade goods and services in a safe and open environment. In addition to giving users more privacy and security, this also improves the marketplace and lowers costs.</p>
<p>Automobiles</p>	<p>Virtual Reality Showrooms: Companies like BMW (“BMW Apps: Virtual & Augmented Reality”) and Audi are utilizing virtual reality (VR) technology to build virtual showrooms that let customers explore and experience their items in a very immersive and engaging way. This not only improves the consumer experience but also offers a level of relevance and customization that is not attainable with conventional marketing techniques.</p>	<p>Unique Product Recommendations: Companies like Tesla are developing personalized product suggestions based on client preferences and behavior using artificial intelligence (AI) and machine learning.</p>	<p>Integrated Vehicles: Organizations like Tesla and BMW are utilizing the Internet of Things (IoT) to develop connected cars that can gather and analyze data in order to enhance customer experience, vehicle safety, and efficiency.</p>

These examples demonstrate the potential advantages of Web 3.0 marketing techniques. Web 3.0 marketing techniques can improve customer experiences by being more relevant, personalized, and engaging while also fostering brand loyalty. Companies must make sure that they are utilizing these technologies in a responsible and compliant manner because these strategies also introduce additional ethical and regulatory challenges.

Major Findings and observations

According to the results of a study, Web 3.0 represents a significant change in how businesses approach marketing. Companies now have access to new tools and technology that enable them to develop more specialized and successful marketing campaigns thanks to the emergence of blockchain, AI, and the Internet of Things (IoT). With a decentralized, privacy-focused, and user-driven approach, Web 3.0 marks a huge change in how the internet functions and will have a big impact on marketing. Marketing techniques will be increasingly influenced by decentralized technologies, such as blockchain and decentralized finance, which will open up new channels for interacting with and engaging consumers. Web 3.0's growing use of virtual and augmented reality technology will give marketers new chances to develop engaging and interactive customer experiences.

One of the main findings of the research is that Web 3.0 gives more importance to data security and privacy. Companies must be careful to make sure they are using this data in an ethical and responsible manner given the increased amount of data being collected and retained nowadays. This necessitates a greater emphasis on data privacy rules and the ethical application of AI. Consumers will place a greater value on privacy

and data control in the Web 3.0 era, therefore marketers will need to come up with fresh strategies for winning over consumers' trust and respect.

Another important finding of the study is that Web 3.0 is influencing customer behavior. Customers are getting more sophisticated and conscious of the information that is being gathered on them, and they are increasingly seeking out brands that are open and reliable. In the Web 3.0 era, businesses that can give customers more control over their data are likely to do better. The emergence of Web 3.0 will put traditional marketing approaches to the test, necessitating the constant learning and innovation of marketers to stay up with the ever-changing technological landscape. To fully exploit the potential of the new marketing era, it will be necessary to examine and comprehend the impact of Web 3.0 on the larger marketing ecosystem, including the role of intermediaries and platforms. In the Web 3.0 era, ethical factors such as the use of decentralized technology to reach clients and foster trust will become more crucial in determining marketing strategies.

Suggestions

As for suggestions, the research recommends businesses concentrate on developing customer trust and openness. This can be accomplished through a variety of tactics, such as:

- giving clients more control over their data
- being open and transparent about the data being gathered and the purposes for which it is being utilized
- putting money towards the creation of innovative technologies that can assist in safeguarding client data
- Being aware of the rules and legislation governing data privacy.

According to the research, Web 3.0 represents a significant change in how businesses approach marketing. Companies now have access to new tools and technology that enable them to develop more specialized and successful marketing campaigns due to the emergence of blockchain, AI, and the Internet of Things (IoT).

The research points to the Web 3.0 age as a significant opportunity for businesses to enhance their marketing approaches and attract new customers. However, it also calls for businesses to be conscious of the moral and legal issues that are connected to this new marketing period. Businesses that can overcome these obstacles and successfully use the new technology and tools at their disposal will be well-positioned to prosper in the Web 3.0 era.

Conclusion

Web 3.0 offers new potential for marketing and customer engagement and signifies a significant change in how the internet functions. Decentralized technology, like blockchain and decentralized finance, will be a major influence on how marketing tactics are developed in this new era. Marketers will need to develop fresh strategies to win clients' confidence and credibility through openness and moral behavior. Additional chances for immersive and interactive customer experiences will be made possible by the expanding use of virtual and augmented reality technologies. Marketers will need to be adaptable, creative, and always learning to stay up with the quickly changing technological landscape in order to win in the Web 3.0 era.

In order to reach and engage with customers, marketing tactics must adapt to the new Web 3.0 paradigm and embrace the use of decentralized technologies, such as blockchain and

decentralized finance. Through transparency, ethics, and pertinent content, marketers must discover new ways to establish credibility with customers as they have more control over their data and privacy. Web 3.0's expanding usage of virtual and augmented reality technology will also give marketers new chances to develop engaging and interactive customer experiences. Since the technology landscape is rapidly changing, marketers need to be adaptable, creative, and always learning if they want to compete in the Web 3.0 era.

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Big Data Security: Information Security Architecture for Big Data Security

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ABSTRACT

Information security has a significant impact on big data. Big data is distinguished by its volume, veracity, value, velocity, and variety, which creates unique challenges for securing it. One of the biggest challenges is the utter volume of big data. Traditional security solutions often need help to scale to meet the needs of big data environments. This makes it difficult to detect and respond to threats to security in real-time. Another challenge is the velocity of big data. Big data is constantly being generated and processed, which makes it challenging to keep up with the latest security threats. Finally, the variety of big data poses its challenges. Big data can come from various sources, including internal systems, external systems, and social media. This diversity of data sources makes it difficult to develop a comprehensive security strategy. Information security can help address the challenges of big data in several ways. First, information security can help to protect the confidentiality of big data. This is important because big data often contains sensitive information, such as personally identifiable information (PII) and financial data. Second, information security can help to protect the integrity of big data. This is important because big data is often used to make crucial decisions, such as business decisions and medical decisions. Finally, information security can help to protect the availability of big data. This is important because big data is often used to support critical business operations. This research paper has effectively outlined the concept of big data, Significance of Information Security on Big Data, Big Data Challenges to Information Security & Privacy, Security Measures and Strategies, case study of PRIVATALK, and Big Data Security Future Direction.

Keywords: Big Data, Information security, privacy, security

Introduction

These days, we practically always hear the term "big data" in our daily lives. This term dates back to circa 2005 and describes a broad variety of huge data sets whose size and complexity make them nearly difficult to handle and process with conventional data management methods. Big

Data is used in business and finance, where vast amounts of data are exchanged daily between computerized systems and stock exchanges, banks, online retailers, and onsite purchasers. This data is then collected and stored for use in inventory tracking, consumer behavior analysis, and market research. Every two years, the

amount of data that has to be analyzed is anticipated to double. Many sources, such as social media, sensors, scientific applications, surveillance, video and picture archives, Internet search indexing, medical records, corporate transactions, and system logs, provide these frequently unstructured data. Big data is becoming more and more popular as the number of devices linked to the so-called "Internet of Things" continues to rise to unanticipated heights, generating vast volumes of data that must be converted into insightful knowledge. The volume of data that has to be examined is expected to increase every two years. These usually unstructured data come from a variety of sources, including social media, sensors, scientific applications, surveillance, photo and video archives, Internet search indexing, medical records, business transactions, and system logs. With the number of devices connected to the so-called "Internet of Things" reaching previously unimaginable heights and producing enormous amounts of data that need to be transformed into meaningful information, big data is growing in popularity. Big Data is expanding with the help of public clouds, and conventional security solutions are adjusting to private computing architectures, restricted by a clearly defined security perimeter akin to that of ineffective firewalls. Security operations must operate across the heterogeneous composition of various hardware, operating systems, and network domains using Big Data. Software-defined networking's (SDN) abstraction capability is a crucial feature in this kind of computing environment that solves riddles and makes it possible to implement safe Big Data services on top of heterogeneous architecture in an effective manner.

Objectives of study

- To study and understand the concept of big data.
- To study the importance of information security within the realm of big data.
- To understand the challenges posed to information security and privacy by big data.
- To describe the security measures and future directions for big data.

Conceptual understanding of Big Data

Big data is an evolving term that describes any huge amount of structured, semi-structured, and unstructured data that has the potential to be mined for information.

The 5Vs that define Big Data are Variety, Velocity, Variety, Value, and Volume-

- **Volume:** There has been an exponential growth in the volume of data being dealt with. Data is not just in the form of text data but also in the form of videos, music, and large image files. Data is now stored in terms of Terabytes and even Petabytes in different enterprises. With the growth of the database, we need to re-evaluate the architecture and applications built to handle the data.
- **Velocity:** Information is arriving at a never-before-seen rate and needs to be processed quickly. RFID tags, sensors, and smart metering are driving the need to cope with torrents of data in near-real time. Most businesses struggle to respond fast enough to handle the velocity of data.
- **Variety:** Data can be presented in different varieties; it can be in structured, semi-structured, or unstructured formats.
- **Veracity:** Veracity states the reliability and

quality of data, which is crucial in making informed decisions.

In addition to these specific technologies, information security involves developing and implementing security policies and procedures. Big data should be protected from unauthorized access, modification, and destruction through the use of these policies and procedures. Overall, information security plays an essential role in protecting big data. It is possible for organizations to ensure the security of their big data by implementing the appropriate security measures.

Significance of Information Security on Big Data

- **Data privacy and compliance:** Big data frequently involves the collection and processing of vast quantities of sensitive information. Understanding the impact of information security is pivotal for ensuring compliance with data security regulations and securing individuality sequestration.
- **Prevention of data breaches:** Information security measures are essential in precluding unauthorized access, data breaches, and cyber-attacks. Studying the impact helps identify susceptibility and implement effective security strategies to guard valuable data assets.
- **Maintain data integrity:** Information security plays an overcritical part in maintaining the delicacy and reliability of data. Ensuring data veracity is crucial for making informed decisions and avoiding the dispersion of false or deceiving information.
- **Addressing Evolving Threats:** Cyber threats and attack vectors continuously evolve. Studying the impact of information

security on big data helps associations to stay ahead of arising threats, adapt security measures accordingly, and conserve a visionary cybersecurity posture.

- **Easing collaboration and sharing:** Associations frequently collaborate and share data within and across industries. A robust information security structure provides secure data sharing and cooperative initiative while guarding sensitive information from unauthorized access and abuse.

Big Data Challenges to Information Security & Privacy

The exponential growth of interconnected devices generates a colossal data flow, posing unknown information security challenges. Traditional border-based security results like firewalls and DMZs prove inadequate within these evolving trends. The ever-increasing user and data mobility, driven by BYOD (Bring Your Own Device) policies, necessitates extending security beyond organizational networks.

This raises a pivotal question...

What security and privacy policies and technologies best address the rising requirements of Big Data in light of these new scenarios?

To gain further sapience, we can structure these challenges into four crucial Big Data aspects.

- **Infrastructure Security:** This encompasses ensuring secure distributed computations instanced by MapReduce.
- **Data Privacy:** Addressing Privacy-conserving data mining ways and granular access control mechanisms.
- **Data Management:** Guaranteeing secure data provenance and storage results.

- **Integrity and Reactive Security:** Enforcing real-time anomaly and attack discovery measures.

Further analysis reveals a set of critical threat areas within Big Data

- **Information Lifecycle:** Comprehending data provenance, ownership, and classification.
- **Data Creation and Collection:** checking implicit vulnerabilities in data capture processes.
- **Lack of Security Procedures:** Addressing the absence of robust data security protocols.

Despite these challenges, the fundamental objectives of Big Data security remain constant – safekeeping, confidentiality, integrity, and availability. Still, achieving these pretensions necessitates new approaches acclimatized to the unique demands of this data-driven paradigm.

The essential complexity and hugeness of Big Data necessarily generate critical security and privacy concerns. Six distinct characteristics – Variety, Volume, Velocity, Value, Variability, and Veracity (Fig: 1) uniquely define Big Data and significantly influence information security. These complications pose substantial challenges for designing security results that effectively address all these angles and conditions. However, such an out-of-the-box solution for securing big data remains fugitive.



(Fig-1)

Security Measures and Strategies

The rise of big data presents a double-edged sword, with immense possibilities for innovation and perceptivity alongside a tidal surge of security and privacy concerns. Traditional security measures designed for small, static data sets falter in the face of Big Data's massiveness, velocity, and variety. So, how do we navigate this complex landscape, ensuring the safety and security of Big Data without hindering its potential?

Understanding the Threats Before diving into results, we must identify the lurking risks. Big Data faces different threats, including:-

- **Data Breaches:** Hackers are targeting sensitive information within Big Data systems.
- **Privacy Violations:** - Improper data collection, operation, or sharing compromises individual Privacy.
- **Insider Threats:** Violent actors within associations are exploiting Big Data access.
- **Data Manipulation:** Tampering with data for particular gain or misinformation campaigns.
- **Building a Secure Foundation:** - A robust security posture forms the bedrock of any effective strategy.

This foundation includes

- **Data Governance:** Enforcing clear policies and procedures for data collection, storage, access, and disposal.
- **Access Control:** Granular control over who accesses what data, grounded on the "least honor" principle.
- **Data Encryption:** Encryption at rest and in ride to render data unusable in case of a breach.

- **Network Security:** strengthening firewalls, intrusion detection systems, and other network defenses.
- **Regular Security checkups and Penetration:** Testing proactively relating and doctoring vulnerabilities.
- **Embracing Privacy-Enhancing Techniques:** Beyond traditional security, privacy-enhancing ways to protect individual Privacy within Big Data.

Some of the techniques are mentioned below-

- **Data Anonymization and Pseudonymization:** Replacing personally identifiable information with non-identifiable alternatives.
- **Differential Privacy:** Adding statistical noise to data for analysis without revealing individual details.
- **Secure Multi-Party Computation:** Allowing data analysis without revealing underlying data to any single user.
- **Federated Learning:** Training machine-learning models on decentralized datasets without pooling all data together.
- **Continuous Vigilance:** Security is not a one-time fix but an ongoing process.

This Vigilance includes

- **Security mindfulness Training:** Educating employees on data security best practices to minimize insider threats.
- **Real-time exception detection:** Continuously cover data for suspicious activity to identify and thwart attacks.
- **Incident Response Planning:** Having a well-defined plan to respond to and mitigate data breaches or security

incidents.

- **Staying Updated on Evolving Threats:** Continuously conforming defenses to address the latest security threats.
- **Leveraging Technological Advancements:** Arising technologies offer promising results for

Big Data security and Privacy: Some of the well-known solutions are:

- **Blockchain:** - Distributed ledgers can enhance data provenance and tamper-proof auditing.
- **Homomorphic encryption:** Enables calculations on encrypted data without decryption, conserving Privacy.
- **Secure Enclaves:** insulated hardware environments for recycling sensitive data without exposing it to the broader network.
- **Holistic Vision for Security:** Big Data projects require a holistic vision for security, considering some factors, which are:
- **Data Source Identification:** Understanding the origin and generators of data.
- **Data Classification:** Identify critical data and align it with organizational security policies.
- **Security Mechanisms at the Data Source:** Enforcing security controls closer to the data itself, including data leakage prevention and access control.
- **Trustful Data Provenance across Domains:** Establishing a secure chain of custody for data across different surroundings.

Therefore, we can navigate the Big Data Ocean with self-assurance by understanding the threats, building a secure foundation, embracing privacy-enhancing techniques, and staying vigilant. Through a holistic approach that leverages emerging technologies and considers security from the ground up, we can harness the vast potential of big data while securing the Privacy and security of individuals and organizations. Securing the Big Data frontier is not a destination but a continuous journey. By constantly adapting and innovating, we can ensure that this data-driven future remains a safe and prosperous one for all.

Here are some specific examples of how information security can be used to protect big data:

- **Data encryption:** Data encryption can be used to safeguard big data at rest and in transit. This makes it difficult for barred individuals to access the data.
- **Access control:** Access control can be used to restrict who has access to big data. In this way, unauthorized users cannot access the information or modify the data.
- **Auditing:** - Auditing can be used to track who has accessed big data and what they have done with it. This helps to detect and investigate security incidents.
- **Security monitoring:** Through security monitoring, threats can be detected and responded to in real-time. This is important because big data is constantly being generated and processed.

Case Study: On A Secure Social Application-
PRIVATALK



Introduction

In today's digital age, social media platforms have become an integral part of our lives. However, concerns regarding data privacy and security have also risen significantly. Users are increasingly wary of how their personal information is collected, used, and shared. Recognizing this growing need for a secure social platform, PrivaTalk emerged as a revolutionary app built on the pillars of Privacy and user control.

Challenges

Traditional social media platforms face several challenges related to user privacy:

- **Data Breaches:** Sensitive user data is often vulnerable to hacks and leaks, exposing users to financial and reputational risks.
- **Targeted Advertising:** Platforms collect vast amounts of user data to personalize ad targeting, raising concerns about data exploitation and manipulation.
- **Limited Control:** Users often have limited control over how their data is used and shared, creating a sense of unease and vulnerability.

(Overview of the architecture
Integrated with the rights
Management system)



PrivaTalk's Solution

PrivaTalk addresses these challenges through a unique set of features that prioritize user privacy and security

- **End-to-End Encryption:** All communication on PrivaTalk, from messages to posts, is encrypted from sender to receiver, ensuring only accredited persons can access the content.
- **Zero Data Storage:** Unlike traditional platforms that store user data on central servers, PrivaTalk utilizes peer-to-peer technology, meaning data is never stored on any centralized server, minimizing the risk of breaches.
- **Pseudonymous Identities:** Users can create accounts with pseudonyms instead of real names, providing an extra layer of anonymity and Privacy.
- **Decentralized Governance:** PrivaTalk operates on a decentralized blockchain network, empowering users to have a say in the platform's development and governance.

Impact and Results

PrivaTalk's focus on Privacy has resonated with

a growing user base concerned about online security. The platform has seen significant growth in recent years, attracting users who value:

- **Peace of Mind:** Knowing their data is secure and not being targeted by intrusive advertising provides users with a sense of comfort and control.
- **Open and Honest Communication:** The secure and anonymous environment fosters more open and honest communication between users.
- **Empowerment:** The decentralized nature of the platform gives users a sense of ownership and participation in the platform's future.

Challenges and Future Outlook

Despite its success, PrivaTalk faces challenges

- **Scalability:** Maintaining a decentralized network while ensuring smooth performance for a large user base can be complex.
- **User Adoption:** Encouraging widespread adoption of a new social platform in a market dominated by established players requires continuous innovation and community engagement.

However, PrivaTalk's commitment to user privacy and its innovative approach position it well for the future. The growing demand for secure online spaces and the increasing awareness of data privacy issues suggest that PrivaTalk has the potential to become a significant player in the social networking landscape.

Concluding remarks for PrivaTalk

PrivaTalk stands as an exciting case study illustrating the positive issues that stem from a devoted focus on user privacy within the realm of social media platforms. Through the deliberate prioritization of user control and security, PrivaTalk has managed to distinguish itself in the competitive geography of social media. This success not only underscores the platform's impact but also provides precious perceptivity into a prospective future where privacy and communication are seamlessly associated.

At the core of PrivaTalk's success is its commitment to placing user privacy at the forefront of its design and functionality. By affording users a heightened degree of control over their particular information and relations, PrivaTalk has successfully navigated the challenges posed by saturated social media requests. The platform's emphasis on security has not only reverberated with users but has also deposited PrivaTalk as a lamp of responsibility in a period where data privacy concerns are paramount.

In this complex case study, PrivaTalk serves as an antecedent for social media platforms seeking to thrive by aligning with user-centric principles. The platform's capability to sculpt out a distinctive niche speaks to the growing demand for privacy-focused results in the digital geography. As PrivaTalk continues to flourish, it offers a compelling narrative of how the delicate balance between Privacy and communication can be achieved, furnishing a roadmap for unborn developments in the ever-evolving social media geography.

Big Data Security: Future Direction

Throughout this research paper, it was possible

to present some of the most critical security and privacy challenges that affect Big Data projects and their specificities. Big Data's unique qualities render information security methods, processes, and tools—which are currently in place to safeguard the ecosystem's security and privacy—ineffective if not applied in an integrated fashion. In addition, this paper offers some remedies to these problems; however, it does not offer a comprehensive solution. Instead, it makes some recommendations for approaches and tools that could help address some of the most pressing and difficult problems related to Big Data security and privacy.

As noted throughout this research paper, although some important steps are being taken toward solving Big Data security and privacy issues, there is still a long road ahead.

The creation of data (as well as the Big Data sources, which include devices), data storage and transit, data translation and processing, and data utilization are the main areas of research challenge in this Big Data ecosystem. To support this lifecycle, a high capacity, and highly distributed architecture will be necessary, exposed to a hostile environment subject to all kinds of attacks. The SDN approach, as proposed in this chapter, is a possible solution to counter these threats. However, further research needs to be conducted, in particular on what concerns the automatic adaptation of switching and behavior-based security policies.

Big Data is changing the way we perceive our world. The impact big data has created and will continue to produce can ripple through all angles of our lives. Global data is on the rise; by 2028, we will have quadrupled the data we induce every day. This data would be generated through a wide array of sensors we're continuously incorporating into our lives. "Internet of Things" would back data collection.

Through the use of smart bulbs in smart cars, everyday devices are generating more data than ever. These smart devices are incorporated not only with detectors to collect data around them but are also connected to the grid, which contains other devices. Today, a Smart Home consists of an all-encompassing architecture of devices that can interact with each other via the vast internet network. Bulbs that shroud automatically backed by ambient light sensors and cars that can glide through heavy traffic using propinquity sensors are exemplifications of sensor technology advancements that we have seen over time. Big Data is also having changing effects on the business world. Companies are using extensive data analysis to target marketing at particular demographics.

Scientific experiments and simulations can quickly produce petabytes of data today. Much of this data is of no interest and can be filtered and compressed by orders of magnitude. Big Data has an immense scope, including a vast scope for research and development.

Conclusion

The vast potential of Big Data is inarguable, offering perceptivity and possibilities that were formerly unimaginable. Still, this data-driven revolution has its challenges, particularly in information security and Privacy. As this research paper has explored, the unique characteristics of Big Data- its volume, velocity, variety, and value- demand new approaches to securing and safeguarding sensitive information. Traditional security results falter in the face of the complexity of big data. Addressing this gap requires a multi-pronged approach integrating robust technological results with comprehensive policies and user-centric practices. From enforcing end-to-end encryption and decentralized infrastructures to

embracing privacy-enhancing techniques and fostering a culture of security mindfulness, the responsibility lies with both associations and individualities. Continuous alert, adaptation to evolving threats, and cutting-edge technologies like blockchain and homomorphic encryption are pivotal in establishing a secure Big Data ecosystem. The path forward lies in striking a sensitive balance between invention and trust. By prioritizing user privacy and control, associations can harness the power of big data while minimizing pitfalls and fostering a future where individuals can confidently share in the data-driven world? While challenges remain, success stories like PrivaTalk, a social media platform erected on strong security principles, demonstrate the viability of ethical data practices and offer hopeful glimpses of a secure and prosperous Big Data future. Eventually, navigating the Big Data security geography requires a sustained commitment to exploration, collaboration, and invention. By working together, we can ensure that the immense potential of big data is realized responsibly and morally, shaping a digital world where security and Privacy go hand-in-hand.

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Study and analysis of financial performance of Oil and Natural Gas Corporation (ONGC) with ratio analysis

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ABSTRACT

This study aims to conduct a comprehensive ratio analysis of Oil and Natural Gas Corporation (ONGC), one of the leading players in the oil and gas industry. Ratio analysis is a fundamental tool for assessing a company's financial performance, liquidity, profitability, and overall health. By examining key financial ratios, including solvency, liquidity, efficiency, profitability, and market value ratios, this study seeks to provide valuable insights into ONGC's financial standing and performance. The analysis will involve comparing ONGC's ratios over a specified period, benchmarking them against industry standards, and potentially against competitors, to evaluate its financial strengths, weaknesses, and areas for improvement. Ultimately, this study aims to offer investors, stakeholders, and management a deeper understanding of ONGC's financial position and performance, facilitating informed decision-making.

Keywords- financial performance, ONGC, Liquidity ratio, profitability ratio, strength, weakness.

Introduction

Oil and Natural Gas Corporation (ONGC) is a prominent state-owned enterprise engaged in the exploration, production, and refining of oil and natural gas resources. With operations spanning across the globe, ONGC plays a pivotal role in meeting India's energy needs and contributes significantly to the country's economic growth. As a key player in the oil and gas sector, ONGC's financial performance and stability are of paramount importance to investors, stakeholders, and policymakers.

Ratio analysis is a useful tool used by analysts, investors, and executives to evaluate a company's financial health and performance. By

reviewing numerous financial ratios obtained from the company's financial statements, stakeholders may receive significant insights about the company's liquidity, solvency, profitability and market value. These insights aid in assessing the company's potential to satisfy its short- and long-term responsibilities, produce profits, optimise asset utilisation, and build shareholder value.

In this backdrop, the purpose of this study is to undertake a comprehensive ratio analysis of ONGC, with an emphasis on important financial ratios across many categories. The analysis will include calculating and interpreting liquidity ratios, solvency ratios, profitability ratios,

efficiency ratios, and market value ratios.

This research aims to give important insights into ONGC's financial performance, strengths, weaknesses, and opportunities for development by assessing its financial ratios over a certain period of time and measuring them against industry norms and, perhaps, rivals. The conclusions of this research can help investors, stakeholders, and management make better decisions about investment, strategic planning, and resource allocation.

Current scenario of Oil and gas industry in India

India's oil and gas industry represents a cornerstone of the nation's economy, profoundly impacting key economic sectors. As India's economic growth is intrinsically linked to its energy requirements, there is a burgeoning demand for oil and gas, making the industry increasingly appealing for investment. To meet this rising demand, the government has launched a number of programmes, including allowing 100% foreign direct investment (FDI) in industries like as refineries, natural gas, and petroleum products. Notably, India is the world's third largest oil user. The industry's market size is significant, with primary energy consumption estimated to nearly double to 1,123 million tonnes of oil equivalent by 2040, corresponding to a projected GDP rise of \$8.6 trillion. India is expected to become one of the greatest contributors to non-OECD petroleum consumption increase globally. In the fiscal year 2021-22, India's consumption of petroleum products reached 204.23 million metric tonnes (MMT), with high-speed diesel being the most used oil product. The oil and gas industry is categorized into three segments: upstream, midstream, and downstream. Upstream activities involve exploration and production,

characterized by high risks and substantial capital investment. Midstream activities focus on transportation, while downstream activities encompass refining and distribution. India's oil supply and demand exhibit an increasing trend, with high-speed diesel constituting the most consumed oil product, accounting for 38.84% of petroleum product consumption in the fiscal year 2021-22. Furthermore, the country's oil consumption is projected to rise significantly in the coming years. India's natural gas consumption is also anticipated to increase, driven by factors such as strong economic growth, urbanization, and supportive governmental policies. This thriving industry has attracted both domestic and international investments, indicated by the presence of major players such as Indian Oil Corporation Limited, Oil and Natural Gas Corporation (ONGC), Bharat Petroleum Corporation Limited (BPCL), Gas Authority of India (GAIL), and Hindustan Petroleum Corporation Limited (HPCL). These companies have significantly contributed to India's economic growth and have become vital sources of employment and commercial partnerships, exemplifying the industry's critical role in the nation's development and prosperity.

Company Overview

The Oil and Natural Gas Corporation (ONGC) is a cornerstone of India's energy security, with a substantial effect on the country's oil and gas exploration and production industries. The Government of India established ONGC in 1956, and it has grown into a critical public sector operation overseen by the Ministry of Petroleum and Natural Gas. ONGC, India's biggest crude oil and natural gas company, accounts for around 71% of India's domestic output. Its notable subsidiary, ONGC Videsh Ltd. (OVL), operates in 15 countries and ranks as the second-largest

petroleum company in India. ONGC holds the staggering distinction of discovering 7 out of the 8 oil and gas basins in India and has established 8.98 billion tonnes of in-place hydrocarbon reserves, with over 570 discoveries and ultimate reserves of 3.13 billion metric tons of oil plus oil equivalent gas (O+OEG). With a dedicated team of around 28,500 professionals, ONGC's operational efforts and achievements are truly remarkable. The company has consistently produced over 1.26 million barrels of oil equivalent per day, accounting for about 71% of India's domestic production, with over 76% of its produced crude oil being light and sweet. ONGC's subsidiaries such as ONGC Videsh Ltd., Mangalore Refinery and Petrochemicals Limited (MRPL), and Hindustan Petroleum Corporation Limited (HPCL) significantly contribute to the energy sector's overall growth and performance. ONGC's success story is profoundly founded in its ambition to become a worldwide leader in integrated energy via sustainable growth, knowledge excellence, and exceptional governance standards. The firm intends to capitalise on competitive advantages in research and development, instill high standards of business ethics and organisational principles, and strive for customer happiness via excellent goods and services. The company's SWOT analysis reveals its robust corporate and market share, successful marketing and business model, and organic expansion. However, it also uncovers weaknesses such as delayed bureaucratic decisions and limited market share growth, creating opportunities for global expansion, technological development, and potential threats in the form of changing crude oil prices and escalating competition. Overall, ONGC's extensive contributions to India's oil and gas industry and its ambitious strategic goals position the company as a pivotal player in the global energy landscape. This overview

encapsulates the essence of ONGC's colossal presence in the Indian oil and gas industry, its subsidiary entities, and the nuances of its operations, accomplishments, and future prospects. Should you require a more in-depth exploration or analysis of specific aspects, feel free to inquire further.

Objectives of the study

- To study and understand the concept of ratio analysis, its types, and the utility and benefits of ratio analysis in financial decision-making.
- To analyse the financial position of the Oil and Natural Gas Corporation.
- To understand the important aspects related to financial position like liquidity, turnover, profitability and leverage position.

Research methodology

The research methodology encompasses an exploratory design employed to delve into the financial status and creditworthiness of the Oil and Natural Gas Corporation. The study's objectives involve understanding the concept of ratio analysis, its types, and the utility and benefits of ratio analysis in financial decision-making. The study is primarily centered on an analysis of ONGC's annual reports spanning from 2018-19 to 2021-21, due to time limitations. The data collection methodologies include the acquisition of primary data from the internal guide and finance manager, thus ensuring access to first-hand information. Additionally, secondary data sourced from the company's annual reports is utilized, providing second-hand information. Notably, a comprehensive four-year financial dataset has been selected for efficient ratio analysis. Should you require

further elucidation or support on this topic, please do not hesitate to inquire.

This methodology suggests a comprehensive approach to assessing ONGC's financial performance, utilizing a blend of primary and secondary data to gain insights into its creditworthiness and overall financial health. If there's a specific aspect of this methodology or additional details you are interested in, feel free to ask for further elaboration.

Data analysis and Interpretation

$$\text{RoE} = \frac{\text{Net Profit (after interest, income tax, and preference dividend if any)}}{\text{Equity Shareholder's funds}} * 100$$

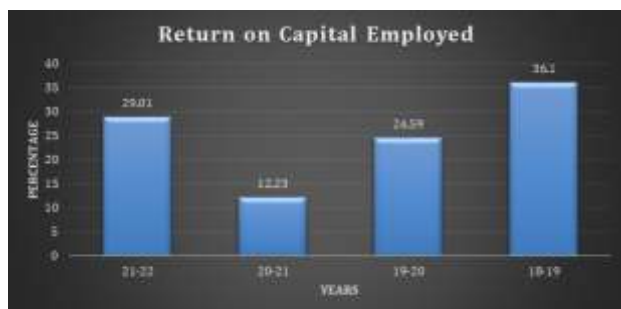
Major financial ratios has been calculated to understand the financial position and stability of the company.

Profitability Ratio

Return on Capital Employed

$$\text{Return on Capital Employed} = \frac{\text{Net Profit Before Tax and Interest}}{\text{Capital employed}} * 100$$

Years	21-22	20-21	19-20	18-19
Return on Capital Employed	29.01	12.23	24.59	36.10



Interpretation

Over time, changes in the company's

profitability and capacity to provide returns on the capital invested in its activities have been reflected in variations in the ROCE. A greater ROCE is often seen favorably since it shows that the business is efficiently using its capital to produce profits.

Return on Equity

Years	21-22	20-21	19-20	18-19
Return on Equity	19.91	9.55	4.99	14.50



Interpretation

This is mainly due to increase in earnings before interest & tax on account of increase in revenue from operations.

Return on Total Assets

$$\text{Return on Total Assets} = \frac{\text{Net Profit After Tax}}{\text{Total Assets}} * 100$$

Years	21-22	20-21	19-20	18-19
Return on Total Assets	8.52	3.88	2.01	5.84



Interpretation

This is mainly due to increase in earnings before interest & tax on account of increase in revenue from operations.

Return on Total Assets

$$\text{EPS} = \frac{\text{Net Profit (after interest, income tax, and preference dividend)}}{\text{Total Number of Equity Shares o/s}}$$

Years	21-22	20-21	19-20	18-19
Earnings Per Share	32.04	8.94	10.7	20.9



Interpretation

The earning per share is increases and decreases to year by year. If we can see in the figure. But in 20-21 EPS is decreases because equity share is a more than PAT. It is a 8.94% due to less profit in pandemic . It is good for shareholders. They get good return.

Price Earning Ratio (PE ratio)

Years	21-22	20-21	19-20	18-19
Price Earning Ratio (PE ratio)	4.53	7.88	7.95	6.57

$$\text{Price Earning Ratio} = \frac{\text{Market Price per Equity Share}}{\text{Earnings Per Share}}$$



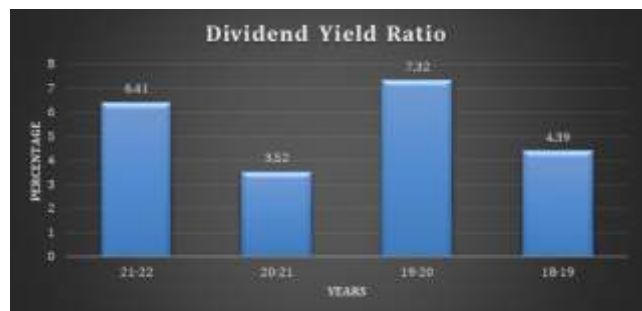
Interpretation

It seems that the PE ratio has fluctuated over the four-year period, potentially indicating changes in investor sentiment or shifts in the company's performance. The PE ratio is more in year 19-20 and 20-21 due the increase in the price of the crude oil and natural gas so the company earn more profit in those years.

Dividend Yield Ratio

$$\text{Dividend Yield Ratio} = \frac{\text{Dividend Per Share} * 100}{\text{Market Price Per Share}}$$

Years	21-22	20-21	19-20	18-19
Dividend Yield Ratio	6.41	3.52	7.32	4.39



Interpretation

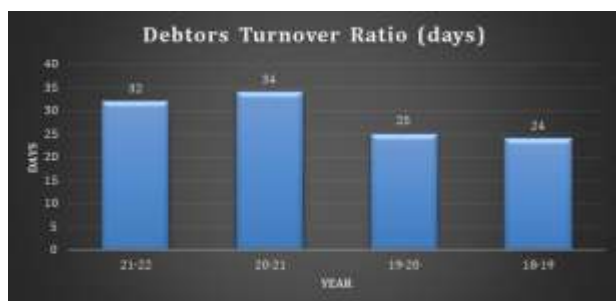
The dividend yield ratio has fluctuated over the years, indicating changes in the company's dividend policy and/or stock price. Generally, a higher dividend yield ratio is considered attractive for income-seeking investors, as it suggests a higher return on their investment through dividends

Turnover Ratio

Debtors Turnover Ratio

$$\text{Debtors Turnover Ratio} = \frac{\text{Net Credit Sales}}{\text{Average Accounts Receivables}}$$

Years	21-22	20-21	19-20	18-19
Debtors Turnover Ratio (days)	32	34	25	24



Interpretation

The ONGC sell their product to the semi government companies and its subsidiaries like HPCL etc. So, the debtors' turnover ratio is revolving around 30 days and its has very less chances of bed debts.

Inventory Turnover Ratio

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of goods sold}}{\text{Average inventory}}$$

Years	21-22	20-21	19-20	18-19
Inventory Turnover Ratio	13.51	8.00	11.83	14.15



Interpretation

The inventory turnover ratio for FY 2021-22 stands at 13.51, reflecting a 68.88% increase from the ratio of 8.00 in FY 2020-21. This increase can be attributed to a rise in revenue from operations by `422,043 million, coupled with a decrease in average inventory by `3,526 million. Notably, the surge in revenue from operations primarily stems from a `357,274 million increase in crude oil revenue due to higher crude oil prices, a `10,198 million rise in natural gas revenue attributable to increased natural gas prices, a `53,242 million increase in value-added products revenue, and a `1,329 million increase in other operating revenue.

Creditors/Payable Turnover Ratio

$$\text{Creditors Turnover Ratio} = \frac{\text{Net Credit Purchases}}{\text{Average Accounts Payable}}$$

Years	21-22	20-21	19-20	18-19
Creditors/Payable Turnover Ratio (Days)	55.02	69.41	54.82	64.13

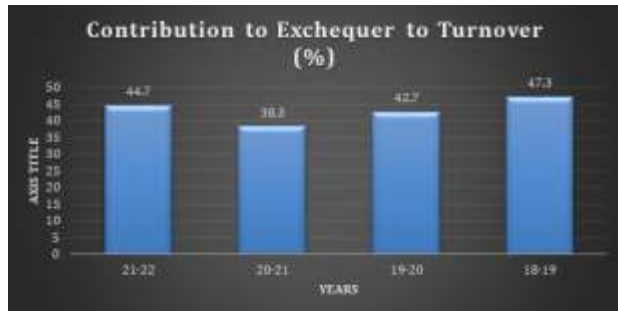


Interpretation

This means that, on average, ONGC took around 60 days to pay its trade creditors during the financial year.

Contribution to Exchequer to Turnover

Years	21-22	20-21	19-20	18-19
Contribution to Exchequer to Turnover (%)	44.7	38.3	42.7	47.3



Interpretation

The "Contribution to Exchequer to Turnover" ratio shows the company's tax contribution as a percentage of its revenue over the four-year period. The ratio appears to have fluctuated during this time due to the change in taxation policy by government as well as increase in profit in year 21-22 and less profit in 20-21.

Financial Ratios/Liquidity Ratios

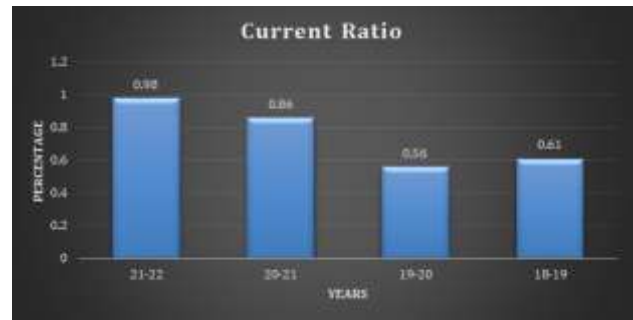
Current Ratio

$$\text{Liquid Ratio} = \frac{\text{Liquid Current Assets}}{\text{Liquid Liabilities}}$$

$$\text{CURRENT RATIO} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Years	21-22	20-21	19-20	18-19
Liquid Ratio	0.41	0.39	0.38	0.40

Years	21-22	20-21	19-20	18-19
Current Ratio	0.98 : 1	0.86 : 1	0.56 : 1	0.61 : 1

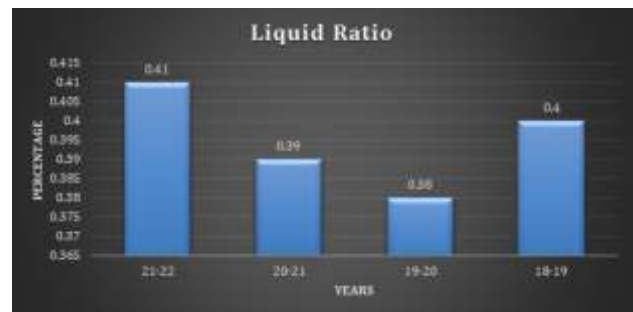


Interpretation

This assessment indicates a fluctuation in the current ratio. When compared to the previous year, the current year's ratio demonstrates an improved liquidity position. In 18-19, the ratio stood at 0.61:1, while in 19-20, it decreased to 0.56:1, reflecting a decline in liquidity. This decline can be attributed to reduced cash balance and receivables due to the pandemic. However, in the subsequent two years, the ratio has consistently increased.

Liquid Ratio

$$\text{Liquid Ratio} = \frac{\text{Liquid Current Assets}}{\text{Liquid Liabilities}}$$



Interpretation

Based on the current year's ratio, the company's liquidity position seems reasonably satisfactory. This ratio reflects the company's repay ability, which has remained satisfactory throughout the year. In comparison to the previous year, the current year's ratio shows improvement, with a figure of 0.39 in 20-21 and 0.41 in 21-22.

Debt/Equity Ratio

$$\text{Debt Equity Ratio} = \frac{\text{Long Term Debt}}{\text{Shareholder's Funds}}$$

Years	21-22	20-21	19-20	18-19
Debt/Equity Ratio	0.42	0.54	0.57	0.49



Interpretation

In FY 2021-22, the Debt Equity ratio stands at 0.03, reflecting a 57.14% decrease from 0.07 in FY 2020-21. This decrease stems from a reduction in debt by ₹6,257 million and an increase in other equity by ₹325,895 million. The decline in debt is the result of repaying current borrowings during FY 2021-22.

Major Findings

- With the exception of the year 19-20, the company consistently maintains a favorable current ratio of above 0.60, indicating its capacity to meet current obligations. This demonstrates the firm's strength in managing working funds effectively.
- The company is maintaining of Liquid assets in satisfactory manner. As the company having moderate value of Liquid ratio.
- The company is keeping sufficient bank & cash balances and marketable securities.

- In above all current assets and liabilities ratios are moderate which that company needs to work.
- In the year 21-22 debt equity ratio is 0.42 which is comparable less to previous years.
- Inventory turnover is 13.51 which is 68.88% due to increase in revenue from operation which is mainly due to increase in crude oil/ mainstream revenue.
- The debtors turnover ratio is constant revolves around 30 days because ONGC sells its product to PSU.

Suggestion

- The main source of revenue for ONGC is MRPL. (Mangalore Refinery Petrochemical Ltd) and OPAL which is also a public sector organization, Hence, there is a suggestion to sell to private sector for the increase in revenues.
- During the Internship tenure I observed the cost incurred in Administration work, selling work and other miscellaneous expenses were on a higher side therefore, a suggestion was to reduce such cost to improve the profitability.
- Productivity and Time Loss are the major issues which I observed during the tenure of my internship could be improved.
- The company needs to enhance its interest coverage ratio in order to meet its long-term debt obligations.
- The company's net profit has shown growth throughout the study period, indicating effective control over all expense categories and a favorable trajectory for continued progress in this direction.

- The dividend per share has observed as decline trend over the study period, but the high increase in year 21-22. Gives light for better future hence it may be suggested Oil and Natural Gas Corporation should take key interest to maximize the shareholder wealth by increasing dividend pay-out.

particularly in maintaining adequate liquidity, reducing debt dependency, and effectively managing inventory turnover. However, there are opportunities for improvement in optimizing current asset and liability management. ONGC's consistent debtor's turnover ratio indicates stable sales to PSU. These findings provide insights for ONGC's management to further enhance its financial performance and strengthen its position in the oil and gas industry.

Conclusion

Overall, the ratio analysis suggests that ONGC demonstrates strong financial management,

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- <https://ongcindia.com/web/eng/investors/annual-reports>
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1. Adams, W.G., The Bakerian Lecture on the Forms of Equipotential Curves and Surfaces and Lines of Electric Force, Transactions of the Royal Society of London, 24, 1876, pp. 1-32

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