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[1] Gregoriadis G., Engineering liposomes for drug delivery: progress and problems. Trends

Biotechnol, 13 (12): 527–537, (1995)

Books:

[1] Joseph R. Robinson and Vincent HL Lee, Ed. Controlled Drug Delivery Fundamentals and

applications, 2nd Edn, Vol 29, Lippincott Williams's publisher: 555–561, (1994)

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[1] Brown, M.B., Traynor, M.J., Martin, G.P., Akomeah, F.K., in: Jain, K.K., Walker, J.M. (Eds.), Drug

Delivery Systems, Humana Press, USA 2008, pp. 119-140.

For Patent Reference

[1]H. Aviv, D. Friedman, A. Bar-Ilan and M. Vered. Submicron emulsions as ocular drug delivery

vehicles, U.S. Patent US 5496811, 1996.

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"E- Banking"

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Abstract

This research shows that even in many less developed countries, the application of e-banking can help their local banks reduce operating costs and provide a better and fast service to their customers. The research objectives are to investigate the current trends and developments in e-banking and provide managerial insights for the banking industry. E-business has been continuously growing as a new industry during the last decade. The banking industry has been leading this trend in recent years and now all banking transactions completing through internet applications are sometimes called e-banking. Some key issues addressed in the recent literature about the e-banking include: customer acceptance and satisfaction, privacy concerns, profitability, operational risks, and competition from nonbanking institutions. E-banking has revolutionized the way business is transacted by globalizing the business enterprise.

E-banking technologies have proliferated in recent years, and the availability of a wide range of products has led to increasing adoption among consumers. These technologies include direct deposit, computer banking, stored value cards, and debit cards. Consumers are attracted to these technologies because of convenience, increasing ease of use, and in some instances cost savings. E-banking, in particular, has grown at impressive rates. Between 1995 and 2003, e-banking increased eightfold. Between late 2002 and early 2005, use of online banking increased 47%, a clear evidence that e-banking is associated with better household financial management. All businesses, including small and medium scale industries, no matter their geographical locations, are all beneficiaries of e-banking. It allows companies to make new business contacts from different global business alliances, test new products and services, and make market research and other enquiries all at a minimal cost both financial and otherwise This paper describes an empirical study of investigating recent trend and development of the application of e-banking (banking though internet) in a typical developing country and its economic impact on local financial institutions. Currently, emerging countries are far behind in terms of e-banking development and applications. More specifically, while it is a fact that currently many banks have implemented e-banking services, however, comparing with most developed countries, the e-banking application is only in its infancy stage and there is a huge gap to be fulfilled with new research and development effort. As such, addressing the current issues and challenges in the development of e-banking is the primary motivation of this research.

Key words: electronic banking; e-banking; empirical study; developing countries.

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Introduction

Today we are in the era of globalisation. Multinational organisations worldwide have adopted globalisation as their first strategic choice. Advancement in technology has facilitated globalisation too. There has been a marked improvement particularly in the area of maintenance, storage, availability and transfer of data. The world has literally shrunk to become a "global village".

Banks have transformed themselves and are offering services through internet. From computerization to networking to ATMs and now E-Banking, banks have moved up the value chain. Internet banking refers to the use of internet as a remote delivery channel for banking services. It means any user with a personal computer and a browser can get connected to his bank website to perform any of the virtual banking functions. The number of visits to the bank can be minimized effectively by operating from the internet account. Thus the number of contacts required to perform a transaction and solve a problem has been reduced through online banking. The usual branches of banks have culminated into PC networks, whereby the consumer can draw all the benefits and services of the bank at a single click of the mouse. Once the branch offices of bank are interconnected through terrestrial or satellite links, there would be no physical identity for any branch. It would a borderless entity permitting anytime, anywhere and anyhow banking. A customer can log on banks website and access his account.

Electronic Banking (E-Banking)

It is an umbrella term for the process by which a customer may perform banking transactions electronically without visiting a brick-and-mortar institution. The following terms all refer to one form or another of electronic banking: personal computer (PC) banking, Internet banking, virtual banking, online banking, home banking, remote electronic banking, and phone banking. PC banking and Internet or online banking are the most frequently used designations. It should be noted, however, that the terms used to describe the various types of electronic banking are often used interchangeably.

E-banking are the buzzwords in the global commercial activities today E-banking or electronic banking refers to conducting banking activities with the help of information technology and computers.

E-banking is a mix of services which include Internet banking, Mobile banking, ATM kiosks, Fund Transfer System, Real Time Gross Settlement (payment & settlement system), Credit/Debit/Smart/Kisan Cards, Cash management services, and Data warehousing, Operational data for MIS and Customer Relationship Management. Latest innovations in technology like broadband transmission, internet access via mobiles (GSM) and WebTV will further provide impetus to digital revolution.

Further, banks are looking forward to scan the image of a cheque which can be zapped to another bank, into the depository and back to customer's bank. Banking transactions can be carried out 24 hours a day using these methods. In fact concept of Anytime, Anywhere banking is making it easy for customers to access their money more conveniently. It has been

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established that increasing the role of technology in a service organization can serve to reduce costs and often improve service reliability.

Internet banking in India

The Reserve Bank of India constituted a working group on Internet Banking. The group divided the internet banking products in India into 3 types based on the levels of access granted. They are:

Information Only System General Purpose information like interest rates, branch location, bank products and their features, loan and deposit calculations are provided in the banks website. There exist facilities for downloading various types of application forms. The communication is normally done through e-mail. There is no interaction between the customer and bank's application system. No identification of the customer is done. In this system, there is no possibility of any unauthorized person getting into production systems of the bank through internet. **Electronic Information Transfer System** The system provides customer- specific information in the form of account balances, transaction details, and statement of accounts. The information is still largely of the 'read only' format. Identification and authentication of the customer is through password. The information is fetched from the bank's application system either in batch mode or off-line. The application systems cannot directly access through the internet. **Fully Electronic Transactional System** This system allows bi-directional capabilities. Transactions can be submitted by the customer for online update. This system requires high degree of security and control. In this environment, web server and application systems are linked over secure infrastructure. It comprises technology covering computerization, networking and security, inter-bank payment gateway and legal infrastructure.

Internet banking involves use of Internet for delivery of banking products & services. It falls into four main categories, from Level 1 – minimum functionality sites that offer only access to deposit account data – to Level 4 sites – highly sophisticated offerings enabling integrated sales of additional products and access to other financial services- such as investment and insurance. In other words a successful Internet banking solution offers

1. Exceptional rates on Savings, CDs, and IRAs
2. Checking with no monthly fee, free bill payment and rebates on ATM surcharges Credit cards with low rates
3. Easy online applications for all accounts, including personal loans and mortgages
4. 24 hour account access
5. Quality customer service with personal attention

Impact of on line banking

It has been observed that customers who adopt online banking are typically more profitable to the bank, stay with the bank longer and use more products strengthening the bank customer relationship. Information Technology and Internet banking

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has bridged the information gap, which was interestingly because of human involvement. Banks can make the information of products and services available on their site, which is, an advantageous proposition.

Prospective customer can gather all the information from the website and thus if he comes to the branch with queries it will be very specific and will take less time of employee. Customer can visit these websites and can compare the services offered by a bank with that of another. Customer can get all the information, by saving money and time. The trend thus emerging out is that of virtual corporate system where the human role is minimized to maximum effect.

The overall banking size and structure has increased considerably. It can also be accredited to the current market characteristics. More private players and multinational banks are establishing their base in India. Earlier nationalized bank dominated the scenario. Now after deregulation private banks have emerged as a powerful force. As a result, there is a fierce competition among these players for capturing the savings of individuals and current accounts of organisations. This has been spearheaded by the liberalization in the insurance industry. Insurance industry is giving fierce competition through their offerings on various policies. This sudden surge has necessitated the use of technology in offering better services competitively. Most of the banks have coupled IT with their offering to add value.

Several banks have been positioning themselves as a one-stop shop financial service provider with a fairly exhaustive range of products, including deposit products, loans, credit cards, debit cards, depository (custody services), investment advice, bill payments and various transactional services. These apart, banks have also been entering into the business of selling third- party products such as mutual funds and insurance to the retail customers. To provide their customers greater flexibility and convenience as well as to reduce servicing costs, banks have been investing to computerize their branches and in new delivery channels such as ATMs, phone banking, internet banking and mobile banking.

TECHNOLOGY IN BANKING SERVICES

Many of the world's biggest and successful banks have grown out of the technological changes which they are able to identity early. The Indian banking industry has a long way to go before it can compete globally. The state of affairs has been perpetuated mainly because of late introduction of communication technology in Indian banks. Our information technology has to be geared to compete with information technology elsewhere in the World and unless we are very fast in the area, it may be difficult for us to take advantage of the liberalization process.

The bank which used the right technology to supply timely information will see productivity increase and thereby gain a competitive edge. To compete in an economy which is opening up, it is imperative for the Indian Banks to observe the latest technology and modify it to suit their environment. Not only banks need greatly enhanced use of technology to the customer friendly, efficient and competitive existing services and business, they also need technology for providing newer products and newer forms of services in an increasingly dynamic and globalised environment. Information technology offers a chance for banks to build new systems that address a wide range of customer needs including many that may not be imaginable today.

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On-line banking, for example, promises to let customers carry out transactions via a direct connection to the bank's core customer-account functions. Customers will review all of their data, all their date, all their cheques, all their credit-card details.

In the future, banks will be freed of the constraints of a single delivery channel. They will be able to create, package, market and deliver products for niche segments, and, because the price of technology in tumbling, they will be able to do so cost-effectively.

Technology will allow banks to be closer to customers, to deliver a wider range of services at lower costs, land to streamline interest systems so that all data is together in one place where it can be used to spot trends that can lead rapidly to new products. Electronic delivery of banking services will allow data to be gathered and analyzed. Interactivity will give consumers a opportunity to register their preferences, actually steering to development of new products.

RECENT DEVELOPMENT IN BANKING SERVICES

The following services rendered by the banks are:

Automatic Teller Machine (ATM)

An ATM is a computerized telecommunications device that provides a financial institution's customers a secure method of performing financial transactions in a public space without the need for a human clerk or bank teller. ATMs are linked to bank's central computer and identify the customer through magnetic coding on the card provided to customer and Personal Identification Number (PIN), keyed in by the customer. It updates the account of the customer after the completion of the transaction. The transaction using ATM can range from simple transactions involving cash withdrawals and deposits to making hotel reservations etc.,

2. Electronic Funds Transfer – Point of Sales Terminals (EFTPOS)

EFTPOS can be installed at Airlines, Hotels, Railways, Super Bazaars and other commercial centers. Customer will get rid of the botheration of carrying cash, as the payments can be made through cards backed by the security features of personal identification numbers (PIN) or password etc., at selected installations where POS terminals are installed. Point of Sales Terminals can be linked to the bank's host computer.

3. Electronic Funds Transfer System

To transfer funds instantly among various branches at various locations in the country; by connecting these branches through a network using the latest communication technology which includes satellite, leased lines, dial-up lines etc.

4. **Electronic Clearing Service (ECS)**

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In April 1995, the RBI introduced electronic clearing service between selected metro centres in the country under which transfer of funds from one centre to another could be done quickly. ECS is essentially a more effective method of handling bulk payment transactions and inward remittances, like pension, interest, dividend, salary or commission cheques. It adds 3 benefits to customer's inwards remittances: Speed, Safety & Convenience. As a subscriber to ECS, customer's bank account would be directly credited on every due date.

5. Credit Cards/Debit Cards

These cards are used to store information related to customer's account and can be used to perform many functions involving purchase of goods and services. These reduce cash-handling expenses and the risk involved in handling cash. Hence, enhance customer safety and convenience. Debit card is similar to credit card with some important exceptions. While the process is fast and easy, a debit card purchase transfers money to the store's account. So, it's important that you have funds in your account to cover your purchase.

6. **Electronic Pass Book**

For the issuer, the system provided low cost, security and easy adaptation to the existing system through two real-life systems which were operating in the country.

7. **Home Banking**

The first commercial in-home banking system in the UK was launched by a building society in 1983. Offering a two-way communication system to any subscriber. Two-thirds of European banks now offer home banking systems which provide account interrogation, payment of bills, inter-account transaction, loan generation and other banking facilities.

8. Corporate Electronic Banking

Banks have established electronic based products for their corporate customers. The system provides customers with control over financed twenty-four hours a day as well as a diverse range of market information and reporting. Corporate customers can dial into local access points in the data network through personal computers and modems. They are thus connected instantly to the group's mainframe system

9. Anywhere Banking

"Anywhere Banking" is done by linking of metro branches through satellite linked communication network using VSATs and on-line computer network. Inter-connectivity through satellite-based communication

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Conclusion

Indian banking industry, today is in the midst of an IT revolution. A combination of regulatory and competitive reasons has led to increasing importance of total banking automation in the Indian Banking Industry. Information Technology has basically been used under two different avenues in Banking. One is Communication and Connectivity and other is Business Process Reengineering. E-banking enables sophisticated product development, better market infrastructure, implementation of reliable techniques for control of risks and helps the financial intermediaries to reach geographically distant and diversified markets.

The rate of adoption of IT by foreign and private sector bank in the country has been significant over the last five years, which can be attributed to fierce competition and the internet phenomena worldwide. The arrival of private and multinational banks with their superior state of the art technology based services pushed the Indian banks to follow the suit by going in for the latest technologies to meet the threat of competitors and retain their customer base. "The last four years have seen dramatic changes, making customers' convenience critical aspect of banking". Indian metros are surging ahead in online banking usage. Today the delivery channel of banks include direct dial up connections, private networks, public networks etc. and the devices include telephone, Personal Computers including Automated Teller Machines, etc.

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"FINANCIAL INCLUSION - A GATEWAY FOR THE DEVELOPMENT OF RURAL MASSES" – AN EMPIRICAL STUDY

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Abstract

Rural households face numerous constraints in their efforts to immune themselves against risks by accumulating assets. Lack of savings instruments makes it challenging for them to acquire their risk capital. They invest in informal savings vehicles such as gold and other precious metals. Those households for whom savings is a risk coping strategy have been saving even if the returns on these assets are minimal or inadequate. In addition, lack of awareness on the availability of savings instruments for rural masses keep their money idle, i.e., without savings in a proper portfolio. Though they have been saving, their motive is not to take advantage of the financial opportunities, but to save for their financial security. Understanding the prevailing situation of poor banking and financial investment among the rural masses, the Reserve Bank of India initiated the international practice of including the common man in financial services. Financial inclusion is the fair, timely and adequate access to financial services that include savings, credit, payment and remittance facilities at an affordable cost, and in a transparent manner through institutional agencies adopted by the Reserve Bank of India in 2006. Based on the discussion held above, it has been realized that an empirical study could be undertaken to analyze the financial services awareness level and investment pattern of rural masses in India.

Introduction

Increasing consumerism among the urbanites and low earnings of those in the rural areas are the two main factors for the decline in savings. With much of the rural population still below poverty line, there is a little scope for mobilizing savings. There is a need to improve the funds flow to the rural masses in order to increase the earnings potential of the rural population. Moreover, in India, out of the 600,000 villages, only about 32,000 villages have access to commercial bank branches.

The number of villages served by a single bank branch is 19; around 60 per cent of the rural population does not have any access to banks. Just over 40 per cent of the population across the country has bank accounts, and this ratio is much lower in the north-eastern region.[1]

For any household, real financial security is dependent on the foundation they have built which can help not only smooth consumption but also deal with emergencies. Even if the assets have negative

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returns, rural households have chosen it as a hedge against the risks. Some, who are lucky enough to stay close to a bank branch, invest in bank savings accounts or fixed deposits. Understanding the prevailing situation of poor banking and financial investment among the rural masses, the Reserve Bank of India initiated the international practice of including the common man in financial services. Financial inclusion is the fair, timely and adequate access to financial services that include savings, credit, payment and remittance facilities at an affordable cost, and in a transparent manner through institutional agencies adopted by the Reserve Bank of India in 2006.

TABLE: 1

STATISTICS ON FINANCIAL INCLUSIONS

Particulars	Values
Total bank accounts	300 million
Unbanked population (rural)	60 per cent
Unbanked population (all India)	40 per cent
No of villages in India	6,00,000
PSU, RRB rural branches	45,000

Source: Sreelatha Menon, Business Standard, RBI sets financial inclusion at a distance with 15 km cut-off, May 12, 2008.

Today, financial inclusion is a vital medium for extending growth and equitable development to rural India, since access and availability of banking and payment services to the entire population is essential for the creation of an inclusive and efficient economy, and for enabling India's sustainable and all-encompassing growth, providing the facilities to all Indians may appear to be a simple task, given the reach of urban banking and the benefits of technology to the rural masses. However, India suffers from problems like low levels of financial literacy among the rural workforce, an adult literacy rate of about 67 per cent, poverty and low income levels, multiplicity of regional languages, difficult terrain in some regions. This task of providing financial services becomes even more formidable, as the people who are to receive the services may first need to be made aware of their benefits.

On their part, the suppliers of these facilities, mostly banks, need to be convinced of financial viability and will open up new markets for their growth, while giving them access to large, new, low- cost deposits. For the financial inclusion efforts, on the supply side, the banks need to invest in technology, upgrade their existing server capacities, expand connectivity and computer-based banking solutions to the hinterlands, train their staff to be rural customer-oriented, and to provide service with a smile even though the time taken per transaction may be higher in the rural areas.

The policy-makers and regulators also face the challenge of putting in place the regulations and provisions and to guide the banks and other market players to come forward and willingly take part in financial inclusion efforts, while still retaining the ability to monitor and supervise the facilities that shall be provided to millions of new customers in distant places. Based on the discussion held above, it has been realized that an empirical study could be undertaken to analyze the financial services awareness level and investment pattern of rural masses in India. The concept framed has been considered as the basis for the current study.

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Statement of Problem

Over the next decade, India needs to invest several hundred billion dollars in the infrastructure to support national development. Power, roads, ports and education were expanded considerably to support higher rates of productivity and growth. Investments in the power sector could alone absorbed US $100 billion or more. Investment in housing and roads needs another thousand of crores and generate millions of jobs. The combined requirements far exceed the amounts available for investment by the public sector. Providing attractive conditions for foreign private investment is one option, but this would result in long term outflows not only for debt repayment as well as repatriation of high profits on foreign owned assets. This might be acceptable if there were no other alternative, but India has a more attractive option, that is utilization of non-productive funds of households both in rural and urban area, by means of converting them into productive investment. This could be possible if the waves of financial literacy successes and the rural masses are considered as the important sources for financial inclusive services.

Review of Literature

Rajarshi Ghosh and Asis Kumar Pain (2005) examined household savings in India. The authors say that savings is the difference between income and expenditure. A high level of savings helps the economy to progress on a continuous growth path, since investments is mainly financed out of savings. Given the importance of savings, there have been extensive studies on the behavioral and other factors which influence savings.

G.*Naga Sridhar (2007)* comment in his study that *d*espite their expanding reach, banks still need to tap a larger share of rural household savings in India and compete with lucrative investment options such as real estate in the process. According to the study, household savings, as a share of Gross National Savings in India, are the highest in the world at 69 per cent as against 55 and 44 per cent in France and China, respectively.

Raghavan Guruswami (2010) says that financial literacy has become an increasingly important requirement for functioning in matured economies. Trends in work patterns, demography and service delivery suggest that it will become even more important in the years ahead. Improvements in financial literacy can not only support social inclusion but also enhance the contribution to the economy as a whole. Financial illiteracy leads to financial exclusion, financial exploitation and financial discrimination.

The Detailed review of various literatures reveals the fact that right from the beginning of the 21st century; Indian government agencies aim to provide these financial service facilities to all Indians that may appear to be a simple task, given the reach of urban banking and the benefits of technology. However, the extent of the challenge can be appreciated from the magnitude of financial inclusion exercises to be carried out in rural India. The same has been identified as the researchable gap, and motivated the researcher to carry out a research work that will analyse financial awareness level and investment pattern of rural masses in India, especially in Coimbatore District of Tamil Nadu.

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Objectives

To fulfill the basic aim of the study, the following objectives are framed:

- To analyze rural households' level of awareness towards savings modes and investment avenues.
- To analyze the investment behaviour based on the risk patterns and necessity.

Hypotheses of the Study

- There exists no uniformity in the investor's level of perception towards various factors that influence them in selection of saving/investment medium.
- The priority of investment purpose by one investor significantly varies from that of other.

Research Methodology

In this study descriptive design and exploratory method had been used to execute the research work. It is mainly based on primary data and at the same time secondary data were also used to refer earlier studies so as to find the research gap. Coimbatore district had been chosen as the study area where 2000 sample respondents had been selected randomly on the basis of educational qualification from the entire district and ensure that the sample must represent the universe. Questionnaires had been monitored to all of them and collected relevant information from them. This process had taken three months time starting from January to March, 2011.

Results and Discussion

In this section, the researcher has analyzed the surveyed respondents' level of awareness regarding saving/investment schemes, mode and factors influenced them to save; the factors influenced their saving/investment pattern and the purposes for which they save/invest.

TABLE: 2

INVESTORS' LEVEL OF AWARENESS ON VARIOUS SAVING/INVESTMENT AVENUES

Variables	Total sum	Average mean	Rank
Safe/Low Risk Investment Avenues (Cronbach's Alpha: .799)			
Saving accounts	8460	4.13	1
Bank fixed deposits	7781	3.80	2
Public provident fund	6360	3.10	3
National saving certificates	5762	2.81	4
Kisan vikas patras	5451	2.66	6
Post office savings	6592	3.22	7
Government securities	5473	2.67	5
Moderate Risk Investment Avenues (Cronbach's Alpha: .706)			

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Mutual funds	6632	3.24	2
Life insurance	7019	3.42	1
Debentures	5562	2.71	3
Bonds	5427	2.65	4
High Risk Investment Avenues (Cronbach's Alpha: .780)			
Equity share market	6049	2.95	1
Commodity market	5608	2.74	2
Forex market	5416	2.64	3
Traditional Investment Avenues (Cronbach's Alpha: .612)			
Real estate's/Property(s)	7216	3.52	2
Gold/Silver	7355	3.59	1
Chit funds	6684	3.26	3
Emerging Investment Avenues (Cronbach's Alpha: .821)			
Virtual real estate	6655	3.25	1
Hedge funds	5898	2.88	2
Private equity investments	5502	2.68	3
Art & passion	5251	2.56	4

Source: Primary Data

Table explains the level of awareness of rural masses towards various investment avenues. Under the aspect of safe/Low risk investment avenues, the savings accounts, Bank fixed deposits, public provident fund, National savings certificate has secured the I, II, III, IV ranks with a mean score of 4.13, 3.80, 3.10, and 2.81 respectively. The aspects of Government securities, Kissan vikas pathras and post office savings has secured the V, VI, VII ranks with an mean score of 2.67, 2.66, 3.22, respectively. Under the moderate risk investment avenues, the products of Life insurance, Mutual funds, Debentures, Bonds has secured the I, II,III, IV ranks with an average score of 3.42, 3.24, 2.71,and 2.65 respectively. Under the Traditional investment avenues, Gold, Silver, Real estate, property and chit funds has secured the I, II, III ranks with an average score of 3.59, 3.52 and 3.26 respectively. Under the emerging avenues the products of virtual , real estate, Hedge funds, private equity investment and art and passion has secured the I, II, III, IV ranks with an average of 3.25, 2.88, 2.68 and 2.56 respectively.

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TABLE: 3
FACTOR INFLUENCES IN SELECTION OF SAVING/INVESTMENT MEDIUM

Variables	Total sum	Average mean	Rank
High liquidity	7845	3.83	2
Safety of money	8244	4.02	1
Regular returns	7400	3.61	3
Higher returns	6947	3.39	5
Long term benefits	6990	3.41	4
Capital appreciation	6423	3.13	6
Tax benefits	6151	3.00	8
Prestige value	6137	2.99	9
Others	6205	3.03	7

Source: Primary Data

Among the various factors that influences rural investors to invest like: safety of money, High liquidity, Regular returns, Long term benefits, Higher returns factors have secured the I, II, III , IV and V ranks with an average mean of 4.02, 3.83, 3.61, 3.41 and 3.39 respectively. The other variables Capital appreciation, other factors, Tax benefits and Prestige value factors have gained VI, VII, VIII and IX ranks with an average mean of 3.13, 3.03, 3.00 and 2.99 respectively.

Ho: There exists no uniformity in the investor's level of perception towards various factors that influence them in selection of saving/investment medium.

TABLE: 4
THE RESULT OF RELIABILITY STATISTICS FOR FACTOR INFLUENCES IN SELECTION OF SAVING/INVESTMENT MEDIUM

Sl. No	Variables	Mean	SD	Cronbach's alpha
1.	High liquidity	2.173	1.040	.850
2.	Safety of money	1.978	0.960	
3.	Regular returns	2.390	1.032	
4.	Higher returns	2.611	1.152	
5.	Long term benefits	2.590	1.145	
6.	Capital appreciation	2.866	1.169	
7.	Tax benefits	2.999	1.243	
8.	Prestige value	3.006	1.230	
9.	Others	2.973	1.312	

Level of Significance: 5 per cent

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The result of Cronbach's alpha draws a significant amount of correlation between the variables tested.

TABLE: 5

RESULT OF ANOVA TEST

FACTOR INFLUENCES IN SELECTION OF SAVING/INVESTMENT MEDIUM

Source		Sum of Squares	DF	Mean Square	Chi-square value	Sig	Grand Mean
Between people		11065.129	2049	5.400	2468.059	.000	2.621
Within people	Between items	2344.823	8	293.103			
	Residual	13236.288	16392	.807			
	Total	15581.111	16400	.950			
Total		26646.240	18449	1.444			

Level of Significance: 5 per cent

The result of the Cronbach's Reliability Analysis and F-test establishes a significant reliability between the variables tested (0.850 i.e., 85.00 per cent). Therefore, the null hypothesis framed stand accepted and it is concluded that there exists no uniformity in the investor's level of perception towards various factors that influence them in selection of saving/investment medium.

TABLE: 6
PRIORITIES OF INVESTMENT

Variables	Total sum	Average mean	Rank
Children's education	17578	8.57	1
Family well being (security)	15616	7.62	2
Ward's marriage	12659	6.18	4
Construction of house	14156	6.91	3
Status and prestige in the society	10058	4.91	6
Aspiration to lead a comfortable life	9978	4.87	7
Health care	12180	5.94	5
Repayment of debts	8830	4.31	8
To met contingency	8185	3.99	9
Others	3689	1.80	10

Source: Primary Data

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The table depicts the various priorities of investment purposes of the respondents in the order of ranking. It is evident from the table that children's education is the top most priority of investment by the respondents followed by maintaining family well being, construction of houses, wards marriage/health care, status/prestige in society, aspiration to lead a comfortable life, repayment of debts, to meet contingencies and other general purposes respectively.

Kendal's coefficient of concordance test was performed to measure the association between the saving perceptions exhibited by the sample rural household investors.

Ho: The priorities of investment purpose by one investor significantly various from that of other.

TABLE: 7
RESULT OF KENDALL'S CONCORDANCE OF CO-EFFICIENT ON PRIORITIES OF INVESTMENT PURPOSE

W	S	Level of Significance	Chi-Square Value	Table Value
0.987	82	5 per cent	9.891	16.919

The calculated chi-square for the Kendall's value 9.891 is less than the table value 16.919 at 5 per cent level of significance. Therefore, the null hypothesis framed is accepted. Hence, it is inferred that the priorities of investment purpose by one investor significantly various from that of other preferences.

Findings

From the elaborate data analysis it has inferred that the rural household in the study region have gained reasonable knowledge on the various saving and investment medium. But it is very ironical to assess that their knowledge is very much limited traditional well known saving and investment avenues like bank saving, holding insurance policy, investment in equities, gold or in land/building. The sample population's knowledge on the modern and market sophisticated investment avenues are very much limited. It has been concluded that safety of money has recorded primary factor that has influenced the rural masses to save, it has secured first rank with an average score of 4.02. It is evident from the data interpretation that children's education is the top most priority of investment by the respondents followed by maintaining family well being and construction of houses.

The result of the Cronbach's Reliability Analysis and F-test establishes a significant reliability between the variables tested (0.850 i.e., 85.00 per cent). Therefore, the null hypothesis framed stand accepted and it has been concluded that there exists no uniformity in the investor's level of perception towards various factors that influence them in selection of saving/investment medium. The calculated chi-square for the Kendall's value 9.891 is less than the table value 16.919 at 5 per cent level of significance. Therefore, the null hypothesis framed is accepted. Hence, it is inferred that the priorities of investment purpose by one investor significantly various from that of other preferences.

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Suggestion

- In India the focus of financial inclusion at present is confined to minimum access to a savings bank account without any additional changes, to all. Internationally, the financial inclusion has been viewed in a much wider perspective. Having a current account / savings account on its own, is not regarded as an accurate indicator of financial inclusion. Hence, just opening the NFAs (No frill accounts) can never solve the real purpose of financial inclusion. Although by definition it is just to provide financial services to all sections of the society at an affordable cost. But for inclusive growth and upliftment of the population at bottom of the pyramid, the orientation of banks and the general masses have to be changed. Thus, it is suggested that along with the financial inclusion, measures for financial literacy of the rural people are essential to be undertaken by the banks.

- Banks should know how to best leverage between communications and technology in ways to engage and empower people in the area of financial literacy. Recognizing that people receive, learn and digest information in different ways, it would be useful to survey all possible avenues of communication to determine the best way of capturing people's attention and interest. The use of technology in the training of trainers could also be explored. Accordingly, the banks' managers need to design and innovate a low cost business model suitable for their branch as guided by the RBI.

Conclusion

Now, consumers' especially rural citizen must be able to differentiate between a wide range of financial products and services, and providers of those products and services. Previous, less-indebted generations may not have needed a comprehensive understanding of such aspects of credit as the impact of compounding interest and the implications of mismanaging credit accounts. Increase consumer awareness as to the necessity of financial education and how they can access it. Financial education is not just for investors. It is just as important, if not more so, for the average family trying to balance its budget and save for the children's education and the parents' retirement. More needs to be learned about the financial education needs of consumers at various stages in their lives and how financial education programmes can be designed to best address these needs.

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A TOOL TO CREATE HUMAN RESOURCES MORE EFFECTIVE IN ORGANISATION CORPORATE SOCIAL RESPONSIBILITY (CSR)

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ABSTRACT

"Way to creating Human Resources more effective in building connections with society and employees through Corporate Social Responsibility Initiatives."

Corporate Social Responsibility creates a forever image in the minds of the society and the employees, It not only caters to the awareness among the employees but also leads to a positive image branding for Human Resources Management in the minds of the organizations, employees and customers.

The purpose of this paper is to understand how Corporate Social Responsibility can lead to the creation of better effect of Human Resources Mgt. in Organisation and Customers. It investigates the usefulness of Corporate Social Responsibility initiatives for positive image branding of Human Resources Management in the minds of the organizations employees and customers.

The present study is based on secondary data, information collected from authentic sources such as books, journals, magazines and research reports and electronic data gathered through related web sites. Rationalization and exploration of different types of conceptual information presented in the study is the result of observation, in depth reading, experiences and rational judgment of the author of the paper.

KEY WORDS:
Corporate Social Responsibility, Organisation Perceptions, Corporate Social Responsibility Initiatives, Employees, Organizations.

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INTRODUCTION

With the era of globalization and cut-throat competition concern of the companies has shifted to Corporate Social Responsibility. "Being Effective and Best" seems to be the new slogan for many Organisation in 2011. After a year economic misery and banking crisis, employees and organizations want to get associated with the best practices of HR that believe more than a profit. HR Engineering is one of the factors that increase the financial value of the organisation and manpower. Elements that can be included in the valuation of manpower include: changing recruitment practices , attrition rate, employee recognition of organizations and other HR elements, HR language made by employees " perceptions of HR and other relevant practice and regulations, Survival of the company depends upon how responsible company is towards society and employee". More concerned a company is, it is easier for it to create the positive image in the minds of the employees and customers that leads to working towards building Human Resources effectiveness in organisation.

Different concerns define Corporate Social Responsibility differently.

World Business Council for Sustainable Development defines Corporate Social Responsibility as ***"The continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large."*** Jamshedji Tata has very beautifully defined the Corporate Social Responsibility ***"The clear definition of Corporate Social Responsibility is that the community is not just another stakeholder in our business but the very purpose of our existence."***

A new concept of co-creation on has been triggered by the companies in which they are giving sessions that will involve employees by letting them co-create or co-decide, as with Mahindra and Mahindra Ltd. Other examples of Effectiveness of HR following the co-creation trends include TNT, which Operates a Couriers and cargo world wide. Though there are hidden costs but the difference made by such initiatives is huge and there is always a challenge for HR corporate to identify Corporate Social Responsibility. By linking accountability with responsibility, companies can identify new ways to bring new practices to new employees and organizations.

LITERATURE REVIEW

Majority of the private companies say they embrace corporate social responsibility not only because it's the right thing to do, but also because it strengthens their HR practices. The percentage of HR value represented by corporate social responsibility is trending upward but all other identifiable contributors to corporate HR value- manpower requirement, selection, and the industry in which a company competes –

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appear to be declining. The relationship between HR image and Corporate Social Responsibility is strongest for productivity, not for profitability. That is, if the company is well known in its community, its Corporate Social Responsibility activities will strengthen its HR image more than they would if the company were less well known. According to a study of Human Resources paper, The donations by listed companies grew 10% during the fiscal ended March 2010. As many as 108 companies donated up to 20% more than the previous year. Organizations and employees increasingly making a broader contribution to society.

According to the research carried by Cone Inc., in 2010, 79% of employees would switch to a Human Resources associated with a good cause. The study was based on a public goodwill index and India received 119 points in the index against a global average of 100. Thailand was at the top slot with 124 points.

Malini Mehra, founder and CEO of Social Markets, an organization that works towards transition to sustainable development and realisation of human rights and social justice, explains, "There is minimalist version, Corporate Social Responsibility is little more than a humanitarian activity-tree planting, schools and health clinics. In the maximalist version, Corporate Social Responsibility is about character and conduct, where integrity and responsibility run right through every seam of the firm's activities and ethos.

INITIATIVES OF INDIAN COMPANIES TO PROMOTE HR IMAGE WITH THE HELP OF CORPORATE SOCIAL RESPONSIBILITY

The 2010 list of Forbes Asia's 48 heroes of Philanthropy contains four Indians. Nearly all leading corporate in India are involved in Corporate Social Responsibility programme in areas like education, health, livelihood creation, skill development and empowerment of weaker sections of society. Notable efforts have come from the Tata Group, Infosys, Bharti Enterprises, ITC Welcome group, IOC among others. For HR, it is an excellent way to show they care, taking the lead with innovative "giving back" to society. Few ways by which Procter and Gamble did in the past was, that they teamed up with UNICEF to introduce Nutristar-a powdered drinking product that addressed micronutrient malnutrition in some populations to bring low-cost water purification technologies for family of employees. The company also promoted better hygiene in at-risk communities and in return had the benefit of increase in productivity, lower the attrition rate, workers participation in Mgt. and retention .

A recent initiative of Corporate Social Responsibility by Mahindra and Mahindra is that it joined hands with the NGO, jointly announced a sponsorship programme wherein Mahindra and Mahindra will

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sponsor "Co-Creation" campaign globally. To celebrate the dedication and efforts of employees ,staff and families, Mahindra and Mahindra will produce a documentary video that will provide the insight into the experiences of employees and organisations which will guide and improve the lives of forthcoming recruitments.

GOVERNMENT INITIATIVES TO PROMOTE CORPORATE SOCIAL RESPONSIBILITY AMONG COMPANIES

Although corporate India is involved in Corporate Social Responsibility activities, the central government is working on a framework for quantifying the Corporate Social Responsibility initiatives of companies to promote them further. According to Minister of Corporate Affairs, One of the ways to attract companies towards Corporate Social Responsibility work is to develop a system of Corporate Social Responsibility credits, similar to the system of carbon credits which are given to companies for green initiatives.

Apart from schools and hospitals that are run by trusts and societies, the government too is exploring to widen the scope of public-private partnerships to build and maintain schools and hospitals in return for a fixed annuity payment Besides the private sector, the government is also ensuring that the public sector companies participate actively in Corporate Social Responsibility initiatives.

UNDERSTANDING THE EFFECT OF CORPORATE SOCIAL RESPONSIBILITY IN CREATING HR IMAGE

A promotional initiate emphasizing a HR image affiliation with a social cause has a high degree of affinity. How much a given initiative will help or hurt a given Hr image will depend on the characteristics of its employees and organisation. A high degree of affinity can enhance the effectiveness of a promotional initiative that increases the likelihood of employees treating the initiative as an important and positively weighted attribute. However, when a promotional initiative does not mention an affiliation, employee may weight a HR image as negative attribute. Employees would weigh the Hr practices as positive with those types of affiliations that have affiliation with a cause like cancer research, environmental protection or disaster relief. Moreover, a social-cause affiliation could also have a "halo effect" on how Hr image is seen on other attributes, such as trustworthiness or quality.

The management of socially responsible behavior is important because of its impact on the perception of the HR image. Enriching a HR with ethical and social questions increases its value. These associations influence the employees in their assessment of productivity and increased organisation loyalty. Many proactive corporations monitor employee satisfaction closely and as a result individuals may express their trust and appreciation of the Corporate Social Responsibility efforts by continuing to work with the same company. Companies that have made Corporate Social Responsibility a central part of their

businesses are reaping the benefits as improved HR image. It works best for those companies in which responsibility is a core company value and informs all aspects of the business. Corporate Social Responsibility initiatives are not only about philanthropy but translating these ideas into practical business HR strategies.

CONCLUSION

The benefits of using Corporate Social Responsibility in HR content are endless. The most important one is that it helps to build a HR reputation and is a point of differentiation. It also encourages employees trust and loyalty. If the employee see that HR are addressing the issues that are important to them, it follows that they are likely to continue to work for them. Corporate Social Responsibility initiatives can be extremely effective at forging deep meaningful connections with its employee that transforms the loyalty, as a promoter of the company within their social networks. The need for more emphasis on the Corporate Social Responsibility concept and its company-to- employee communication is mandatory. Though a number of companies websites and their annual reports include information on these practices but it is seen that either this information does not reach to the employee or the current communication strategy is not strong enough to link the Corporate Social Responsibility actions to HR Image.

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"Internet Marketing and E-Commerce"

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1. Introduction

E-Commerce-

E-commerce has become a buzzword for business over the past few years, with increased awareness about the use of computer and communication technologies to simplify business procedures and increase efficiency. Combing a range of processes, such as electronic data interchange [EDI], Electronic Mail [E-mail] World Wide Web [WWW], and internet applications. E-commerce provides ways to exchange information between individuals, companies, and countries and, most important of all, between computers. More simply out, E-commerce is the movement of business onto the World Wide Web. This movement has been broken up into two main sectors consisting of business-to-business and business-to- consumer. E-commerce refers to marketing, selling and business over the internet. The available e- commerce information on the internet is huge and still growing.

Electronic commerce is electronic [i.e. on line and mainly internet] bases methodology, to address the need of business and consumers for cutting costs while improving the quality of goods and services. Convenience of shopping on the internet, open for twenty four hours a day seven days a week, makes it further attractive. It allows people to transcend the barriers of time and distance and take advantage of global markets and business opportunities not even imaginable today, opening up a new world of economic possibility and progress.

Almost everything that can be sold via other media can be sole electronically also. Moreover, as technology advances new products and services, to be marketed are also being crated. There are different kinds of sites is available for conducting e-commerce. i.e. direct selling, content selling includes the selling of information, financial services, reservation, education and training, entertainment, product demonstration, bill payment, stock exchange etc. There are several ways in which e-commerce products and services can be sold. But all these kinds of selling is a part of the following five levels of e- commerce.

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Model	Description
B2B	Sell products or services to other business.
B2C	Sell products or services directly to consumers.
B2G	Business selling to local, state, and federal agencies.
C2B	Consumers fix price on their own, which business accept or decline.
C2C	Consumers sell directly to other consumers.

Internet Marketing-

As businessdictionary.com cleverly defines, Marketing is 'The management process through which goods and services move from concept to the customer'. Though colorfully put by most of such prime resources, one also needs to understand the in-depth value of the above-mentioned (or facsimile) statement. A core part of the management fundamentals, Marketing is concerned with the sales advantages of the product (under study), the potential market for the same and the designing of fool- proof marketing strategies to enter the product successfully into the targeted segment of the market. A marketing expert not only requires the core knowledge about his product and the various protocols associated with his job but also needs to be creative in his own ways. At times, he may have to come up with solutions which may sound absurd to the masses, but have long term promises. One such example of a creative market penetration strategy comes from a globally acclaimed chain of fast food restaurants which actually executed a 'free walk-in sample' campaign for a particular state in America for one month. In its case, the company learned about the massive responses to their campaign. This way, the restaurant gained a huge amount of potential customers without having to spend millions crafting complex penetration strategies. So, in a way, Marketing is not just about spending lavishly, it is achieving the best out of a wise investment.

Since times immemorial, human beings have been known for their ever-growing hunger for advancement – be it a seizure over a neighboring kingdom (as was a usual case centuries back) or a sophisticated weapon to dominate over nature's attacks to control the population. History has shown us the triumphant victory humans have achieved in almost all his missions. However, with the globalization of this *magnum opus* species, there has also been a simultaneous intensification of the various challenges that he is subjected to – from the investment of millions of brains into the development of a life-saving technology to the subjection of a single resource to multiple grounds – the war just keeps getting vague.

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As against the age-old barter system, man has invented and deployed highly sophisticated tools & platforms for his trading needs. Till a couple of decades ago, money stayed as the prime factor controlling the trigger to establishment and expansion of a particular trade across two platforms. However, with the upsurge of globalization to every possible nook and corner in the world, business today is more than a financial prospective – it is a mode of extending not only the monetary arms of your firm, but also the broadcasting of your company (as a brand itself), your vision and the social contribution you associate with your mission. Also, with the millions of potentially equal (and many leagues ahead) competitors all set to lure your customer away, even well established ventures find it intricate to stay on their toes. Keeping your brand value alive (and rising) is what it takes to keep you swimming – and this is where Marketing comes in!

2. *Methodology*

The data were collected from the secondary sources viz., websites and also from various issues of which are published. The suitable statistical tools were employed for the meaningful interpretation of the data.

3. *Growth of Internet Marketing*

Internet marketing has become the fastest growing form of marketing. According to the Direct Marketing Association, U.S. companies spent $161 billion on direct marketing last year, accounting for whopping 49% of total U.S. advertising expenditures. These expenditures generated an estimated $1.85 trillion in internet marketing sales, or about 7.4% of total sales in the U.S. economy. And internet marketing driven sales are growing rapidly. The Direct Marketing Association estimates that internet marketing sales will grow 7.1% annually through 2010, compared with a projected 5.2% annual growth for total U.S. sales.

Internet marketing continues to become more Web oriented, and Internet marketing is claiming a fast growing share of internet marketing spending and sales. The Internet now accounts for only about 18% of direct marketing driven sales. However, the Direct Marketing Association predicts that over the next five years Internet marketing expenditures will goes at a blistering 21% a year, three times faster than expenditures in other direct marketing media. Internet driven sales will grow by 14.7%.

Whether employed as a complete business model or as a supplement to a broader integrated marketing mix, direct marketing brings many benefits to both buyers and sellers.

4. *Benefits of Internet Marketing*

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I] Benefits to Buyers:- For buyers, internet marketing is convenient, easily, and private. Internet marketers never close their doors, and customers don't have to battle traffic, find parking spaces, and trek through stores to find products. Form the comfort of their homes and offices, they can browse catalogs or company Web sites at any time of the day or night. Buyers can learn about products and services without tying up time with salespeople. It gives buyers ready access to a wealth of products. It also gives buyers access to a wealth of comparative information about companies, products, and competitors.

II] Benefits to Sellers: - For sellers, It is a powerful tool for building customer relationships. Using database marketing, today's marketers can target small groups or individual consumers and promote their offers through personalized communications. Because of the one-to-one nature of internet marketing, companies can interact with customers online, learn more about their needs, and tailor products and services to specific customer tastes. It also offers sellers a low cost, efficient, speedy alternative for reaching their markets. It has grown rapidly in business to business marketing. It can also offer greater flexibility. It allows marketers to make ongoing adjustments to its prices and programs, or to make immediate and timely announcements and offers.

5. Analysis

Of the many masterpieces carved by us, Internet surely stays into the top five – this astounding network makes it possible for us to access globally available resources to dynamic knowledge, entertainment and much more. The expansion of this dimension over the conventional platforms has gone to such an extent that today, virtually every business and individual find at the least one significant activity of their own which is associated with the Internet.

Even in a country like India where computer literacy roughly touches 7 percent, a single day serves a whopping 65 million Internet users, making this nation a promising online market.

An online market, as opposed to the traditional (or offline) market system is a business place restricted to the Internet platform. Such a business platform can be accessed by any relevant resource - like a computer system of a multimedia supporting cellular phone. India is an upbeat consumer of electronics, and hence the introduction of higher amounts of users over to the Internet. Hence, even globally recognized technological giants have turned their heads over to us as a promising customer base.

So what is an Online Market – it is technically a bit different from what a routine businessman might expect, though the though remains the same. A company may wish to extend its name from the

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neighboring streets over to the Internet, the reasons being any or every of the following: Research, development, deployment and/or endorsement of any of its products which is or can be associated successfully with the Internet. An example of such a transaction can be any retail company – like an 'Electronic Store', which proposes to extend its shopping place to its own website, where people might browse through the various products and may even purchase one online. Simply developing his own website is no good for the retailer, since no one knows about the existence about his portal (even though he may be famous in his neighborhood). This is where 'Online Marketing' comes into the picture. With the various tools & techniques, this retailer can reach out to the online masses and make them aware of his website.

During the last decade, online campaigns primarily concentrated on sending promotional E-mails to random (and/or targeted segment of users). However, with the increase in such spam attacks, many E-mail clients have established an anti-spam filter for their users. So the next mode of reaching potential customers is by flaunting your business on fair to heavily trafficked websites. There are some categories of websites which attract more attention – search engines (like Google, Yahoo, etc.), Social Networking Websites (like Facebook, Twitter, etc.), Media Based Websites (like Online Music Portals, Youtube, etc.), Location Based Websites (like a city based portal) and so on. Such portals save as a potential platform for Online Marketing. An online marketing strategy can range from the display of simple text or graphic elements endorsing your brand to high end media elements like animated videos. Some businesses go ahead, offering contests, complimentary samples or free-to-use applications (like online games) that are in some way made to associate with their brand. This style of online marketing is termed as viral marketing, which in itself is a vast and ever-growing field in management studies.

6. Conclusion

E-commerce, as a vehicle to boost up trade, especially international trade, has already been recognized by international business community, especially in European Union, North American markets and some of the other developed nations like Japan, Singapore, Hong Kong, China etc. However, e-commerce and its related technologies are still in its infancy stage. Participation in ecommerce is certainly the keyword of success, especially in international trade for every country and its industries sooner or later and India and Indian industries, therefore, cannot be exception to it.

Unlike offline marketing, the online sibling has a different set of pre-requisites, benefits and disadvantages. A brand set to be marketed online needs to have a firm platform established over the

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Internet – maybe a website which will be reached by visitors who enroll in any of their promotional activity. The resources to be invested are much lower in amount in the case of Internet marketing, since one simply needs technical and financial aids to endorse the activity. One saves the hurdles experienced in local marketing, like allocation of zones & the various levels of recruitment, etc. One often finds companies who specialize in Online Marketing and who can provide you with professional end-to-end solutions for your needs. Also, with the ever-increasing number of visitors to the Internet, many such portals have extended their hands to aspiring businesses, thus creating promising prospects. Today, many brands employ the most creative of their resources to design a strategy which will amalgamate the various active platforms, so as to come up with a winning market penetration.

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E-Commerce & E-Business

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Introduction:

Even today, some considerable time after the so called 'dot com/Internet revolution', electronic commerce (e-commerce) remains a relatively new, emerging and constantly changing area of business management and information technology. There has been and continues to be much publicity and discussion about e-commerce. Library catalogues and shelves are filled with books and articles on the subject. However, there remains a sense of confusion, suspicion and misunderstanding surrounding the area, which has been exacerbated by the different contexts in which electronic commerce is used, coupled with the myriad related buzzwords and acronyms.
This book aims to consolidate the major themes that have arisen from the new area of electronic commerce and to provide an understanding of its application and importance to management.
In order to understand electronic commerce it is important to identify the different terms that are used, and to assess their origin and usage.
According to the editor-in-chief of *International Journal of Electronic Commerce*, Vladimir Zwass, 'Electronic commerce is sharing business information, maintaining business relationships and conducting business transactions by means of telecommunications networks'.
1. He maintains that in its purest form, electronic commerce has existed for over 40 years, originating from the electronic transmission of messages during the Berlin airlift in 1948.
2 .From this, electronic data interchange (EDI) was the next stage of e-commerce development. In the 1960s a cooperative effort between industry groups produced a first attempt at common electronic data formats. The formats, however, were only for purchasing, transportation
and finance data, and were used primarily for intra-industry transactions. It was not until the late 1970s that work began for national Electronic Data Interchange (EDI) standards, which developed well into the early 1990s. EDI is the electronic transfer of a standardised business transaction between a sender and receiver computer, over some kind of private network or value added network (VAN). Both sides would have to have the same application software and the data would be exchanged in an extremely rigorous format. In sectors such as retail, automotive, defence and heavy manufacturing, EDI was developed to integrate information across larger parts of an organization's value chain from design to maintenance so that manufacturers could share information with designers, maintenance and other partners and stakeholders. Before the widespread uptake and commercial use of the Internet, the EDI system was very expensive to run mainly because of the high cost of the private networks. Thus, uptake was limited largely to cash-rich multinational corporations using their financial strength to pressure and persuade (with subsidies) smaller suppliers to implement EDI systems, often at a very high cost. By 1996 no more

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than 50,000 companies in Europe and 44,000 in the USA were using EDI, representing less than 1 per cent of the total number of companies in each of the respective continents. According to Zwass, electronic commerce has been re-defined by the dynamics of the Internet and traditional e-commerce is rapidly moving to the Internet. With the advent of the Internet, the term e-commerce began to include:

- Electronic trading of physical goods and of intangibles such as information.
- All the steps involved in trade, such as on-line marketing, ordering payment and support for delivery.
- The electronic provision of services such as after sales support or on-line legal advice.
- Electronic support for collaboration between companies such as collaborative on-line design and engineering or virtual business consultancy teams.

Some of the definitions of e-commerce often heard and found in publications and the media are:
Electronic Commerce (EC) is where business transactions take place via telecommunications networks, especially the Internet.
3.Electronic commerce describes the buying and selling of products, services, and information via computer networks including the Internet
4. Electronic commerce is about doing business electronically
5. .E-commerce, ecommerce, or electronic commerce is defined as the conduct of a financial transaction by electronic means.
6 .The wide range of business activities related to e-commerce brought about a range of other new terms and phrases to describe the Internet phenomenon in other business sectors. Some of these focus on purchasing from on-line stores on the Internet. Since transactions go through the Internet and the Web, the terms *I-commerce* (Internet commerce), *icommerce* and even *Web-commerce* have been suggested but are now very rarely used. Other terms that are used for on-line retail selling include *e-tailing*, *virtual-stores* or *cyber stores*. A collection of these virtual stores is sometimes gathered into a '*virtual mall*' or '*cybermall*'.

E-BUSINESS

As with e-commerce, *e-business* (electronic business) also has a number of different definitions and is used in a number of different contexts. One of the first to use the term was IBM, in October 1997, when it launched a campaign built around e-business. Today, major corporations are rethinking their businesses in terms of the Internet and its new culture and capabilities
and this is what some see as e-business. E-business is the conduct of business on the Internet, not only buying and selling but also servicing customers and collaborating with business partners.
E-business includes customer service (e-service) and intra-business tasks. E-business is the transformation of key business processes through the use of Internet technologies. An e-business is a company that can adapt to constant and continual change.
The development of *intranet* and *extranet* is part of e-business. E-business is everything to do with back-end systems in an organisation. In practice, e-commerce and e-business are often used interchangeably

WHO E-CARES E-COMMERCE & E-BUSINESS

Some analysts and on-line business people have decided that e-business is infinitely superior as a moniker to e-commerce. That's misleading and distracts us from the business goals at hand. The effort to separate the E-commerce and E-business concepts appears to have been driven by marketing motives and is dreadfully thin in substance. Here's the important thing: E-commerce, E-business or whatever else you may want to call it is a means to an end. The different names, definitions and words referred to

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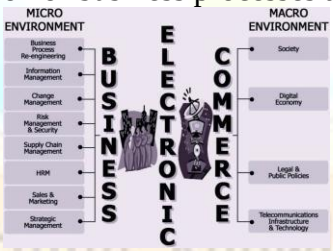
in the previous sections are merely a sample of the glossary that has originated from marketing departments to sell a concept, the media to describe a sensational
'new' phenomenon, consultants to justify their fees and recommendations, and business to validate and implement the new technology. In fact there is no one definitive meaning of e-commerce or e-business that is universally established. The different terms are used to illustrate different perspectives and emphases of different people in different organisations and business
sectors. Some argue that it makes little sense to have a restrictive definition for the term e-commerce since it is unlikely that there will be agreement on a single unique definition. 'Attempting to define E- commerce or E-business is guaranteed to generate Byzantine debates with meaningless origins. It reminds me of trying to answer the following question: "If one synchronized swimmer drowns, would the others follow?" Because of this trend, it is necessary when undertaking any electronic commerce, electronic business or any other e-related project or assignment, to clearly define any term in the context and environment in which it is being used.

AN E-DISTINCTION

For the purpose of clarity, the distinction between e-commerce and ebusiness in this book is based on the respective terms commerce and business. Commerce is defined as embracing the concept of trade, 'exchange of merchandise on a large scale between different countries'
By association, e-commerce can be seen to include the electronic medium for this exchange. Thus electronic commerce can be broadly defined as the exchange of merchandise (whether tangible or intangible) on a large scale between different countries using an electronic medium – namely the Internet. The implications of this are that e-commerce incorporates a whole socio-economic, telecommunications technology and commercial infrastructure at the macro-environmental level. All these elements interact together to provide the fundamentals of e-commerce. Business, on the other hand, is defined as 'a commercial enterprise as a going concern'. E-business can broadly be defined as the processes or areas involved in the running and operation of an organisation that are electronic or digital in nature. These include direct business activities such as marketing, sales and human resource management but also indirect
activities such as business process re-engineering and change management, which impact on the improvement in efficiency and integration of business processes and activities.



Conclusion:

In today's Globalization & Vast Competition the role of E commerce is very important for managing different activities in commerce. It plays effective role for conducting our Business Environment effectively & successfully.

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Management of Tribal Development Schemes

Research Guide

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Tribes of Maharashtra-

Tribes of Maharashtra constitute are the native residents of this region. Various kinds of tribal groups of Maharashtra with their culture, costume, tradition echoes the colour of the state. Tribes of Maharashtra are the primitive people of this region and are scattered in different parts of the state. Mostly they are the inhabitants of the hilly areas. Some of the tribes are of primitive and nomadic character. Tribes like Warli Tribe are some of the tribes that inhabit in the land of Maharashtra. Constitution of India recognises some these tribal groups as Scheduled Tribes. There are certain cultural aspects, which have made the culture and tradition of these tribes of Maharashatra enriched and ennobled. In other words their dialect, clothes, folklores, rites and practices show that these tribes of Maharashtra

Many of these tribes of Maharashtra have adapted to the lifestyle and culture of nomads and till today, these tribes of Maharashtra state have retained their originality intact. As per some scholars and anthropologists, Maharashtra has 313 nomadic tribal communities and 198 unnoticed tribal groups.These people are also adept in wood carving. Poultry farming, animal husbandry, cultivation are some of their major occupations. Apart from these, some of them earn their livelihood by selling forest products, and different articles of bamboo.

In Maharashtra, both the men and women of the Chodhari tribes are fond of wearing beautiful clothes. The people of this tribal community are vegetarian and they are basically agrarian people. Apart from this, they are also engaged in making clothes, tools, fishing, and jewellery etc. Tribal Development Department was in action under Social Welfare Dept. till 1972. The state government of Maharashtra established co-operative Tribal Developments Corporation in 1972. And the Tribal Development Dept. came into existence independently in 1973. Tribal sub-plan scheme was implemented during 1975-76. As a result, the direction of development did not remain only the welfare

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scheme, but it became the development scheme. Regional development programmes were empharized alongwith the growth of the individual. For the purpose, various government systems such as Director, Tribal Development Dept., Executive Director, Maharashtra State Tribal Development Corporation, Tribal Research & Training Institute were raised at state level.

The Tribal Development Dept. was restructured during 1992, for effective implementation of the schemes.

Administrative system-

Minister, Tribal Development Dept.

↓

State Minister, Tribal Development Dept.

↓

Principal Secretary Tribal Dept.

Commissioner Tribal Research & Training Institute, Pune	1. Administrative Director M.S. Tribal Corp. Ltd., Nasik 2. Shabari Tribal Finance & Dev. Corporation Ltd., Nasik	Commissioner Tribal Dept. Nashik
↓	↓	↓
Joint Commissioner Schedule Tribes validity Tribal Officer	Committee 24	Upper 4 Commissioner

Method of Structuring Tribal Development Sub-plan –

Expanses are provided for the implementation of Tribal Sub-plan by planning dept. to various governments departments. These expanses are regulated by these depts.. as per their will and priority. These government officers decide the schemes, programmes & developments works on which the expanses are to be spent. Figures were emphasized instead of giving benefits to the Tribals. In order to eliminate these errors, the state government pur forth the same during 5th year plan. A committee, headed by Honrable Sukathankar D. M. was constituted to analyze these facts. As per recommendation,

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the Finance Dept. provides funds to Tribal Dev. Dept. This departments regulates the expanses given to the actual Tribal beneficiaries.

Programmes under Tribal sub-plan –

The following programmes are implemented by Tribal Dev. Dept. for the individual & social development of the Tribals. In the state, sub-plans are executed under 12 titles. They are –

1. Agriculture & applied services.
2. Special Programme for Rural Development
3. Irrigation & Flood control
4. Electricity Generation.
5. Business & Minerals.
6. Transportation & Communication
7. General Finance Services.
8. Social & Collective Services
9. Healthy Water Supply & Worker Welfare
10. Backward Welfare
11. Worker & Worker Welfare
12. Nutrition

Brief analysis of Tribal sub-plan & the programmes under it –

1) Agriculture & Applied Services –

Development of farm productivity of Tribal Families, soil-co-servation, Fruit-productivity, Animal Husbandry, Milk products, Fishering, Forest Conservation.

2) Special programmes for Rural Development –

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Swarn Jayanti Gram Swayam Rojgar Yojana, Draught Zone Development, Labour Gaurantee Scheme, Indira Awas Yojana, Adarsh Gram Yojana come under this title.

3) Irrigation & Flood Control –

Facilities such as small canal & wares, trenches planning rood dooms, small pumps are provided under this head.

4) Power Generation -

Rural Electrification, Non-traditional power sources such as solar hearth, solar fence, solar lamps etc. are provided under this title.

5) Business & Minerals -

Seri-culture, seed money help to educated un-employed, District Business Centre, Training etc.

6) Transportation & Communication -

Road building, Narrow bridge, etc.

7) Social & Collective Services –

Public Education, sports & Youth welfare, Health Services, Water supply, Housing Development, Village Development, Welfare of Backwards, Worker Welfare, Social Welfare, etc. are provided under this title.

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Ahemadnagar District Annual Expenditure on Tribal Development Scheme Of Agriculture & applied services.

(Figures in lakhs) ü

Year	Granted Expenditure		Received Amount		Actual Expenditure	
	Integrated Tribal Development Programme	Additional Integrated Tribal Development Programme	Integrated Tribal Development Programme	Additional Integrated Tribal Development Programme	Integrated Tribal Development Programme	Additional Integrated Tribal Development Programme
2001-02	189.83	50.00	89.39	28.52	78.62	27.93
2002-03	185.43	52.19	46.75	13.60	64.40	11.15
2003-04	158.01	55.28	44.89	21.70	43.35	20.43
2004-05	19.57	15.96	12.00	7.55	12.00	7.55
2005-06	69.22	32.49	57.64	21.10	57.47	21.05
2006-07	72.26	37.03	48.67	30.97	48.09	29.61
2007-08	179.16	90.65	196.68	90.55	196.65	89.82
2008-09	169.22	40.08	260.04	49.42	259.59	49.42
2009-10	224.05	59.76	146.24	40.92	140.62	40.92
2010-11	171.70	84.93	136.54	71.36	135.64	70.92

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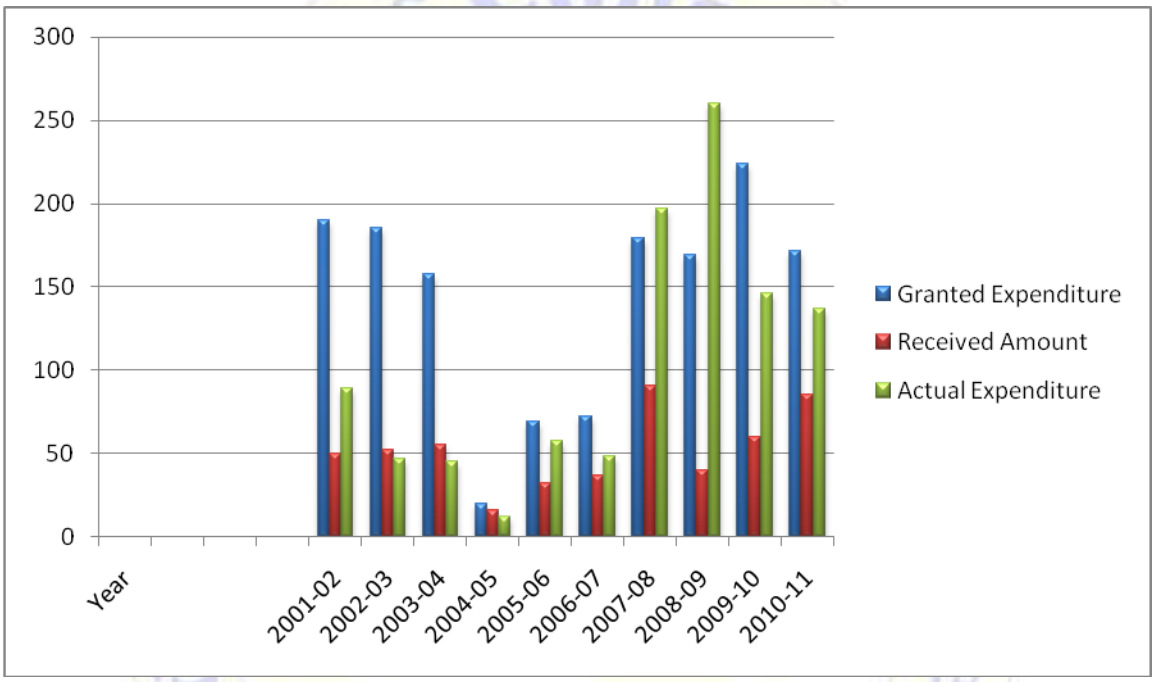
Chart showing Ahemadnagar District Annual Expenditure on Tribal Development Scheme Of Agriculture & applied services.

(Figures in lakhs)



In above table and chart under tribal development scheme Agriculture & applied services expenditure, granted expenditure, and actual expenditure between 2001-2002 to 2010-2011 are given. Provision made for both Integrated Tribal Development Programme and Additional Integrated Tribal Development Programme. Provision made in 2010-2011 is increase from 2001-2002. In 2003-04 provision and expenditure is very less in Integrated Tribal Development Programme. In 2004-05 provision and expenditure is very less in Additional Integrated Tribal Development Programme. In 2007-08 maximum provision and expenditure made in both Integrated Tribal Development Programme Additional Integrated Tribal Development Programme.

Conclusion – Maharashtra State Govt. established Tribal Development scheme Dept. As a result, the schemes for the Tribals could reach to them. By eliminating the errors, the schemes could be implemented effectively. Under tribal development scheme Agriculture & applied services both

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Integrated Tribal Development Programme and Additional Integrated Tribal Development Programme included. It helps tribal people .

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QUALITY- A KEY STRATEGIC FACTOR FOR BRANDING BUSINESS

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"Quality is never an accident; it is always the result of high intention, sincere effort, intelligent direction and skillful execution. It represents the wise choice of many alternatives." – Willa Foster

Abstract:

The importance of quality is a main concern for many organizations, both public and private. In today's global competition and economic liberalization, quality has become one of the important factors for achieving competitive advantage. A good quality product or service enables an organization to add and retain customers. Poor quality leads to discontented customers, so the costs of poor quality are not just those of immediate waste or rectification but also the loss of future sales. The business environment has become increasingly complex and the marketplace has changed from local to global. Constant pressure is applied on the management to improve competitiveness by lowering operating cost and improving logistic. Customers are becoming increasingly aware of rising standards, having access to wide range of products and services to choose from. There is an ever-increasing demand for quality product and/or services and this global revolution had forced organizations to invest substantial resources in adopting and implementing total quality management strategies. The subject of quality for a business or organization must be understood before it can be determined if it is important. The purpose of business is to attract customers and make a profit. This requires the ability to keep the customers they have and draw in new ones. One of the characteristics important to customers is quality. This cannot be denied in

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that those who have a great reputation and good customer service flourish in today's economy. The question to be answered is how businesses focus on quality principles and do they have quality high on their objectives/policy in their operational plan.

Keywords: Total Quality management, Quality, Strategic.

1 Introduction

The introduction of total quality management (TQM) has played an important role in the Development of contemporary management. Quality, considered a key strategic factor in Achieving business success, is more than ever required for competing successfully in today's global market place (Dean & Evans, 1994), and it has become the key slogan as organizations strive for a competitive advantage in markets characterized by liberalization, globalization and knowledgeable customers (Sureshchandar, Chandrasekharan, &Anantharaman, 2001). Total quality management (TQM) is an integrated organizational effort designed to improve quality at every level. However, defining quality is not as easy as it may seem, because different people have different ideas of what constitutes high quality. A good quality product or service enables an organization to add and retain customers. Poor quality leads to discontented customers, so the costs of poor quality are not just those of immediate waste or rectification but also the loss of future sales. Technological innovations have diffused geographical boundaries resulting in more informed customers. The business environment has become increasingly complex and the marketplace has changed from local to global. Constant pressure is applied on the management to improve competitiveness by lowering operating cost and improving logistic. Customers are becoming increasingly aware of rising standards, having access to wide range of products and services to choose from. There is an ever-increasing demand for quality product and/or services and this global revolution had forced organizations to invest substantial resources in adopting and implementing total quality management strategies.

TQM into a Business

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TQM is not an easy concept to introduce into businesses - particularly those that have not traditionally concerned themselves too much with understanding customer needs and business processes. In fact - many attempts to introduce TQM fail!

One of the reasons for the challenge of introducing TQM is that it has significant implications for the whole business.

For example, it requires that management give employees a say in the production processes that they are involved in. In a culture of continuous improvement, workforce views are invaluable. The problem is - many businesses have barriers to involvement. For example, middle managers may feel that their authority is being challenged.

So **"empowerment"** is a crucial part of TQM. The key to success is to identify the management culture before attempting to install TQM and to take steps to change towards the management style required for it. Since culture is not the first thing that managers think about, this step has often been missed or ignored with resultant failure of a TQM strategy.

2 What is the Role of Each Building Block in Managing Organizational Quality?

1. Continuous Quality Improvement – Superior quality/performance is not a luxury, it is essential to survival.

2. Process Focused Improvement – Poor service and outcomes is the result of process Deficiencies, not people deficiencies. Some organizations try to inspect quality after the fact.

3. Total Commitment of Senior Managers – As stated earlier, management commitment is vital to overcoming uncertainty, establishing credibility and providing the stability to allow change to gain a foothold in the organization. Senior managers must create and maintain buy-in for quality improvement at all levels of the organization.

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4. Customer Orientation – As described earlier, quality is achieved by knowing, meeting, and exceeding the customer's expectations.

5. Education and Training – Everyone must receive training on the organization's quality practices and values. All members of the workforce (the board, contractors, managers, and staff) must know the organization's quality values, goals for consumers/other stakeholders and the outcomes associated with these goals. This information must be provided to new members of the workforce.

6. Employee Participation in Making Improvements – Those that do the work are most Knowledgeable about how to improve it. They are frequently referred to as the "process owners." Empowering the workforce and helping everyone to be a change agent or steward for quality is critical to an organization's success with quality improvement.

7. Teamwork – Teamwork integrates behaviors that help the total organization exceed the sum of its parts. Teamwork promotes cooperation, coordination, information sharing, mutual support, consensus decision-making, etc. Working together across functions and departments, breaking down silos and problem-solving is critical drivers for improvement teams.

8. Recognition and Reward – People will act accordingly to how they are received and rewarded. QI thrives on the elimination of blame, finger pointing, and fire fighting.

9. Organizational Culture Supports Quality Goals – To create a culture of quality, an Organization must align its organizational processes with quality planning and desired Outcomes. Quality leadership starts with the leaders who plant the seeds, create the Environment for success, empower others and deploy quality throughout the organization.

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Source: Total Quality: Management, Organization and Strategy (1999) by Evans & Dean

3. Total Quality Management and Continuous Improvement:

TQM is the management process used to make continuous improvements to all functions.TQM represents an ongoing, continuous commitment to improvement. The foundation of total quality is a management philosophy that supports meeting customer requirements through continuous improvement.

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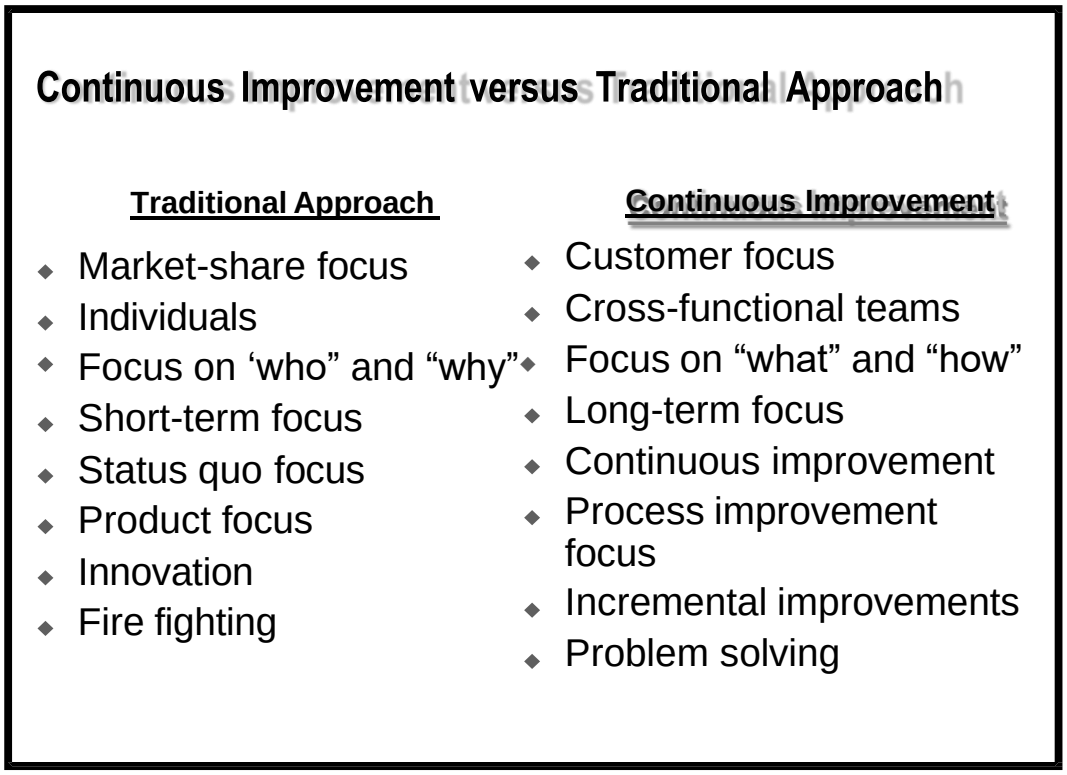

Total Quality Management

4 Cost of quality

Prevention costs are all costs incurred in the process of preventing poor quality from occurring. They include quality planning costs, such as the costs of developing and implementing a quality plan. Also included are the costs of product and process design, from collecting customer information to designing processes that achieve conformance to specifications. Employee training in quality measurement is included as part of this cost, as well as the costs of maintaining records of information and data related to quality.

Appraisal costs are incurred in the process of uncovering defects. They include the cost of quality inspections, product testing, and performing audits to make sure that quality standards are being met. Also included in this category are the costs of worker time spent measuring quality and the cost of equipment used for quality appraisal.

Internal failure costs are associated with discovering poor product quality before the product reaches the customer site. One type of internal failure cost is *rework*, which is the cost of

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correcting the defective item. Sometimes the item is so defective that it cannot be corrected and must be thrown away. This is called *scrap,* and its costs include

External failure costs are associated with quality problems that occur at the customer site. These costs can be particularly damaging because customer faith and loyalty can be difficult to regain. They include everything from customer complaints product returns, and repairs, to warranty claims, recalls, and even litigation costs resulting from product liability issues. A final component of this cost is lost sales and lost customers. For example, manufacturers of lunch meats and hot dogs whose products have been recalled due to bacterial contamination have had to struggle to regain consumer confidence.

5 Total *Quality Management & Business Excellence*

Total Quality Management & Business Excellence is an international journal which sets out to stimulate thought and research in all aspects of total quality management and to provide a natural forum for discussion and dissemination of research results. The journal is designed to encourage interest in all matters relating to total quality management and is intended to appeal to both the academic and professional community working in this area.

Total Quality Management & Business Excellence is the culture of an organization committed to customer satisfaction through continuous improvement. This culture varies both from one country to another and between different industries, but has certain essential principles which can be implemented to secure greater market share, increased profits and reduced costs.

The journal provides up-to-date research, consultancy work and case studies right across the whole field including quality culture, quality strategy, quality systems, tools and techniques of total quality management and the implementation in both the manufacturing and service sectors. No topics relating to total quality management are excluded from consideration in order to develop business excellence.

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Conclusion:

Total Quality Management (TQM) is an approach that seeks to improve quality and performance which will meet or exceed customer expectations. This can be achieved by integrating all quality-related functions and processes throughout the company. TQM looks at the overall quality measures used by a company including managing quality design and development, quality control and maintenance, quality improvement, and quality assurance. TQM takes into account all quality measures taken at all levels and involving all company employees.

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"Impact of Training and Development – A study of selected Manufacturing Industries in Aurangabad Industrial Area"

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Abstract

In todays global business, the ability to effectively train and develop the people we need is vital to our success.New training technologies do broaden our reach, but technology alone is seldom sufficient to achive our goals.In post crisis era, continuous learning is essential to success. Individuals need to learn to succeed in life and at work. Companies need to ensure their employees continue to learn effectively and efficiently, so they can keep up with increased job demands, and so the company can gain or maintain competitive advantage. The skills and performance of employees and managers must be upgraded continuously. Meeting this requirement involves efficient and effective training and development process and evaluating performance for the purpose of providing feedback and motivating employees to perform effectively. Over time, both jobs and tasks change in quality and quantity and as such, employees need to be trained in order to match the new demands of their work. If this is not done, instead of them working at current level or value, they would work at the old level which would in turn negatively affect the organization. This is because one cannot do today's work with yesterday's method and be in business tomorrow. Since global financial crisis leading to economic recession, the small and medium enterprises have been bearing the brunt of impact. In this paper, from the perspective of strengthening human resources training for solving the economic difficulties, the author analyses the patterned training concepts and models, explores the ways and measures of efficient and effective training and development methods.

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Introduction:-

In today's global business, the ability to effectively train and develop the people we need is vital to our success. Training makes a very important contribution to the development of the organizations human resources and hence to the achievement of its aims and objectives. To achieve its purpose, training needs to be effectively managed so that the right training is given to the right people, in the right form, at right time and at the right costs. The scope of training is no longer limited to developing knowledge and competencies in individuals. As considerable emphasis is placed on human relations in an organization and on promoting interpersonal effectiveness, training has acquired new dimensions in organizational functioning. Having recognized the role of training in enhancing productivity and improving organizational functioning, many public sector undertakings and business houses have established their own in house training infrastructure. The industries are supposed to change financial crisis into the development opportunities and more importantly strengthen the training of human resources. Besides, they need change, inherent training concepts and patterns, put effective training approaches and measures into practice and create training models and methods. The academic circles at home and abroad explore a variety of useful programs on how to deal with the global financial crisis, but have not got so much research findings from the point of enhancing human resource training for industries.

The Status and Issues of Human Resources Training for industries in Aurangabad

After the breakout of the financial crisis, due to the limited educational level of managers in some industries in our country, they are not aware that the training of human resources is an emerging industry; they do not have deep awareness of the functions of training; they even can not see the human resources is one of the most effective investment and one of the most important means to break the difficulties of the enterprise's development. On the contrary, they consider the input of the employees' training as a consumption investment. The purpose of the business is to make money, in their opinion, spending money on training is absolutely unnecessary, and will increase the cost of business. Besides, with the end of the training activities, training expenses will also gradually disappear, will not generate revenue. Hence the composition of industries in Aurangabad industrial area is such that only medium and large scale industries are going for training and development of employees. Aurangabad industrial area is one of the fastest developing industrial areas in Marathwada. Aurangabad was once the fastest developing city in Asia.

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Table No 1

Progress of Industries in Aurangabad

Name of of Industrial Area	Total Area (Ha)	Total Plots (No)	Plots Distributed	Remaining plots	Distribution Of sheds
chikalthana	719	758	752	6	93
Waluj	1521	1595	1522	73	100
Station road	34	81	77	4	6
Shendra	902	435	382	53	-

Source: joint Director of Industries, GOM, Aurangabad

Table No 2

Progress of Tiny, Small, Medium and Large scale units

Name of industrial area	No of units	Total investment (Rs Lakhs)	Employment (No)
MIDC: Railway station	27	1428	437
MIDC: Chikhalthana	216	27903	4142
MIDC: Waluj	633	130393	13358
MIDC: shendra	4	662	87
Aurangabad city	401	20940	3974
Total	1281	181326	21998

Source: Joint director of industries, GoM, Aurangabd

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Table No 3

Major industrial enterprises with FDI & EOU

Scale of industries	Amount invested	No of units
Medium and Large scale	5268 cr	79

Source: Joint Director of industries, GoM, Aurangabd

The medium and large scale industries understudy were found to use both behavioral and on the job training methods. Behavioral methods are more of giving practical training to the trainees. The various methods under behavioral approach allow the trainee to behave in real fashion. These methods are best used for skill development.

The various methods that come under behavioral approach are

Games and Simulations: Games and Simulations are structured and sometimes unstructured, that are usually played for enjoyment sometimes are used for training purposes as an educational tool. Training games and simulations are different from work as they are designed to reproduce or simulate events, circumstances, processes that take place in trainees' job.

Behavior Modeling uses the innate inclination for people to observe others to discover how to do something new. It is more often used in combination with some other techniques.

Business games are the type of simulators that try to present the way an industry, company, organization, consultancy, or subunit of a company functions. Basically, they are based on the set of rules, procedures, plans, relationships, principles derived from the research.

Case Studies try to simulate decision making situation that trainees may find at their work place. It reflects the situations and complex problems faced by managers, staff, HR, CEO, etc. The objective of the case study method is to get trainees to apply known concepts and ideologies and ascertain new ones. The case study method emphasize on approach to see a particular problem rather than a solution. Their solutions are not as important as the understanding of advantages and disadvantages.

In-Basket Technique – It provides trainees with a log of written text or information and requests, such as memos, messages, and reports, which would be handled by manager, engineer, reporting officer, or administrator.

Role play is a simulation in which each participant is given a role to play. Trainees are given with some information related to description of the role, concerns, objectives, responsibilities, emotions, etc. Then, a general description of the situation, and the problem that each one of them faces, is given.

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On the job training:- The development of a manager's abilities can take place on the job. The four techniques for on the job development are:

Coaching is one of the training methods, which is considered as a corrective method for inadequate performance. According to a survey conducted by International Coach Federation (ICF), more than 4,000 companies are using coach for their executives. These coaches are experts most of the time outside consultants. A coach is the best training plan for the CEO's because

- it is one to one interaction
- It can be done at the convenience of CEO
- it can be done on phone, meetings, through e-mails, chat

Mentoring is an ongoing relationship that is developed between a senior and junior employee. Mentoring provides guidance and clear understanding of how the organization goes to achieve its vision and mission to the junior employee.

Job rotation takes on different perspectives. The executive is usually not simply going to another department. In some vertically integrated organizations, for example, where the supplier is actually part of same organization or subsidiary, job rotation might be to the supplier to see how the business operates from the supplier point of view. Learning how the organization is perceived from the outside broadens the executive's outlook on the process of the organization. Or the rotation might be to a foreign office to provide a global perspective.

Job Instruction Technique (JIT) uses a strategy with focus on knowledge (factual and procedural), skills and attitudes development.

Techniques used in Training and Development in Aurangabad Industrial Area:-

40% industries in Aurangabad followed the behavioral pattern of training the employees. This pattern was found to be among the managerial level and middle level employees. 60% were given on the job training; this was a fact which had some reservations, the industries which were effected in someway or the other way with crises carried on the same system of on the job training which is much cheaper in terms of other options of behavioral and cognitive method of Training and Development.

The methods which can prove to be effective apart from behavioral and on the job training are cognitive method and off the job training method. HR department were unable to define what exactly person need to do after induction, infect during the course of interview it was revealed that only MNC's had a definite way of recruitment, training & Development process, similarly there was virtually no system of training and

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development in medium scale industries and the only training which they gave was to an employee doing a specialist job, that too on the job training with other employee was given. This speaks volume that the methods through they are tailor made but there is insensitivity in using them for training and developing the HR in their organizations.

The various methods that come under cognitive approach are:-

a) Lecture method:- It is one of the oldest methods of training. This method is used to create understanding of a topic or to influence behavior, attitudes through lecture.

b) Demonstration:- This method is a visual display of how something works or how to do something. As an example, trainer shows the trainees how to perform or how to do the tasks of the job. In order to be more effective, demonstration method should be should be accompanied by the discussion or lecture method.

c) Discussions:- This method uses a lecturer to provide the learners with context that is supported, elaborated, explains, or expanded on through interactions both among the trainees and between the trainer and the trainees. The interaction and the communication between these two make it much more effective and powerful than the lecture method.

d) Computer based training (CBT):- With the worldwide expansion of companies and changing technologies, the demands for knowledge and skilled employees have increased more than ever, which in turn, is putting pressure on HR department to provide training at lower costs. Many organizations are now implementing CBT as an alternative to classroom based training to accomplish those goals.

e) Intelligent tutorial systems (ITS):- This Intelligent Tutorial system uses artificial intelligence to assist in training or tutoring the participants. This system learns through trainee responses.

Off the job training:- the various methods of off the job training are

Sensitivity training is about making people understand about themselves and others reasonably, which is done by developing in them social sensitivity and behavioral flexibility.

Transactional Analysis provides trainees with a realistic and useful method for analyzing and understanding the behavior of others. In every social interaction, there is a motivation provided by one person and a reaction to that motivation given by another person. This motivation reaction relationship between two persons is a transaction.

Games and Simulations are structured and sometimes unstructured, that are usually played for enjoyment sometimes are used for training purposes as an educational tool. Training games and simulations are different from work as they are designed to reproduce or simulate events, circumstances, processes that take place in trainees' job.

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Conclusion and Recommendations:-

Staff training and development has been identified by various scholars and anchors to be very crucial to an organization and its effectiveness. In the light of the above, organizations are therefore encouraged to train and develop their staff to the fullest advantage in order to enhance their effectiveness. As training reduces the work of the manager in terms of close supervision it also Improves the drive, initiative and quality of work of the employees thus assist them to be more committed to achieving the goals and objectives of the organization and this has the tendency of enhancing effectiveness among workers within the organization. In the current context of the global financial crisis, the SMEs should combine the actual situations, take active and effective human resources management and development strategy and adapt excellent human resources development services for enterprises for improving the ability of translating crisis into opportunities for development, enhancing the capacity and adaptability, achieving sustainable development and establishing themselves in an invulnerable position. However, for any organization to succeed, training and re-training of all staff in form of workshops, conferences and seminars should be vigorously pursued and made compulsory.

It is high time that industries take conscientious lead in training and development of there manpower in Aurangabad industrial area for effective and qualitative output.

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Six Sigma – Exploring the new horizon in world class manufacturing technology

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ABSTRACT

We have all had the experience of purchasing a product only to discover that it is defective in some way or does not function the way it was designed to. This could be a new backpack with a broken zipper or an "out of the box" malfunctioning computer printer. Many of us have struggled to assemble a product the manufacturer has indicated would need only "minor" assembly, only to find that a piece of the product is missing or defective. As consumers, we expect the products we purchase to functions intended. However, producers of products know that it is not always possible to inspect every product and every aspect of the production process at all times. The challenge is to design ways to maximize the ability to monitor the quality of products being produced and eliminate defects. One way to ensure a quality product is to build quality into the process.

The research paper explores six sigma and the terminologies associated with it. It goes on explaining the concept of six sigma by taking real life examples into consideration.

Six Sigma – An Introduction

Six Sigma is a business management strategy, originally developed by Motorola that today enjoys wide-spread application in many sectors of industry. Six Sigma seeks to identify and remove the causes of defects and errors in manufacturing and/or service delivery and business processes. It uses a set of management methods, including statistical methods, and creates a dedicated infrastructure of people

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within the organization who are experts in these methods. Six Sigma aims to deliver "Breakthrough Performance Improvement" from current levels) in business and customer relevant operational and performance measures.

Six Sigma initiatives are planned and implemented in organizations on "Project by Project" basis. Each project aims not only to improve a chosen performance metric but also sustain the improvement achieved. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified financial targets (revenue increase, cost reduction or profit increase).

Levels in Six Sigma

A value from 1 to 6 that signifies the maximum number of defects per million:

1 Sigma = 690,000 defects/million = 31% accurate

2 Sigma = 308,537 defects/million = 69.1463% accurate

3 Sigma = 66,807 defects/million = 93.3193% accurate

4 Sigma = 6,210 defects/million = 99.3790% accurate

5 Sigma = 233 defects/million = 99.9767% accurate

6 Sigma = 3.4 defects/million = 99.999997% accurate

Six Sigma relies heavily on advanced statistical methods that complement and reduce the process and product variations. It is a new way of doing business that would eliminate the existing defects efficiently and would prevent defects from occurring.

It is a methodology to improve a business process by constantly reviewing, updating and re-tuning the existing process. Six Sigma improves the process performance, decreases variation and maintains consistent quality of the process output. This leads to defect reduction and improvement in profits, employee morale, product quality and finally customer satisfaction.

Six Sigma strives for perfection. It allows for only 3.4 defects per million opportunities for each product or service transaction. It relies heavily on statistical techniques to reduce defects and measure quality.

Six Sigma – Historical Background

Six Sigma was originally developed as a set of practices designed to improve manufacturing processes and eliminate defects, but its application was subsequently extended to many other

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types of similar business processes as well. In Six Sigma, a defect is defined as anything that could lead to customer dissatisfaction and / or does not meet business set specifications.

The elements of the methodology were first formulated by Bill Smith at Motorola in 1986. Six Sigma was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects, based on the work of pioneers such as Shewhart, Deming, Juran, Ishikawa, Taguchi and others.

Like its predecessors, Six Sigma asserts that:

• Continuous efforts to achieve stable and predictable process results (i.e. reduce process variation) are of vital importance to business success.

• Manufacturing and business processes have characteristics that can be measured, analyzed, improved and controlled.

• Achieving sustained performance and quality improvement requires commitment from the entire organization, particularly from top-level management.

Understanding Statistical Terminologies in Six Sigma

1. **Population:** The total number of items from which a sample is taken.
2. **Sample:** is a subset of population that is to make inference about the population. Typically, the population is very large, enumeration of all the values in population impractical or impossible. Samples are expected to be selected in such a way as to avoid presenting a biased view of the population.
3. **Understanding Variation**: consider the situation -1 below

- A person goes for grocery shopping only to select the slowest cash counter in the store.
- He received a haircut that was shorter or longer than usual, and definitely not what he asked for,
- He decided to go shoe shopping, but got stuck with the most ignorant salesperson available.

Consider the situation -2 below:

- The same person went to grocery shopping and reached the fastest cash counter in the store.
- He received a haircut that was exactly as he wanted.
- He decided to go shoe shopping, and the best salesperson in the shop.

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Sure, the person must be happy being in situation-2, but what about the times when the same person is in situation-1? Often we wonder why this variation?

Let's examine a few ways to help us evaluate variation in processes:

Let's say that on your way home you stop at your local pizza shop to order a pizza that you (and your family) are waiting for. We will consider the general concept of variation by examining the preparation time (in minutes) of 10 pizzas being prepared by the two local shops. The times are listed below.

ABC pizza	6.5	6.6	6.7	6.8	6.8	6.9	7	7.1	7.2	7.3
XYZ pizza	4.2	5.4	5.8	6.2	6.7	7.2	7.2	8.5	9.3	10

If we use common statistical tools, such as mean, median, mode we get the following results.

4. **Mean:** The mean is the average data point value within a data set.

To calculate the mean, add all of the individual data points then divide that figure by the total number of data points. Calculating the mean (x bar) in both cases, we get

- Mean for ABC pizza=6.89
- Mean for XYZ pizza=7.05

5. **Median:** relating to or constituting the middle value in a distribution. The median is the middle point of a data set, 50% of the values are below this point, and 50% are above point. Median is the middle value, when all possible values are listed in an ascending order. (If number of data points (n) is even, then median is average of $\frac{n}{2}_{th}$ and $(\frac{n}{2}+1)^{th}$ reading. If the data points is odd, then median)

In this example, median will be average of the 5^{th} and 6^{th} reading.

Calculating the median in the both cases, we get

- Median for ABC pizza=6.85
- Median for XYZ pizza=6.95

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6. **Mode:** The value, that occurs most frequently in a series of observations or statistical data. The most often value in the data set. So, the mode in both cases will be:
   - Mode for ABC pizza=6.8
   - Made for XYZ pizza=7.2

	ABC pizza	xyz pizza
Mean	6.89	7.05
Median	6.85	6.95
Mode	6.8	7.2

You can see from these results that the two pizza shops have nearly equal "means". So, on an average, customers wait for pizzas at the two shops.

However, we can see a very clear difference: ABC pizza has preparation times with much less variation than the times for XYZ pizza.

7. **Range:** The easiest way to measure variation in a process is the range. It is simply the difference between the highest value and the lowest value among the data points.

By inspection and comparing the difference in variation between the preparation times of the two pizza companies, we get an idea of variation. But in business, we need more than an idea we need to measure and quality the process- variation.

- Range for ABC pizza =0.8
- Range for XYZ pizza =5.8

The much larger range in case of XYZ pizza shows that their process has much larger variation than the ABC pizza.

8. Statistical Deviation as a measure of Process Variation:

The standard deviation (s) of a set of sample data is measure of variation of the data

Sample standard deviation = Sigma = s== $\sqrt{\frac{\sum_{i=1}^{n}(xi-xbar)\,square}{n-1}}$

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Using this formula we can now compare the variation of two pizza companies and note that

Standard deviation for ABC pizza =0.26

Standard deviation for XYZ pizza=1.8

Thus the standard division for ABC pizza (0.26 minutes) is much lower than the standard deviation for XYZ pizza (1.8 minutes). In other words, the variation in ABC pizza process is much less than the variation in the XYZ pizza process. In our definition of standard deviation, we have referred to the standard deviation of sample data as S.

If we want to calculate the standard deviation (σ) of a population, we would divide by the population size N, instead of n-1.

Population standard deviation=sigma=σ =

$$= \sqrt{\frac{\sum_{i=1}^{n}(\text{xi} - \text{xbar})\,\text{square}}{n-1}}$$

9. **Variance:** It is another measurement of spread of distribution which indicates how it's possible values are spread around the expected value.

$$S^2 = \frac{\sum_{i=1}^{n}(\text{xi}-\text{xbar})\,\text{square}}{n-1}$$

10. Six Sigma Process:

- The term "Six Sigma process" is a process having six standard deviations between the mean and the nearest specification limit, so that you will make practically no items that will exceed the specification. Therefore there will be no possibilities of defects.

- Achieving a six sigma level of quality means the processes are producing max 3.4 defects per million opportunities (DPMO).

- Six Sigma is a problem solving methodology that can be applied to any process to eliminate the root causes of defects and associated causes.

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- A process is said to be operating at "six sigma level", when the estimated part to part variation is 50% of tolerance.
- For six sigma process, the estimated defect percentage due to part to part variation is 0.002 PPM considering the process mean is centered.
- For the six sigma process, the estimated defect percentage due to part to part variation is 3.4 PPM considering the process mean is shifted by 1.5 sigma from target value.
- Objective of six sigma initiative to make all the process operates at "six sigma level".

11. **Specification/Tolerance**: It is the permissible limit of variation in a dimension or value of a parameter of a manufactured object.
12. **Defects per unit (DPU) and Defects per million opportunities (DPMO):** DPU is the number of defects observed in given unit of products or process.

$$DPU=\frac{NO\ of\ defects\ detected\ (at\ given\ review\ point)}{No\ of\ units\ processed\ at\ that\ review\ point}$$

Defects per million opportunities (DPMO):

$$DPMO=DPU\times\frac{10,00,000\ (1\ million)}{oppotunities\ for\ error\ per\ unit}$$

13. **PPM:** This acronym stands for parts per million. It is another way of representing DPMO in Six Sigma.
14. **Process capability (Cp):** It is the statistical measure of inherent variation for a given characteristics in a stable process.

In other words, it's the measure of the ability of a process to produce outputs that meets the specification.

It expresses the range of the natural variation as determined by common cause. It answers the question "Is my process good enough?"

15. **Process Capability Index (Cp_k):** Cp_k stands for process capability index. Cp_k tells us, how close the process average with reference to specifications (target value). If Cp_k is negative, the process mean is outside the specification limits.

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Facts stating six sigma results

Company	Annual Savings
General Electric	$2.0+ billion
JP Morgan Chase	*$1.5 billion (*since inception in 1998)
Motorola	$ 16 billion (*since inception in 1980s)
Johnson & Johnson	$500 million
Honeywell	$600 million

- There is variation between part to part in the manufacturing process of various.
- There is common cause and assignable cause present in process, which should be totally avoided.
- Many times operator do not follows the Standard Operating Procedure (SOP).
- Mistake proofing technique are not present the manufacturing area.
- Many times operators approach is casual while handling jobs and using of measuring instruments.
- Six Sigma Savings as % of revenue vary from 1.2 to 4.5 %
- For $ 30 million/yr sales – Savings potential $ 360,000 to $ 1.35 million.
- Investment: salary of in house experts, training, process redesign.

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"Competitive advantage through cogeneration system using environmental factors in manufacturing industries"

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Introduction:

Cogeneration first appeared in late 1880s in Europe and in the U.S.A. during the early parts of the 20th century, when most industrial plants generated their own electricity using coal-fired boilers and steam-turbine generators. Many of the plants used the exhaust steam for industrial processes.

When central electric power plants and reliable utility grids were constructed and the costs of electricity decreased, many industrial plants began purchasing electricity and stopped producing their own. Other factors that contributed to the decline of industrial cogeneration were the increasing regulation of electric generation, low energy costs which represent a small percentage of industrial costs, advances in technology such as packaged boilers, availability of liquid or gaseous fuels at low prices, and tightening environmental restrictions.

The aforementioned trend in cogeneration started being inverted after the first dramatic rise of fuel costs in 1973. Systems that are efficient and can utilise alternative fuels have become more important in the face of price rises and uncertainty of fuel supplies. In addition to decreased fuel consumption, cogeneration results in a decrease of pollutant emissions. For these reasons, governments in Europe, U.S.A. South East Asia and Japan are taking an active role in the increased use of cogeneration. In India, the policy changes resulting from modernized electricity regulatory rules have induced 710 MW of new local power generation projects in Sugar Industry. Other core sector industries are also already moving towards complete self generation of heat and electricity.

Key words: Cogeneration system, Environmental Factors, Renewable sources of energy.

What is cogeneration?

By definition, Cogeneration is on-site generation and utilisation of energy in different forms simultaneously by utilising fuel energy at optimum efficiency in a cost-effective and environmentally responsible way. Cogeneration systems are of several types and almost all types primarily generate electricity along with making the best practical use of the heat, which is an inevitable by-product.

The most prevalent example of cogeneration is the generation of electric power and heat. The heat may be used for generating steam, hot water, or for cooling through absorption chillers. In a broad sense, the system, that produces useful energy in several forms by utilising the energy in the fuel such that overall efficiency of the system is very high, can be classified as Cogeneration System or as a Total Energy System. The concept is very simple to understand as can be seen from following points.

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1) Conventional utility power plants utilise the high potential energy available in the fuels at the end of combustion process to generate electric power. However, substantial portion of the low-end residual energy goes to waste by rejection to cooling tower and in the form of high temperature flue gases.

2) On the other hand, a cogeneration process utilises first the high-end potential energy to generate electric power and then capitalises on the low-end residual energy to work for heating process, equipment or such similar use.

Cogeneration in industries:

All continuous process chemical plants such as fertilizers, petrochemicals, hydrocarbon refineries, paper and pulp manufacturing units, food processing, dairy plants, pharmaceuticals, sugar mills, etc always require an uninterrupted input of energy in the form of electric power and steam to sustain the critical chemical processes. It is established fact that if these types of industrial plants set up the cogeneration systems with an appropriate power-and-heat balance, they would be able to achieve optimum cogeneration plant efficiency with best possible use of fuel, the primary source of energy.

Small continuous process chemical industrial units generally depend on the grid power, while generating process steam through conventional fired industrial boilers. Large and medium scale chemical industries can implement duly engineered feasible cogeneration system to meet their requirement of essential energy inputs - power and steam (at a desired parameters) achieving better availability, reliability and economics of the plant operations.

Cogeneration technology:

A proper selection of a cogeneration system configuration, from a few basic system, makes it feasible to produce first either electrical energy or thermal energy.

1. Steam turbine based cogeneration system

2. Gas turbine based cogeneration system

3. Combined steam/gas turbine based cogeneration system

4. Reciprocating engine based cogeneration system

Most widely used cogeneration systems in the chemical process industrial plants are based on steam turbine, gas turbine or combined steam/gas turbine configurations with installations based on reciprocating engine configuration in moderate number. These configurations are widely accepted by the industries due to their proven track record and easy commercial availability of required equipment.

Factors for selection of cogeneration system:

1.Normal as well as maximum/minimum power load and steam load in the plant, and duration for which the process can tolerate without these utilities, i.e. criticality and essentiality of inputs.

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2. What is more critical - whether power or steam, to decide about emergency back-up availability of power or steam.

3. Anticipated fluctuations in power and steam load and pattern of fluctuation, sudden rise and fall in demand with their time duration and response time required to meet the same.

4. Under normal process conditions, the step by step rate of increase in drawl of power and steam as the process picks up - whether the rise in demand of one utility is rapid than the other, same or vice-versa.

5. Type of fuel available - whether clean fuel like natural gas, naphtha or high speed diesel or high ash bearing fuels like furnace oil, LSHS, etc or worst fuels like coal, lignite, etc., long term availability of fuels and fuel pricing.

6. Commercial availability of various system alternatives, life span of various systems and corresponding outlay for maintenance.

7. Influence exerted by local conditions at plant site, i.e. space available, soil conditions, raw water availability, infrastructure and environment

8. Project completion time, cost and long term benefits

Operating strategies for cogeneration plant:

1. The cogeneration plant is operated as base load station to supply electric power and thermal energy and short fall in power is drawn from the utility company and heat from standby boilers or thermal fluid heaters.

2. The cogeneration plant is operated to supply electric power in excess of the industry's requirements, which may be exported, if feasible, to nearby consumers, whilst total thermal energy and heat energy available is utilised in the industry.

Techno-economic advantages of cogeneration technology:

1. The cogeneration technology's conformance to vital and widely discussed concept of energy conservation due to highly efficient use of fuel energy through system optimisation studies prior to project execution.

2. With relatively lower capital cost and low operating cost, due to high overall plant efficiency, the cost of power and steam becomes economically quite attractive for the industry. Recurring costs are also lesser.

3. Industrial cogeneration plants supplement the efforts of the state electricity boards to bridge the ever-widening gap between supply and demand of power by very efficient power generation in-house.

4. As electricity from a cogeneration system is generally not required to be transferred over a long distances, the transmission and distribution losses would be negligible.

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5. Reliability of cogeneration systems is very high, which also reduces dependency of industries on the state electricity board grids for power requirements to bear minimum. This would save the plant from unexpected disturbances of power system.

6. Impact on environmental pollution from cogeneration system is low in comparison to large size power plants due to less consumption of fuel and efficient operation.

7. If cogeneration systems are implemented in sugar mills or rice mills, totally renewable source of energy or waste fuel such as bagasse or rice husk can be used to fire the boiler to generate steam. This steam can be used to drive the steam turbine. This would save the precious national fossil fuel resources.

Advantages/Disadvantages of cogeneration system variants:

Variant	Advantages	Disadvantages
Back Pressure Steam Turbine and Fuel firing in Conventional Boiler	- High fuel efficiency rating - Very simple Plant - Well suited to all types of fuels of high or low quality - Good part load efficiency - Moderate relative specific capital cost	- Little flexibility in design and operation - More impact on environment in case of use of low quality fuel - Higher civil construction cost due to complicated foundations
Extraction-cum-Condensing Steam Turbine and fuel firing in Conventional Boiler	- High flexibility in design and operation - Well suited to all types of fuels, high quality or low quality - Good part load efficiency - More suitable for varying steam demand	- More specific capital cost - Low fuel efficiency rating, in case of more condensing - More impact on environment in case of use of low quality fuel - Higher civil construction cost due to complicated foundations - High cooling water demand for condensing steam turbine
Gas Turbine with Waste Heat Recovery Boiler	- High fuel efficiency at full load operation - Very simple plant - Low specific capital cost - Lowest delivery period, hence low gestation period - Less impact on environment (with use of clean fuels) - Least maintenance option - Quick start and stop - Still better efficiency with supplementary firing in Waste heat recovery boiler -Least cooling water requirement	- Moderate part load efficiency - Limited suitability for low quality fuels - Not economical, if constant steam load a problem

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Combined Gas and Steam Turbine with Waste Heat Boiler - Optimum fuel efficiency rating - Relatively low specific capital cost - Least gestation period	- Optimum fuel efficiency rating - Relatively low specific capital cost - Least gestation period - Less impact on environment - High operational flexibility - Quick start and stop - Still better efficiency with supplementary firing in Waste heat recovery boiler	- Average to moderate part load efficiency - Limited suitability for low quality fuels - High civil construction cost due to more and complicated foundations/buildings - More cooling water demand with condensing steam turbine
Reciprocating Engine and Waste Heat Recovery Boiler with Heat Exchanger	- Low civil construction cost due to block type foundations and least nos. of auxiliaries - High electrical power efficiency - Better suitability as emergency standby plant - Least specific capital cost - Low cooling water demand	- Low overall plant efficiency in cogeneration mode - Suitability for low quality fuels with high cleaning cost - High maintenance cost - More impact on environment with low quality fuel - Least potential for waste heat recovery

Conclusion:

It is universally accepted fact that the primary sources of energy like fuels are fast depleting as they all are non-renewable in nature. The costs of these primary sources of energy have been showing upward trend since last twenty years or so. Hence, it has become a challenge for all developing nations to save energy to a much greater extent so as that the primary sources of energy last longer and longer.

Based on discussion, it can be authentically said that use of cogeneration system in industrial sector is one of the best viable options for energy conservation in the most effective and economical way. Depending on type of process or industry, its requirement of power and steam, their essentiality, etc., an appropriate cogeneration system can be easily selected.

Thus, it is essential for management to look into the aspects of cogeneration system for competitive advantage by using these economically cheap and easy available forms of energy generation.

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GREEN MANUFACTURING: NEED FOR TODAY'S INDUSTRIAL SUCCESS.

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INTRODUCTION

Green Manufacturing is part of a continuous improvement strategy helping manufacturers improve their productivity, profitability and competitiveness. Green seamlessly integrates with Lean Manufacturing practices to optimize processes resulting in improved environmental, worker health and safety and energy performance. Generating waste costs money. You pay for it three times over - when you buy it, when you process it and when you dispose of it. Using environmental best practices to eliminate the "other wastes" is the next logical step in the Lean transformation. Green manufacturing is a term used to describe manufacturing practices that do not harm the environment during any part of the manufacturing process. It emphasizes the use of processes that do not pollute the environment or harm consumers, employees, or other members of the community. Green manufacturing addresses a number of manufacturing matters, including recycling, conservation, waste management, water supply, environmental protection, regulatory compliance, pollution control, and a variety of other related issues. The center for Green Manufacturing at the University of Alabama defines the goal of green manufacturing as *"To prevent pollution and save energy through the discovery and development of new knowledge that reduces and/or eliminates the use or generation of hazardous substances in the design, manufacture, and application of chemical products or processes."* In *Bridge to a Sustainable Future (*April 1995), the Clinton White House defined an environmental technology as a technology that

- reduces human and ecological risks,

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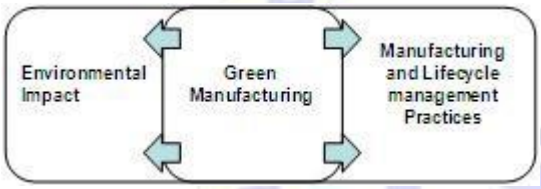
- enhances cost effectiveness,
- improves process efficiency, and
- creates products and processes that are
- environmentally beneficial or benign."

Manufacturing plays a very strategic role in an organization, especially to build competitive advantage and improve performance. With rapid changes in technology, customer needs and globalization, manufacturing itself is constantly transforming and evolving. The beginning of the century saw the automobile industry introduce the mass production techniques which revolutionized manufacturing processes. Over the years the need for meeting individualistic customer demands without compromising productivity or quality, brought about the introduction of flexible and mass customization techniques.



The focus is now on Green manufacturing. Recent volatility in the price of fossil fuels and global awareness about the finite nature of our resources is creating the need for a more sustainable way of how we produce and use. Green manufacturing itself is not new. The concept has been around for a couple of decades, but has never received much attention from manufacturers except for participation in seminars and scoring well in polls and surveys. However recent trends show that with the heightened focus on climate change, a transformation of mindset is happening and so positive action is now finally imminent. There are many interpretations of green manufacturing and all convey similar meaning. According to Melnyk and Smith, it is a system that integrates product and process design issues with issues of manufacturing, planning and control in such a manner as to identify, quantify, assess, and manage the flow of environmental waste with the goal of reducing and ultimately minimizing environmental impact while also trying to maximize resource efficiency.

Green Manufacturing is also known by plethora of different names: Clean manufacturing, environmentally conscious manufacturing, environmentally benign manufacturing, environmentally responsible manufacturing and Sustainable manufacturing. Irrespective of the various acronyms, the primary goal remains the same - designing and delivering products that minimize negative effects on the environment through their production, use, and disposal.

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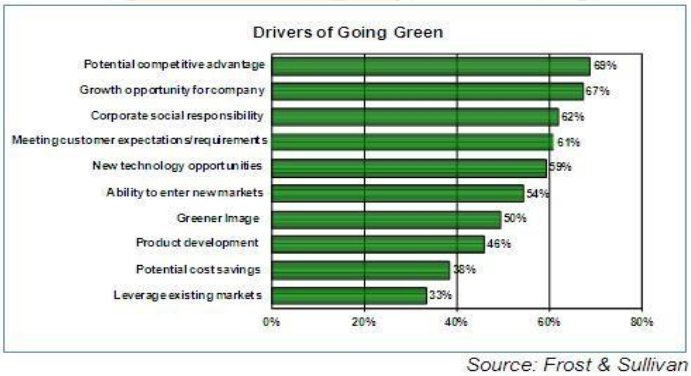
The fundamentals of green manufacturing are very simple and relate to minimizing the use of resources and the environmental impact of a product. This philosophy is extended to all the elements of its life cycle - from its design to its end of life.

There are tremendous opportunities which will arise with Green manufacturing. Each element of this cycle has the potential to be an industry by itself, given the rapid growth rate and demand it is expected to generate in the mid to long term. Although it is very difficult to estimate the market size for green manufacturing, industry experts feel this would be very significant in the coming decade. As government, companies and consumers realize the importance of going green the barriers for investment in these technologies is expected to fall rapidly.

THE DRIVERS FOR GREEN



Source: Frost & Sullivan

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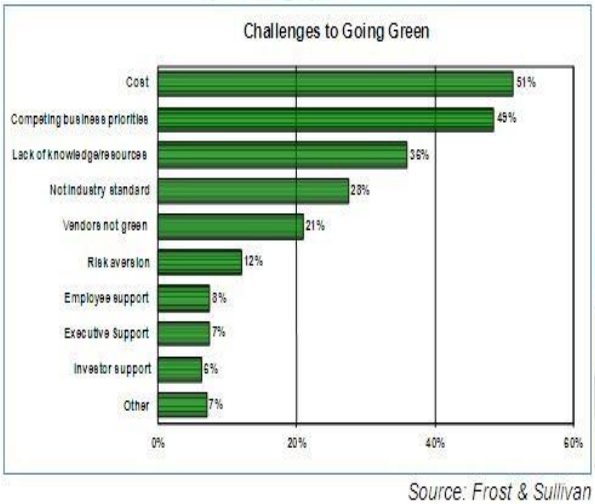
There are many drivers which are expanding the boundaries for green manufacturing. Frost & Sullivan recently conducted a survey among senior industry leaders to find some of the drivers for going green. A growing number of executives today feel that going green will help them to compete more effectively in the marketplace in the long term. Also organizations tend to conform to implicit expectations of their communities, which is another driver of change. In summary the major drivers can be grouped into three key areas:

1. Competitiveness: The natural desire of manufacturing firms to improve its processes and capabilities for competitive advantage. This can manifest in terms of technology, new product and process development as well as opportunities for business.
2. Corporate Social Responsibility: The growing pressure on manufacturing firms to become more responsible to the social and environmental impact it creates. Companies would like to brand themselves with a "green" image.
3. Legislation: Manufacturing firms have to constantly strive to meet current and upcoming stricter environmental regulations.

THE CHALLENGES



Source: Frost & Sullivan

Although the benefits look very obvious, there are many challenges to going green. The most significant is the economic mindset and rationalities of organizations. And it cannot be denied that going green will be at an initial cost with potential savings coming much later. In fact according to a 2005 report by the U.S. Small Business Administration, in 2004 the business sector was forced to shoulder 65% of the

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environmental regulatory costs. This worked out to an average of $4,850 per employee for U.S. manufacturing companies.

Another key challenge is that most companies have not integrated the process of continuous environmental management into the core of their business strategy, either because it conflicts with their existing priorities or simple because they are ignorant about how to do it. Moreover companies do not have specific environmental performance indicators or social performance metrics by which they are measured by their stakeholders. Many firms today are engaged in some level of environmental management, however such solutions may not in themselves promote effciency gains or improvements in productivity. This would further reduce incentive for deploying green manufacturing company wide

AREAS OF APPLICATIONS OF GREEN MANUFACTURING:

- Lean manufacturing
- Attention paid to waste generated along the way
- Energy reduction in streamlined logistics
- Materials reuse, recycling
- Green plastics (biodegradable)
- Product design
- Use of recycled materials
- Design for service, disassembly and recycling
- Green chemistry
- Avoidance of toxics
- Harmless solvents
- Solventless technologies
- Semiconductor, electronics
- More benign manufacturing processes
- Automobile design and manufacture

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GREEN MANUFACTURING AND POLLUTING INDUSTRIES

Recently, concerns with polychlorinated biphenyl (PCB) manufacturing have been raised due to the extreme health effects caused by the processes involved. The U.S. Environmental Protection Agency (EPA) has extensively studied the effects of PCB effluent discharge on animals as well as humans. Other industries, such as the automotive, construction, and power industries, among others, that employ Resource-intensive operations also pose significant dangers to the environment.

GREEN MANUFACTURING AND GLOBAL WARMING

Owing to increased concern about global warming and the ramifications of pollute industries for the global environment, manufacturers are seeking practical solutions that can be implemented to sustain green manufacturing practices. Consumers assume that the products they consume are safe and do not harm the environment. However, manufacturers and consumers need to take a closer look at manufacturing practices. There is a growing need to understand that certain products and their related manufacturing practices can endanger the environment.

Advantages and Disadvantages of Green Manufacturing

When a business makes the decision to become a green, or environmentally friendly, manufacturer, it consciously decides to promote certain values. These values center on the goal of protecting the environment but can also focus on things such as technological innovation and progress.

BENEFITING THE ENVIRONMENT

Green manufacturing can directly benefit the environment. For example, green manufacturing can help to reduce waste and harmful emissions and work toward preserving resources that are finite and nonrenewable. Many customers want to support businesses that implement green manufacturing, so by implementing this process, a business can also gain new customers.

BENEFITING THE BUSINESS

Because of the public's consensus about the need to protect the environment, a company can directly improve its public relations by implementing green manufacturing. Additionally, this process can lower costs for the business over the long term through the implementation of more efficient systems and

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fostering a company culture dedicated to innovation in processes. Further, these more efficient processes can result in lowering the amount of waste a business produces.

SURVIVING THE TRANSITION

One of the disadvantages of green manufacturing a business can experience relates to the transition to green manufacturing. Businesses will need to locate funding sources to finance the switch to green manufacturing. Although the process should ultimately save the business money, in the short term implementing green manufacturing can cost business significant amounts of money. Further, the transition generally requires not only the implementation of new manufacturing processes, but also the ability to design and build the necessary technology and machinery to support green manufacturing. Additionally, a business will typically have to find new talent to come in and educate current employees on how to work in the new green manufacturing environment.

INTERNATIONAL TRADE DISADVANTAGES

Another potential disadvantage to going green relates to international trade. Many businesses hesitate to implement a green manufacturing system because they fear that this process will become an impediment to the free flow of goods and profitable trade deals. This hesitation can apply to a wide range of manufactured products and industries. For example, a business might hesitate to implement green manufacturing because it fears losing an international supplier that does not participate in green manufacturing.

CONCLUSION:-

Green manufacturing holds enhanced promise for the government, manufacturers, and industry across the United States. Moving away from traditional and wasteful manufacturing practices will give green manufacturing a significant boost. Green manufacturing is all about making the right choices. In order to provide the value they do to our lives, manufacturers must harm the environment. But they can't afford to pillage the earth. All manufacturers should strive to maximize the value they produce while minimizing the damage. The good news is that making smart environmental choices often results in cost savings, especially in areas such as energy efficiency. Most often, if you can reduce the amount of energy you use, you're saving you're bottom line as much as the environment. Unfortunately, green might be the most overused word in the English language these days. Everybody wants to "go green" (or show you how to do it). The most popular marketing approach today is to label a product "green" because that's the buzzword of the day, and if people think your products are green, then they'll want to

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buy them. You see it every time you turn on the television or walk into the grocery store. Everything is green these days. And what's true in consumer products is also true in industrial goods and services. Marketing directors around the world are looking at their product lines and trying to figure out which products can be repositioned as "green." Various processes, products and supplies are being labeled green to take advantage of the latest marketing fad. How a manufacturer is supposed to know what's green and what's just hype?

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"Total Quality Management"

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ABSTRACT

Quality Management in every sense of the global without these negates of consideration in every spectrum of Quality Management is lacking it may be just has a management which may achieve its profit goals but those goals are not enough in the contemporary days & age. Dr. Daming of America and Ishikava in Japan discovered this concept in 1945. Initially it was known as Total Quality Movement. Today it is Total Quality Management. What we called the Mantra of TQM precisely the same that quality. As we know contemporary company churn out fabulous amount of mole & that is not because it is LPG but reason is that the global economic has duffel heads full of depthful management Opportunity on the terrafirma of terramadre have been ubiquitous. Since the 1st ray of civilization but the problem was that the health there was no eyes there. Hence those management Gurus in the days of your could spot these opportunity because then quality management was all most absent. That was only management & that management was only macro management no one but no one was had any were wither work about micro management & today difference is only between micro & macro management as contemporary. Management is confluence of micro as well as macro management. Hence, the contemporary management derives benefits of both. Quality management is not a recent phenomenon. Advanced civilizations that supported the arts and crafts allowed clients to choose goods meeting higher quality standards than normal goods. In societies where art and craft were valued, one of the responsibilities of a master craftsman was to lead their studio, train and supervise the work of their craftsmen and apprentices. The master craftsman set standards, reviewed the work of others and ordered rework and revision as necessary. One of the limitations of the craft approach was that relatively few goods could be produced; on the other hand an advantage was that each item produced could be individually shaped to suit the client. This craft based approach to quality and the practices used were major inputs when quality management was created as a management science.

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Introduction:

Total Management Quality [TQC] in every sense of the global without these negates of consideration in every spectrum of Quality Management is lacking it may be just has a management which may achieve its profit goals but those goals are not enough in the contemporary days & age. Dr. Daming of America and Ishikava in Japan discovered this concept in 1945. Total quality management is an established field of study where academicians, consultants, engineers and quality practitioners have contributed their ideas towards its advancement. Initially it was known as Total Quality Movement. Today it is Total Quality Management. What we called the Mantra of TQM precisely the same that quality. Just the word management does not suffix but management must be ultra quality management if someone goes for haphazard or any king of management. It is not defector definition of management. but management adopted by Anil Ambani or Mukesh Ambani, Tata, Sunil Bharti or Kumar Mangalum Birla, Billgates, warren Buffet, Carlos in or legends akin to Dhirubhai Ambani or Ratan Tata that was management in nutshell the definition of management is "To manage your affairs whatever they may be whether it is business, industry, healthcare, governs or manufacturing. Whatever you handle, manage it such a world that your goal in the management must be achieved. Difference between management & miss management is that management spells success miss management spells failure.

As we know contemporary company churn out fabulous amount of moola & that is not because it is LPG but reason is that the global economic has duffel heads full of depth full management Opportunity on the terrafirma of terramadre have been ubiquitous. Since the 1st ray of civilization but the problem was that the health there was no eyes there. Hence those management Gurus in the days of your could spot these opportunity because then quality management was all most absent. That was only management & that management was only macro management no one but no one was had any were wither work about micro management & today difference is only between micro & macro management as contemporary. Management is confluence of micro as well as macro management. Hence, the contemporary management derives benefits of both. Quality management is not a recent phenomenon. Advanced civilizations that supported the arts and crafts allowed clients to choose goods meeting higher quality standards than normal goods. In societies where art and craft (and artisanship) were valued, one of the responsibilities of a master artisan was to lead their studio, train and supervise the work of their artisans and apprentices. The master artisan set standards, reviewed the work of others and ordered rework and revision as necessary. One of the limitations of the craft approach was that relatively few goods could be produced; on the other hand, an advantage was that each item produced could be individually shaped to suit the client. This craft based approach to quality and the practices used were major inputs when quality management was created as a management science.

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- Total quality management is a management approach centred on quality, based on the participation of an organisation's people and aiming at long term success (ISO 8402:1994). This is achieved through customer satisfaction and benefits all members of the organisation and society.

- In other words, TQM is a philosophy for managing an organisation in a way which enables it to meet stakeholder needs and expectations efficiently and effectively, without compromising ethical values.

Key concepts of Total Quality

Total Quality Management is a strategy for business success, based on the following concepts:

Total Quality means:

- achieving strategic goals through customer focus and continuous improvement
- delighting the customer, satisfying needs and expectations
- anticipating the needs of the market
- understanding and managing customer expectations
- understanding the aims and capabilities of the your own organisation
- all employees taking ownership of the products and services delivered

Total Quality requires:

- management leadership and long term commitment
- managers to act as role models who lead and empower change
- a management culture of partnership, learning together, guidance and support for employees
- clearly defined business objectives communicated by managers and supervisors, understood and "owned" by all employees. "Ownership" can be viewed as the "acceptance of accountability".
- Encouraging and empowering all employees to adopt "ownership" behaviour. Ownership of their outputs, ownership of customers problems, ownership of improvement actions.
- A focus on success through people

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- solutions by consensus
- recognition of success
- a "no blame" attitude
- education and training based on defined user needs
- teamwork

Principles of TQM

TQM can be defined as the management of initiatives and procedures that are aimed at achieving the delivery of quality products and services. A number of key principles can be identified in defining TQM, including:

- Executive Management – Top management should act as the main driver for TQM and create an environment that ensures its success.
- Training – Employees should receive regular training on the methods and concepts of quality.
- Customer Focus – Improvements in quality should improve customer satisfaction.
- Decision Making – Quality decisions should be made based on measurements.
- Methodology and Tools – Use of appropriate methodology and tools ensures that non-conformances are identified, measured and responded to consistently.
- Continuous Improvement – Companies should continuously work towards improving manufacturing and quality procedures.
- Company Culture – The culture of the company should aim at developing employees ability to work together to improve quality.
- Employee Involvement – Employees should be encouraged to be pro-active in identifying and addressing quality related problems.

Approach Quality Management:

Sometimes ago in which government & industrialists agree to work hand in hand with the spirit of co-operation & not confrontation most of the nations were at the longer head with industrialists with before the formulation of WTO in 1995. Because there was a feeling of distrust prevalent between these two entities that is government on one hand & industry on other hand. Most of the nation follows the psychology of patrimonial hoys. & needs of industry meet by the advancement of government in the form of providing raw material at the price industry can effort & term industry accept & that was installment system. Tsunami & Albino impact are all poverty as well as overtly associated with in Organic growth of economy. That is not delicious progression of economy. Dr. Klash schwap, who happens to be the head of the Economy Forum of world. According to him WTO is the most lucrative Holly Grave & cornucopia for economy Bonanza but he always laments in every

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Economy Forum. Wherever it takes place in which he always stand joint ventures should not be vulturine by 1st tire nations of the west. According to him, the spirit of WTO has not been enjoyed by the 3rd tire nations but only by the bellwether nations of 1st tire nations. This is open secret that since 1st January 1995, since WTO came in to being from GATT the preamble of WTO always emphasized that this organization would provide level playing field to every member nations

India has to reason that Indian economy is a part of global economy & vice versa. Then & then Indian economy would cat left. Admin Smith emphasis category that the progress in economy can achieved only by joint venture on the national level. Creating a kind of joint venture to work together on the economic vista. Akin to favor with bread & butter who work separately but they earn jointly meaning wealth of all earning member of family ventured together & then family become rich. If India would think its wealth is personal & not collective then India would not survive as part of the global economy. That is the concept the father of modern economy in his megnumopus, the titled "The Wealth of the Nations". Quality Management is needed to achieve all these golden negates of economy. Unfortunately, such broad shoulder nets is missing & contemporary management perceives that that management connotes to respond or tenets of need of customer & not create the needs of customer. Because Quality Management is obliged that it must create needs in the society if needs are not created then economic growth would stagnant & eventually civilization will dwindle away economy moves on the path of needs. As we know today typewriter, radio, calculator etc. disappear because their needs appear & their taking place Computer, DVD because demand of these system created by Market Gurus & who manufactures them. We already chuck out all things, which have no need because they have outlived their utilities & we used instead contemporary things because the need is created. Economic development is not ipsofacto but it is a process mining design & mining carried out mining creating which involving the capital psycho profile of consumer. "Company which wants to sustain its existing without losing its customer clients & consumers or without suffering from defection of product or miring brand positing or inviting the wrath of Austrian that is quiet incompetent to company have only one thing & that us Quality Management. Quality Management does not involve just ironing up profits or grow company. Beyond the of the nations & go for random acquisition & diversification or joint venture.

Every Quality Management has been giving its best short to create a kind of tender relationship between Ecology & Economy & balance of between them tipped & balance sheets of every company would tipped drastically no management would beyond economy as only the aspect no it would regard ecologically. Only aspect but they maintain the kind of balanced relationship between these two spectrums of survival of human development. In 1998 Kalash Schwap held world Economy Forum. He is the head of Forum. This Forum was held on in our Mumbai. & Mumbai he meant "Management is Hearth, Soul & Mind" is that in the previous times management was just Mind activity. It was all about cerebella activity nothing to do with visceral faculties of management. But according to Klash Schwap contemporary Quality Management is trio. That is Art Hearth, Soul & Mind. Art hearth means management should be & considerate to the needs of their workforce. Because it is the workforce provide the in culmination of company. We can't image a company large, small or medium, micro or macro successfully without the Quality Workforce as Quality Management is essential essentials of the company. So is the workforce. Hence if management has no hearth they can't fell compensation for workforce & its most precious contribution.

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Training and education of TQM

A comprehensive training programmed is necessary and must be institutionalized within the entire organization. Training in TQM philosophy, guiding principles and tools and techniques is never ending. Personal and team interaction skills must be continually refined. This training should be given, only as it is needed, to the people who will use it immediately. It should start with specific training for management. Once management has the skills to lead the TQM process, the rest of the organization should be trained to ensure a systematic, integrated, consistent organization-wide effort. Specific job skills training must be provided and constantly updated to reflect the improved processes. All too often management exhorts employees to do things right the first time, to be actively involved in improvement teams, and to participate in the never-ending search for excellence. Yet, at the same time, management fails to provide the necessary training, knowledge, quality tools, and empowerment for effective self-management. Hence, all training should be geared to specific, clearly defined objectives, must be performed as close as possible to the time it is required and is reinforced to ensure the desired results. provide the necessary skills and knowledge- the ability to make it happen . It is an investment that must be made. According to Dahlgaard et al. (1998), Japan, Estonia and India are reported to allocate between 65 and 80 hours per year in training and education activities for every employee. They believe that worker's satisfaction, motivation and ability to act as a constructive part in the process of continuous improvement depend very much on education and training. In the TQM environment, everyone is required to gain additional capabilities to improve the process.

Essential part of Quality Management:

The part of Quality Management without which a kind of bomb can't create between two entities superior & subordinate? Hence, there should also one of the most essential essentials for the Quality Management. Mind as we all understand is like stallion of chariot. Chariot can't put without the stallion which is human mind in management all kind of arithmetic complexity are faced by management & to talk to those of running of company required mind as so. So to run a company Quality Management would need mind to deal with workforce they would need health & to have depth full & compassion soul. Quality management so if you can create confluence of heart, soul & mind than you have quality management in your hand.

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According to Warren Buffet as you guises know is the market conduct of capital market on the global level who is also the richest daddy of his children. His poorest man in the world with maximum amount of 62 billion $ in other word this exactly 25 % which in comparison with all Indian put together. He has always say buy low sale high in the market competition because global economy integration works only in that order if you buy hard they are destine to low & buy low you destine to win. Most of us would like to plunge in price of the shares is out rated & there our worker we find our share makes down & we lose. So, both of us who Warren Buffet would have not market grievances because you listen to the grievances that has never been wrong & lost a piney. If you ask him weather we would like to invest in Indian market we never trusted the market which is volatile & India is one of the most volatile in market. Warren Buffet in his quotation he emphasis that value of customer is much grater then the value of profit. If you lose profit one time lose, but you lose customer is eternal lose. Hence he has always insisted to every company dealing with consumer to be mind flock of the fact that profit can be made every next time if it lost but customer can never be regain once the cost.

Conclusion

Quality Management in every sense of the global without these negates of consideration in every spectrum of Quality Management is lacking it may be just has a management which may achieve its profit goals but those goals are not enough in the contemporary days & age. Dr. Daming of America and Ishikava in Japan discovered this concept in 1945. Initially it was known as Total Quality Movement. Today it is Total Quality Management. What we called the Mantra of TQM precisely the same that quality. The company is contemporary criteria must follow at the "Bottom of Pyramid "The company is contemporary criteria must at the B.O.P .And that is why fortune lies old economy, new economy and new west economy are three type of contemporary economy which are regarded as no earning visibilities fall in the criteria of old economy to high earning visibility is the new economy and highest earning visibility is the new west economy. You can categorize old economy. Old economy in all PSUs, new economy is the contemporary Indian economy. After 1991 economic reform and new west economy is the Japan, China and Barely India have touched. This quotation was quoted by Dr. Mao west frequently when he was on the pinnacle of his carrier. He used to say consumer must learn more and earn more and spends more because spending can be wonderful thing, because he gives tons of gratification. He used to believe that those who spend earn, those who save greater chunk of their posed do not have gratification of more earning satisfaction. To all economist the killer world is on we satisfy in the terms of economy drops the every effort in hence personal or aggregated economy.

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Management is confluence of micro as well as macro management. Hence, the contemporary management derives benefits of both. Quality management is not a recent phenomenon. Advanced civilizations that supported the arts and crafts allowed clients to choose goods meeting higher quality standards than normal goods. In societies where art and craft were valued, one of the responsibilities of a master craftsman was to lead their studio, train and supervise the work of their craftsmen and apprentices. The master craftsman set standards, reviewed the work of others and ordered rework and revision as necessary. One of the limitations of the craft approach was that relatively few goods could be produced; on the other hand an advantage was that each item produced could be individually shaped to suit the client. The paper has also indicated and identified crucial issues for organizations to consider, especially areas found to be lacking in implementation. A better understanding of TQM implementation issues and helps to improve success rates of TQM implementation in the Indian context.

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Redefining Modern Finance: The Role of Data Engineering and Predictive Modeling in Enhancing Risk Mitigation and Operational Agility

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Abstract

This essay delves into the significance of data engineering and predictive modeling in modern finance to achieve risk mitigation and operational agility. Data is the new oil, while algorithms are the new electricity. Financial analysts, instead of investment bankers, are replaced by hotshot data scientists. As computational approaches and data analytics are at the heart of current financial practices, this essay sheds light on data engineering emphasis. It is the foundation of precise and insightful predictive modeling development. Two distinct case studies elucidate how data engineering and predictive modeling are employed. One is the analysis on the trajectory of 17,338 global stocks over the past 30 years. Another is the construction of a diversified risk parity portfolio from millions of random perturbations of 60 U.S. stocks. With everything considered, the presented historical Long-Short Memory network is capable of capturing the thematic volatility of financial products and outperforms stock price trend prediction.

The ultimate goal of finance is to sustain robustness in financial viability. To some extent, the advanced financial system of large corporations and governments has achieved this objective by creating policies and rules in a manner that guarantees housing, food, education, health, transportation, and pensions for all employees. However, the financial system of global capitalism is full of contradictions. Analyzing from the very heart of financial activity, i.e., the practice of investment and financing, it becomes apparent that competitiveness does not rely solely on market competitiveness, good corporate governance, fantastic allocation of scarce natural resources, technological innovation, or the social intelligence of employees. Indeed, the root of competition is how best to bring the most profitable investment and financing projects into being and realize them efficiently. The latter can be seen in financial innovations for income-maximization superstructure, which entirely symbolizes the cost- and risk-minimization infrastructure. Too much emphasis on the former, however, can lead to too many firms investing in a particular sector or type of project, leading to capital saturation and an investment crisis. For instance, in the mid-2000s, investment poured into property

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markets, high-specification manufacturing, tourism, and entertainment, leading to bubbles. When the bubbles burst, the investment crisis strikes while bringing financial risk and innovative collapse. To better understand the essence of risk mitigation and reveal hidden simulations that can be deployed on a day-to-day basis, the considerations on simulation initiatives are on both investment and financing under future uncertainty conditions. It is a nod to operational agility on tackling foreseeable challenges and opportunities or building a healthy and sustainable financial system.

Keywords: Data engineering, predictive modeling, risk Mitigation, operational agility,Modern Finance,Data Engineering,Predictive Modeling,Risk Mitigation,Operational Agility,Financial Technology (FinTech),Risk Management,Data-Driven Insights,Machine Learning in Finance,Financial Analytics.

1. Introduction

Forthcoming advancements in data engineering and predictive modeling are anticipated to fundamentally redefine contemporary financial services, focusing on risk management and the operational agility of traditional institutions. The intersection between finance and technology has never been as critical as it is today, in the midst of a technological revolution, which is not only forecasted to disrupt the long-standing industry practices of banks, funds, and insurers, but is already accomplishing such transformations. The main agents of change are related to recent developments in big data analytics and parallel computing technologies, which are providing the means for efficiently handling the overwhelming volumes of data that are generated every day from firms' systems, open data sources, and the web. As a direct result, a major shift in the way financial decisions are made is already observable, as data-centric evidenced decision-making approaches are gradually superseding the reliance on causal relationships discovered by statistics, econometrics or even intuition. Some financial modeling and institution-specific practices may get redundant in such a fast-altering environment. Professional judgment that was traditionally sufficient to steer complex and unrestricted financial decisions has to be amended by the ability to process, statistically analyze, and eventually shape conjectures out of the right data. The adaptation to this institutional modus operandi shift of financial professionals is getting critical. The first challenge is related to the long-standing difficulties of successfully exploiting business data. The efforts of building firm-specific analytic resources are laborious and time-consuming; a mismatch between the incoming data and the requirements of institutional divisions is not infrequent. Such discrepancies are now exacerbated, as activities like decision-making

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processes and fraudulent operations have been radically altered by technology. The second challenge is about the willingness of professionals to adapt their methods. Young, data-savvy talents that come into professional life equipped with appropriate skills seem to naturally hold an advantage, although. A different examination should take place for seasoned professionals, who built their career based on traditional evidence. Their immediate acceptance of new data-driven anti approaches is contingent on the formation of a novel professional discipline that will act with a similar code of ethics.

Fig 1: Predictive Analytics in Finance

1.1. Background and Significance Finance is a realm characterized by constant and rapid change. Evolving from medieval moneylending, modern finance has an extensively relational and regulatory nature. It is precisely these essential elements that are encouraged. Furthermore,. Problematically, traditional wealth management practices had strayed from their roots. Private wealth investment was no longer a valid surrogate for spurring economic development, especially with the maturation of financial capitalism. This fueled a 'techno-critique' against the pinnacles of the temple of capital and fostered fresh management. Arithmetically, this shift is discernible by the initiation of concepts like 'receivable turnover rate' and 'return on equity'.

Most risibly, its practical implementation has rendered the genome of modern finance politicized, corrupt, and morally obnoxious. The late capitalism mutation made this situation chronic, i.e., instead of refining the scarce resources to afford optimal allocation, finance became a vicious contest in creating money-free value and rewarded rent-seeking. Whatever fig leaf covered the financial Homo creduli did not obstruct the equation of potential defaults should their investments die with national calamity; such inferences are more common in less privileged realms. Effluxion of time would validate that the developmental pathway of a political economy is turf-bound, and indications of economic unviability preceding political crises are more pronounced in the periphery. In the Deleuzian rhizome that both harbors and foments interests, practices, and technologies of finance, the pivotal graph axis races through

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data. Albeit essential, this new 'venation' of finance is hardly ledgered annotated. It is just contending this new atom that is not only divulging what has been long copyright and expertise protected but it also contains the seeds of a scholastic chaos, of unintended consequences that would indomitably turn against their instigators. Another more foreboding iteration would apprehend the data veil as delusional, reducing analyses and results to a parade of the simulacra. Call it the dot.com of the talking heads.

However, it is possible to perform a hermeneutics of data lineage that will attempt to provide a passage, an interpretation through the minutiae, and disturb interlinkages to draw a functional knowledge. With the benefit of temporal aperture, this can also function as an early warning system, a risk assessment administration. Thus this chapter transposes an analysis of data from abstract to an operational methodology. To that end, it will first explore these genuine swarms, how they have been functional in financial systems if tentacular rule or evanescent amorphous myth and how they drive modern financial practices to pervasively look like high-frequency trading. This first section will accordingly provide a vocabulary to decrypt the Layer of the Rebel Data; in turn, it lays the groundwork for the meta-language in which contemporary finance is understood.

Equ 1: Predictive Modeling for Portfolio Optimization

$$R_p = \sum_{i=1}^{n} w_i \cdot r_i$$

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \cdot \text{Cov}(r_i, r_j)$$

Where:

- w_i = Weight of asset i
- r_i = Expected return of asset i
- $\text{Cov}(r_i, r_j)$ = Covariance between returns of assets i and j

2. The Evolution of Modern Finance

The finance of today is a far cry from the world of old— a financial landscape notorious for being ominous and aloof. Popular public image painted by a century of literature, film, and art often depicts finance as a place of all-consuming risk. This image is not far off from the truth, as various historic events such as the stock market crash, rampant inflation and recession, and the mortgage crisis have all left behind a trail of destruction in their wake. Because of these events, traditional finance is often compared to a house of cards, easily knocked down and difficult to rebuild after collapse.

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Empirical approaches to finance soon blossomed with the advent of computers and technology. The publication of a significant financial formula is often described as the moment financial engineering was born, which deals with complex mathematical models and technical computing to help price derivatives such as options. Arguably, this was the dawn of modern finance. Slowly, advanced derivative products developed for large companies were repacked and sold with a new candy-coated image as retail products to everyday people, contritely nicknamed “moms and pops” in grim irony. The legacy of such events was the surplus of toxic products that helped instigate the crisis. However, despite the ill repute, modern finance was moving forward—fast.

The ongoing development of high capacity and broad reaching technology has transformed the way societies work, interact, and conduct business. In the second half of the 20th Century, such broader outreach of technology was shaped mostly by the advent of global connectivity. Along with the generational change in regulation, global financial markets boomed and became significantly more interconnected. In light of possible changes, it is imperative here to study this evolution and deepen understanding of market behavior exhibited under changes in the global financial market environment, and also to explore the challenges faced more globally by financial institutions as they seek to implement advanced technologies onto legacy systems.

Fig 2: Modern Finance

2.1. Traditional Finance vs. Modern Finance Financial services have substantially changed over the last few decades, particularly in the field of decision-support systems, risk mitigation, and portfolio management. Empirical domination has overtaken traditional finance based on simple normative and descriptive assumptions. Modern finance, though still heavily influenced by theoretical models, often industrial, emphasizes the use of empirical models, particularly those deriving from the data science field, for decision support. In this sense, risk mitigation may depend on empirical models which are not always feasible to be explained causally. This is also reflected in the broad use of algorithms. Predictive models and algorithms make up a well-developed field of data science, which in finance can be utilized for a variety of decision problems, from market prediction and portfolio management to default prediction. However, this shifts the financial advice from the realm of personal

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relationships to impersonal ensembles of variables processed in a black-box environment. Accessible Digital Platforms are Enablers of the Otherwise Inaccessible. Another seminal impact of empirical development is the vast access to various financial services through digital platforms, which alter the landscape of financial decisions. While professional portfolio managers in the traditional sense are capable of designing and monitoring complex portfolios, the vast majority of people utilize simplified solutions, i.e. savings or deposit accounts, which allow the bank to use the savings according to the internal algorithm without the customer's explicit knowledge. Real-time Control and Data-Driven Cultures. Last, but not least, in the era of digital platforms and real-time continuous transactions, one very important factor typically overlooked in the models are the speed and the regularity of the information. This is also exacerbated by the fact that digital platforms can directly execute automated decisions as a consequence of some metrics' summary information. This allows launching new financial products as well as conducting other financial transactions that can be adjusted in real time. This also fosters enterprises to move towards entirely data-driven cultures, transforming financial institutions.

3. Data Engineering in Finance

The practices of finance are uniquely positioned for evolutionary changes at the dawn of the Big Data revolution. The sector has always been re-victualling from a wealth of diverse data sources like market trading, movements of various accounting indicators, complex macro-economical, political and natural events, historical data related to past behaviors and financial products, qualitative information such as news or analysis, and much more. More recently, the inventions of electronic payments and internet banking have considerably widened the scope of the datasphere in financial marketplaces.

Further making things complex, there is a web of national, regional and global regulations on top of which operates the sector, with respect to both consumer data rights and risk measurements. This leads to the necessity of the formation of solid data infrastructures as a foundation for further practices. Here, in this context, the processes of data collection, storage, and management are considered from a distinct banking and trading standpoint. The methods and tools utilized in big finance are vastly different from common scalable frameworks for distributed computing or storages. Similarly to concerns in the domain, practices are reliant on asset-conditioned, classical time series based datasets and streaming. However, a wide variety of data sources in the financial sector is integrated within such frameworks, visualizing collected datasets, and discussing prominent demands for any

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formalism, particularly the critically important data quality and governance to prevent "coding bugs" from becoming tragedies in the context, or misleading decisions.

Several technological tools are scrutinized in the context of large-scale implementations: stream processing for near real-time event detection in risk management, data lakes for efficient usage of a wide variety of datasets, sentiment analysis with the use of machine learning based on macro-economical and financial news, and predictive modeling for retail banking safeguards. It is shown that the successful integration of B2B client dataset and macro-economical news stream in bank guarantee modeling practices. This allows the creation of genuinely multi-source assets above baseline performance, along with the crucial risk-calibration of those models, which is essential for reliable decision-making. Moreover, the Big Data framework is outlined, which allows for the smooth technical setup and streamlined interfacing for the execution of hundreds of prediction tasks in bank scenarios .

Fig 3: The Future of Data Engineering as a Data Engineer

3.1. Data Collection and Integration The data collection and integration are the background works for any financial analytics tasks. In a modern financial institution or department, data engineering is as important as financial insights. The most important thing is to collect the accurate and comprehensive data that you need. In many financial scenarios, valuable data is with other institutions, like market data, bank transactions, or alternative procedures. To collect these types of data, APIs are extremely useful. It is an interface provided by the data publisher, and no ETL is needed, so handling data in the available format is OK. In ETL pipelines, small procedures are always embedded in the same hosts as the databases, so directly copying the data from the same data source is much faster. However, this procedure is also always blocked by engineers due to security concerns. Financial data usually has a high level of sensitivity. This is contradictory, but validating each cell can significantly reduce later analytics errors that may have been caused by data issues. Validating basic statistics, extreme values, cardinality, and even cross-checking production data are all feasible ways to check. After data issues are detected, the data provider can quickly locate the problems of the data source and fix these problems as soon as possible. The latest data will directly benefit three separate projects. A good data integration system benefits the data lifecycle. Best practices in the most advanced market works like this: data persistence uses a

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hundred business format, with proper indexes and partitions, memory-optimized, ball compression, memory management; table is widely adopted in stored procedures. Financial institutions or teams may distinguish it from market benchmarks, models, or strategies in several aspects. Now, the hype transport vocabulary on data engineering in the financial sector focuses on privacy and regulation, and these are not emphasized in open source.

The first thing you have to deal with is data you have collected so far. One basic feasible requirement is that all data should be standardized in a playful format that is easily accessible for later modeling development, i.e., local lead CSV. Therefore, all engineers need to write ETL processes to take the production data sources and convert them into a friendly format database. This kind of procedure can be partitioned by time and will be one of the work's responsibilities of things that need to coordinate ETL processes to validate entire data collectively. On the modeling front, funds are supposed to get a better understanding of why this is a default problem. On the regulation and infrastructure front, funds are also expected to make comprehensive registration at the department's level.

Equ 2: Data Engineering in Risk Data Aggregation

$$R_{total} = \sum_{i=1}^{n} W_i \cdot R_i$$

Where:

- R_{total} = Total risk exposure
- W_i = Weight or exposure of risk factor i
- R_i = Risk measure associated with factor i

4. Predictive Modeling in Finance

Finance today is not what it used to be in Adam Smith's days. Mathematically smart 12-year-olds on a mission to deconstruct Wall-Street setting computer servers in their garage to get demographic data from Facebook are the responsive socio-technological architects of modern banking and finance systems. There is substantial literature on financial analytics, and how computational approaches (be they steeped in advanced statistics, complex optimization or machine learning) can (or should) be used to industrialize the handling of financial data. It is interesting to delve into its sibling sub literature, modeling, constructing models. A popular notion here is predictive modeling. A predictive model is a basic probability calculus t(x) = P(Y = 1|X = x), where it is the output of the system (and P means probability). The rest of this paper explains modeling, including foundational theories and common recipes to cook

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models, and how risk and operational banks can implement these by engineering existing data.

The output of outwardly accessible/costless technical and academic work in financial modeling is datasets, algorithms, and software systems (perhaps together with executables). On a blue ocean-sized sea of terabyte-yielding floppies and DVDs are thusly dumped market trend and trader behavior predictions, client turning and risk exposure delimiters, fraud detections scores and portfolio management suggestions. A growing number of us in the field are involved in the design, construction, calibration, validation, and maintenance of the contraptions generating the above. Banks navigate (away from, but often into) economic rocks and shallows have been gradually having the entire medusae army look into building (and, perhaps sometimes even understanding) such models. Too many have thusly learned the trade, and the number of opinions, advice, magic do-this-(down to the cubic millimeter)-and-save-trillions recipes and free models available has exploded with geometric growth throughout the cosmos.

Fig 4: Predictive Data Analytics in Finance and Risk Management

4.1. Machine Learning Algorithms Machine learning algorithms are widely employed for predictive modeling in finance. By automatically identifying patterns in historical behavior and detecting anomalies, machine learning can significantly promote analysis of complex big data sets. Based on their learning nature, machine learning algorithms are mainly divided into supervised and unsupervised learning. In supervised learning, algorithms learn to map inputs to outputs based on a training data set containing optimal input-output pairs. In comparison, unsupervised learning methods predict outputs considering only input data and finding intrinsic structures such as clusters, vendors, and anomalies.

Several widely-used machine learning algorithms under these two methodologies will be described, highlighting their financial applications. For supervised learning, some commonly employed algorithms include linear regression, support vector machines, decision trees, and neural networks. Linear regression is one of the simplest and easiest machine learning

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algorithms to apply and interpret. It models the relationship between dependent variable(s) and independent variable(s) by fitting a linear equation, approximating the mapping function. Decision trees are another commonly used method based on tree data structure. Each internal node represents a downstream on an input feature, directing a way to leaf nodes, which are the predicted scores. Neural networks, often considered as “black box” machine learning methods, have attracted much attention due to end-to-end training possibilities. Multi-Layer Perceptron (MLP) is one of the most typical neural networks. They are composed of data layers, several hidden layers, and an output layer and are effective in analyzing high-dimensional data.

Machine learning enhances the accuracy of predictions by automatically recognizing patterns in big data. On the contrary to traditional heuristics, machine learning approaches require diligent and comprehensive validation and adjustment. A calibration of parameters requires running machine learning models regularly to adapt to changing dynamics. Furthermore, while the machine learning model may successfully describe the financial world at this moment, its accuracy might depreciate over time. This is due to changes in the financial environment or that the trained model may deadlock into too specific features of the training set. This results in a need to continuously validate the machine learning model and, as necessary, enhance its structure.

5. Enhancing Risk Mitigation in Finance

In today’s increasingly globalized and unpredictable environment, the nature of risks faced by financial institutions is constantly evolving. Risks can grow as complex interconnections multiply in the global economy. Nevertheless, they can also materialize in unexpected ways, impeded by sudden shocks like the 10-year US treasury yield just inverting with the 2-year one on August 14th, 2019. Given these considerations, enhancing the risk mitigation of financial institutions represents more than just complying with stress tests. Instead, more comprehensive risk strategies are required. Data-driven approaches can play a crucial role in the identification, monitoring, and quantification of risks faced by financial institutions. In this respect, predictive modeling techniques can be instrumental in the shaping of this new era where known and unknown, foreseeable and unforeseeable risks come along in a combination that forces modeling approaches to cope with complex causal chains . Predictive modeling methods can be used in developing a risk scenario, hence in portraying how a condition-event pair may bring a risk to the institution along with its associated financial impacts. On the occurrence of that condition-event pair, the institution can then assess its current resilience. After the evaluation of the level of the impacts, it tries to withstand them

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by continuous risk monitoring or, if needed, intervention onto the phenomena. Thus, the underlying data-driven environment aims at evaluating the institution's financial resilience under events that affect the economic environment and financial markets in either a direct or indirect fashion.

Next, some practical applications of these enhanced risk strategies on financial institutions are considered. To begin with, there is a focus on those approaches which so to say materialize the enhanced risk monitoring frequencies and strategies. In order to monitor the financial resilience to these risk scenarios, either historical simulations or stress testings can be done. Stress testings are then mainly meant as institution-wide exercises, whereas historical simulations, even if they too can be institutional, are actually more on warning units. Foreseeing the risk novel aspects, scenarios and methods in charge of their evaluation are discussed afterward. Despite the extensive academic work on the subject, mainly focused on regulatory stress tests, some particular patterns may differ. Consequently, a better understanding of the aim of scenario analysis follows. Finally, based on this understanding, a look at where to facilitate a comprehensive approach to risk between the different departments of financial institutions is taken.

Fig 5: Financial risk analytics and modeling

5.1. Scenario Analysis Scenario analysis is a key tool in the risk management process, allowing financial institutions to assess different potential future events and their impacts on financial performance. Scenario analyses are to be designed to consider possible developments that could lead to outcomes that would have a significant impact on the values of most financial assets. Typically, a range of scenarios are examined,

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focusing on developing a widely different set of outcomes. It is important that the developed scenarios are diverse and plausible. Diverse scenarios are developed with the aim of capturing as wide a range of outcomes as possible, while plausible scenarios are those that consider both historical experience and current market conditions. Scenario analyses should be developed taking the data-enhanced engineering approach, integrating historical information about the market, operational knowledge about relevant market indices, cash flows, indices, value, observances, etc., and predictive modeling that can establish relationships between the parameters of the scenario and the financial assets . Scenario analysis is closely related to regulatory requirements and stress testing, especially for monitoring the impact of market risk.

Risk management in financial institutions primarily hinges on managing a portfolio-wide risk exposure through a holistic evaluation of the risks attributed to different components. The overall market risk in a portfolio is mainly assessed through scenario analysis, which serves as the primary tool for both sensitivity/performance examination and planning strategies for risk mitigation. The importance of scenario analysis is extensively demonstrated by real-world examples of stock investment and derivative sales portfolios as well as operational hedge of crucial market indexes, while primary focus is placed on scenario analysis for stock investment portfolios. Therein, the importance of continuous monitoring of the scenarios is stressed, adapting them as market conditions change percent to reflect recent market conditions and changes in investment strategy. Ultimately, scenario analysis is showcased as an indispensable component of a robust risk evaluation process in any sector.

Equ 3: Real-time Analytics for Enhanced Decision-Making

$$R_{real-time} = \hat{R}(t) + \epsilon(t)$$

Where:

- $R_{real-time}$ = Real-time risk estimate
- $\hat{R}(t)$ = Predicted risk based on historical and current data up to time t
- $\epsilon(t)$ = Error term for the prediction, depending on model accuracy

6. Operational Agility in Finance

The increasing pace of global markets not only stresses the need for continuous adaptation of financial institutions but also aggravates the competition in the same industry. Why some financial institutions are able to change quickly, accurately and flexibly depends on not only the differences in vision and strategy but also the differences in the capability of operational agility. Operational agility is the critical internal capability, which reflects the ability of a financial institution to respond quickly to market changes, adversity, or new opportunities. It

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addresses the urgency through information flows, process coordination, and resource restructuring to minimize the effects of uncertain market changes on the continuity and stability of the financial institution's operations. At the same time, financial institutions need to know that a competitive market environment is not only a threat but also an opportunity to achieve success; as a result, operational agility cannot be separated from the pursuit of risks and opportunities, but the financial crisis often threatens the stability of financial institutions. Financial institutions not only need to minimize the constraints of the environment but also change the environment, introduce favorable policies, actively cope with the challenges brought by macroeconomic or financial risks, find opportunities from the changes, and outline the development direction after the crisis.

The concept of market agility is input and the definition of agile operational capability in market agility is explained, and some assumptions and principles are delineated. Agile operational capability is a general company philosophy perspective that concerns a company's ability to reorganize people, processes, and resources flexible and adaptable and restructure internal and external linkages in order to produce and distribute a variety of goods and services in a highly variable and unpredictable market. Instead of investing on a single "best practice" approach, agile method helps managers to develop tailorable methods and tools able to support the specific context and to accommodate uncertainty, variability and risk. At the same time, focus of attention on technology and investments aimed at the real-time processing and management of data, so that it could be possible to measure and monitor what happens inside and outside the company, supporting the prediction of market changes and the generation of rapid and appropriate reactions.

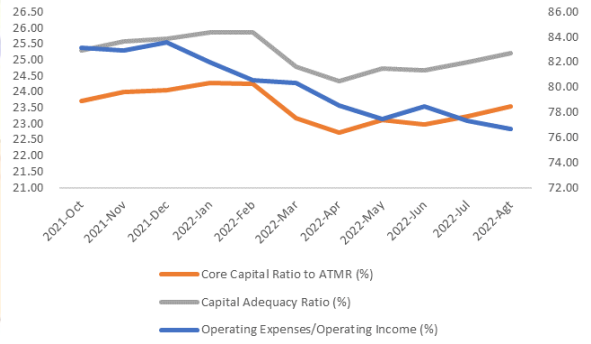

Fig : Digitalization, Emerging Technologies, and Financial Stability

6.1. Real-time Decision Making The speed with which businesses can access and process data can significantly impact the decisions they make and the outcomes that follow. For forward-thinking operational agility, financial organizations need to uncover immediacy. Financial modeling, risk mitigation, and enterprise risk management require rapid

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data management and predictions to act on. Cloud-based systems and big data analytics have moved financial deciders closer to real-time informable decisions. This can provide improved operational journeys as other entities are still accumulating data to model. Reducing the chain of events between the receipt of data and acting upon it offers a sustained competitive advantage. Real-time is prompting a paradigm shift. About half of business executives agree that the longer they take to analyse the collected big data, the fewer useful outcomes emerge. Trade volumes fluctuate second-to-second meaning the advantages of preventive risk mitigation actions can be negligible even five minutes after receiving and validating an alert. Still, financial entities are currently remedying errors that are only recognized after years pass. For finance, a potentially fatal fraud, procedure breach, or misallocation of risk that happened last quarter may go unnoticed for half a decade. An evolving view by many agreement sectors is the usefulness of a proactive anticipatory mentality. To suitably design trade contracts or sensitise wealth management clients of an asset bubble requires the capacity to predict unfavorable price moves in the first place. Gazing ahead rather than scrutinizing the present operation allows for swiffer reactions and mitigations. For several entities, embracing real-time still seems quite remote. Some cite issues of hastily aggregating large quantities of data sourced from a plethora of incompatible systems. For others the required technology is deemed costly, obscure, or the return on investment (RoI) remains unproven.

7. Case Studies

The following case studies will give an idea of the concepts described previously and a first impression of how they can be applied to the financial sector. The case studies range from data engineering techniques, risk prediction to process mining. However, the concept of predictive modeling is a common underlying theme. A critical analysis follows them; what went well, what challenges were faced, what the outcomes were and whether financial institutions used a similar strategic approach. The latter question is important as it is essentially about how organizations are innovating in incorporating these methods, in light of the more well-recorded approaches for turning big data into evidence. These case studies also serve to illustrate the flexibility of the methods presented here. For example, case study C is across-national comparison. This is important given that the enormous volume of big data can often make it seem difficult to adapt to one's specific institutional situation, such as financial goals, regulatory environment, types of decisions, etc. Finally, by outlining lessons learned from each, in light of the analysis, this aims to offer some guidance for how these advanced data analytics methodologies might be strategically and effectively implemented in a big data-rich environment such as this. An important individual entry point into the complex

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and broad world of financial risk assessment is investment and wealth management; particularly in relation to pension annuity products.

7.1. Application of Predictive Modeling in Risk Management

Predictive analytics involves making predictions or recommendations on future potential risks and incidents before they materialize based on data mining and modeling. In consumer finance, predictive analytics can be utilized to predict which consumer is the most likely to repay a loan or which consumer is the most worthy to target for a marketing campaign. Predictive modeling is the technique used to develop the predictive model. It involves several steps, including specifying the predictions to be made, gathering the data, choosing the experimental design, modeling, data partitioning, model validation, and applying the modeling process. Model assumptions, coefficients, and targeted correlations are discussed with regression analysis. Various approaches to predictive modeling are highlighted on evaluation and implementation. In particular, typical predictive modeling algorithms are elaborated, including linear and logistic regression, decision tree, neural networks, and time series models. Real applications are given to demonstrate the usage and effectiveness of predictive modeling in financial risk strategy. For example, a regression equation that models fraud as a function of age, transaction amount, and transaction volume is achieved, given a sample of past data on fraud transactions, instances without fraud, and data for future transactions. The odds ratio that models the probability of occurrence of the claim event is dealt with through a logistic regression model. A neural network model is trained based on known incidences of declared risk (claims) and non-declared risk (no claim). Based on the score prediction of models, corresponding actions can be taken to reduce the risk exposure and improve response time if the incoming data presents an unexpected event.

An obvious challenge encountered in the practical implementation of predictive modeling is in ensuring the quality of available data. Predictive model quality depends on the quality of input data. Common data issues include data segments that are not accurately recorded, are incomplete, or are incorrect. For the purpose of accurate and efficient modeling, the organization has been striving to achieve data mining projects using cleaner data. A second challenge in applying predictive modeling is validation of the models that are built. A good model in a mathematical sense may not be possible to validate in a real-world application. Initial, highly theoretical, models with a lack of data may not produce the best results for the organization. However, the result must be revisited. The implication is that it is very useful to continually evaluate and adjust the suite of models in practice. Further, the results can be taken as being achievable and good starting estimates for discussions with business users.

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8. Conclusion

This research has found that data engineering and predictive modeling have become vital disciplines of modern finance, providing services for ingesting data, transforming data, and utilizing data for predicting future market trends. This study concludes that modern finance increasingly relies on data engineering and predictive modeling for managing market risks and financial investments. Consequently, financial institutions have achieved premiums in risk mitigation and operational agility by embracing advanced data technologies in investment security and liquidity.

The findings of this research suggested that the technological landscape of modern finance is changing with digital banking and cryptocurrencies impacting the contingent systems of financial markets. It is safe to argue that data engineering and predictive modeling are new infrastructures of modern finance that can effectively manage risks and improve agile operations in these volatile markets. Consequently, this study encourages finance professionals to adapt to the new financial landscape shaped by data technologies and recommends them to acquire new competencies and skills in adopting data-driven modeling and problem-solving approaches. In the age of big data, financial institutions and banking markets need to stay innovative and open-minded in exploring and leveraging novel data technologies. Embracing data technologies invites organizations to continually improve and thereby builds up resilience in fluctuant and emergent financial systems. This research also envisions a future of coincidence between finance and technology and hopes that this feasibility study will stimulate financial markets and institutions to integrate data technologies into their risk mitigation and operational practices for financial investments.

8.1. Future Trends

Looking ahead, there are several implications for the financial sector brought about by the convergence of technology, including broader use of artificial intelligence (AI) and machine learning. Data protection will become even more crucial now that all transactions are conducted digitally, while regulatory systems will most likely lag behind these technological advancements. In terms of digital transformation, operational agility will be a critical requirement in the years to come. Banks and other financial institutions will need to be fluid in response to ever-changing circumstances, novel challenges, and opportunities. This is anticipated to give rise to rapidly changing work roles and responsibilities. Continuous learning and a capacity to swiftly adapt are expected to be necessary prerequisites for remaining competitive.

Technological changes will happen more rapidly than in the past, and it will become increasingly difficult to maintain a real-time understanding of the latest developments. It

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follows that many financial sector providers will need to rely on outside expertise, which could be both a considerable challenge and a significant opportunity. Nevertheless, it is likely that only a minority of financial institutions will maintain control of the most advanced technologies. Everyone else will eventually be using the same external service providers, and to some extent, this may homogenize many of their offerings. This is an attempt to provide a forward-looking perspective on the challenges that lie ahead – and the opportunities that will arise – as we continue to witness the acceleration of technological changes in the financial sector. To remain viable, banks and a host of other financial institutions must start by recognizing the necessity of keeping abreast of technological evolutions. Subsequently, it will be crucial to adapt policies, strategies, and operational models accordingly.

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Using Big Data to Explore the Socioeconomic Predictors of Mental Illness Prevalence

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Abstract

Big data research provides a unique lens through which to view complex problems in domains as wide as retail, politics, and epidemiology. In this study, the application of big data demonstrates the socioeconomic predictors for lifetime mental illness prevalence while developing approaches to be used in the future to better explore the role of socioeconomic status in explaining the distribution of mental health outcomes more broadly. The effective and growing use of big data in epidemiological research has the potential to provide real-world and quickly obtained outcomes, identify critical factors in complex problems, and develop theories related to health outcomes in various populations. This study sought to determine key fundamental socioeconomic predictors of lifetime mental illness to better understand the mechanisms through which socioeconomic factors may lead to a higher mental illness burden in populations. The results demonstrated that lower-income quintiles and areas with higher social disadvantage experienced higher odds of lifetime mental illness, while renters and people with no internet access underreported lifetime mental illness. Strategies used in this paper are intended to explore the role of socioeconomic status in the patterns seen for lifetime substance use, chronic health conditions, and disability in the larger database. These results provide researchers and policy/program planners with insights into particular populations whose representation on mental health surveys may be disproportionately low and potentially lead to flawed assumptions.

Keywords: Big Data, Socioeconomic Predictors, Mental Illness Prevalence, Socioeconomic Status, Epidemiology, Health Outcomes, Lifetime Mental Illness, Social Disadvantage, Income Quintiles, Mental Health Surveys, Chronic Health Conditions, Disability Patterns, Substance Use, Internet Access, Policy Planning, Population Representation, Epidemiological Research, Real-World Outcomes, Health Theories, Data-Driven Insights.

1. Introduction

A pressing societal concern, mental illness is currently one of the key public health issues of this generation. Nearly one in five American adults suffer from mental illness. Given the prevalence of this challenge, it is increasingly important to explore the socioeconomic

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dimensions that shape the distribution of mental health in the United States. While the existing research offers us a practical entry point into the subject matter at hand, crucial gaps still exist. The objective of this in-depth descriptive paper is to harness methods of big data to provide a powerful portrayal of the potential inclusion criteria that we will encounter further down the research outcomes, serving as a preliminary forecast for eventual results. This capstone represents a new approach in our exploration of these "predictors of the predictors." This paper uses big data to conduct descriptive statistics and preliminary analyses to show likely directions of future findings in exploring potential areas of research interest: objective and actual socioeconomic predictors of research interest; an update and review of key trends in mental health; a practical and retrospective use of big data. In this brief review of the literature, predominant themes in the research about socioeconomic predictors of mental health are expounded. This paper seeks to fill a gap within modern statistical analysis by using big data for simple, "weather report" patterns and trends in the current mental health of the U.S. population.

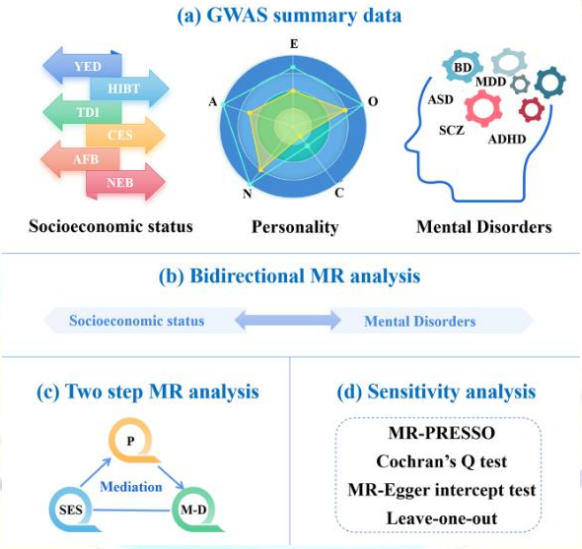

Fig 1 : Socioeconomic status, personality, and major mental disorders

1.1. Background and Rationale

Mental illness has been largely understood in the past as a matter of moral weakness - a failing of an individual's constitution or a product of environmental forces over which one has at least some control. Although today there are far fewer people who still believe that mental health issues are signs of divine retribution or weakness of character, many of our beliefs evidenced in common phrases such as "pull yourself up by your bootstraps" show that a similar idea persists. But surveying the statistics on mental illness tells a different story. About one-quarter to one-third of Americans reported symptoms of an anxiety disorder in the last couple of years, and one-sixth to one-fifth of Americans reported a period of significant

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depression symptoms in the past year. Yet practitioners and researchers looking to find signals in the noise of mental health data are often constrained to the few demographic data points available in established and available surveys. Although some studies have investigated the wide set of potentially interacting risk factors, such as age and gender, judgments of the potential influence of socioeconomic factors such as wealth, employment, and education are a mainstay of mental health analyses. This is a fruitful area of inquiry: separating the broader socioeconomic influence on mental health in such diverse studies is more difficult with large, uncontrolled data sets, but the putative connections between physical and mental health and structural disadvantage persist and invite scrutiny. Traditional research methods have only been able to reduce the massive dimensionality of mental health risk analyses through reduction - dimensional reduction, and sampling reduction.

1.2. Research Aim and Objectives

A research aim should specify a study's main goal or focus. This research aims to use big data methodologies to examine the socioeconomic predictors of mental illness prevalence. Our specific research objectives can be outlined as follows:

• Conduct individual-level analysis to identify individual-level socioeconomic predictors of mental health. • Conduct area-level analysis to identify area-level socioeconomic predictors of mental health. • Use contemporary big data methodologies to complement traditional data sources to perform our analysis and to quantify the value of each additional information robustness.

The successful accomplishment of each research objective will provide implications for the development of mental illness prevalence estimates at both the individual and area levels. Collectively, this research will inform the development of targeted and evidence-based policies and interventions aimed at the prevention of and support for mental health issues across society. Achievement of this aim and the accomplishment of these objectives will increase the working knowledge of researchers and practitioners working within the field of mental health. Specifically, research to date focuses on the collection of narrow data but does not translate this into actual on-the-ground implications. This research will add to the academic and societal understanding of mental health prevalence estimates and predictors, strengthening the available literature.

This research will use an eclectic mixed-methods approach. To accomplish our aim and objectives, we will complete several individually diverse studies using a wide range of complex big data sources and methodologies. Independently, each of these works will be a valuable contribution to the field of mental health. The work will include data analysis using a range of data sources and methodologies. Each study has implications for future research investments. For data analysis, we will have implications for further funding to harness big data in mental health and for surveys to include working hours and transport. For e-health research, the case

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studies that emerge from this research will lay the foundation for future studies. The outcome of this research could also shed light on the domain of policy and clinical practice.

$$X_j = \frac{1}{N_j} \sum_{i \in \mathcal{D}_j} x_i$$

Equation 1 : Feature Aggregation

- X_j: Aggregated feature for group j.
- N_j: Total individuals in group j.
- $\mathcal{D}_j$: Set of individuals in group j.
- x_i: Individual-level feature (e.g., income, education).

2. Big Data in Mental Health Research

Big data has become increasingly prevalent in mental health research and can provide actionable insights to ultimately reduce symptomatology, disability, and mortality. Big data has three key characteristics that differentiate it from other forms of research and data: volume (how much data is being produced), variety (diversity of the data), and velocity (the speed at which the data is generated and processed). The contemporary scope of big data is broad and plays a role in national security and law enforcement, cyber computing research, retail, and the production industry, as well as other people analytics research, including health. Health uses of big data can capture how a consumer thinks, their behaviors, wants, and needs. These diverse kinds of data are emerging as pivotal in addressing predictors of health, including well-being, by providing a comprehensive understanding of determinants that affect physical, mental, and social health across a population or within smaller demographic groups, sub-populations, and individuals.

Outcome-oriented research at times requires diverse data to be combined and conducted in large datasets to have enough power to uncover any real effect or significant predictor. In addition, there are conditions where the lack of data is due to the already small affected population groups, which are hard to locate and lack a general sample size. This can result in traditional statistical studies and big data research ultimately leading to significant understanding and evidence that differ substantially from each other. There are several contemporary developments and ways in which big data differs from traditional data research. As its primary application to health, the research encompasses a variety of huge data information that impacts service delivery and economic development through health industries. Ethical studies should also consider the use of security measures such as obtaining informed consent to secure the rights and interests of participants involved in big data studies involving systemic innovation. Among the most recent big data breakthroughs is the enhancement of understanding and the way that research into major mental health conditions is conducted. The sheer volume of people diagnosed with mental health disorders

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and reporting needs can be captured through sophisticated methods. At a global level, big data can be used to inform and count the number of persons who are recorded as affected.

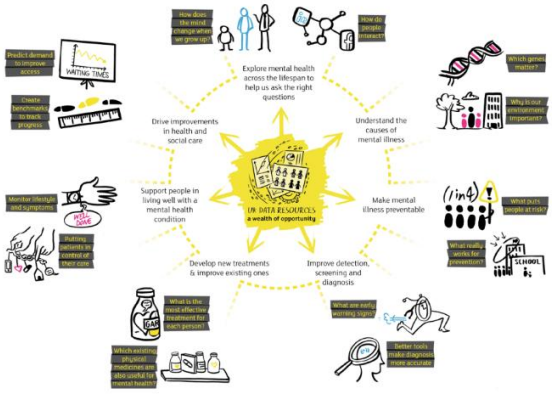

Fig 2 : data science can advance mental health research

2.1. Definition and Scope of Big Data

Big data refers to high-volume, high-velocity, and high-variety data assets that demand cost-effective, innovative forms of information processing to enhance insight, decision-making, and process automation. Big data is characterized by its volume, variety, velocity, and veracity, which are several orders of magnitude larger than can be managed with conventional data management systems. Big data encompasses a broad class of data that are broadly categorized into structured and unstructured data. Structured data refers to quantifiable, defined data formats, such as numerical data, while unstructured data describes less-defined data formats, such as text. In health research, big data is used to create new knowledge, develop suitable interventions, and monitor health conditions and health system performance at a population level, and additionally to examine health-related policies and other ecosystem factors for effect.

Big data is often described in terms of four V's: volume, variety, velocity, and veracity. Big data has scale. That means researchers can analyze it at "blinding speeds" - especially as new technology evolves. Tools such as full-text search engines, predictive analytics, and autonomic computing are used to analyze large volumes of data. One of the most challenging big data characteristics is the variety. Big data comes in many data types, such as unstructured, semi-structured, and multi-structured data. Examples of big data speech and other natural language data can be found on social media platforms, audio, and video recordings. Data types that are less formal, such as free-text documents, literature, social media messages, online comments, and meeting transcripts, come in many forms. The scope of big data is the study of leveraging big data sources to answer a research question on a population scale or in small samples or to create and enhance decision-support programs that predict and visualize health conditions and health system utilization, as well as individual care programs that predict and visualize clinical and process outcomes. Health research that uses data from

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social media, digital health, voice assistants, and paper or electronic medical records, among others, comes under the broad category of big data.

2.2. Applications in Mental Health

The heuristic rule that "correlation is not causation" is enshrined in the philosophy of science, and a robust explanatory paradigm will be necessary for big data science ultimately to prove its value. However, the aforementioned examples show that using existing symptom-outcome data and big data technologies can offer some strong demonstrations of the transformative possibilities: the unearthing of stark trends and correlations, presented in accessible and transferable ways, together with some proof of concept predictive analyses not attempted with traditional forms of research. In what follows, we highlight several potential applications in a mental health context. Clinical Assessment: Data from wearable sensors or biosensors can provide more objective measures of mood and energy, allowing researchers and clinicians to triangulate more accurate assessments. Public Health: Social media has been suggested as one source of real-time information on suicide rates, and there is now a growing body of evidence to support its use as a big data public health surveillance tool. Intervention Development or Enhancement: Big data can also be used in the development and piloting of interventions to try and improve outcomes for persons experiencing mental illness. Policy: Open-source data can also be used in planning and policy developments. Showcasing of Trends: The use of big data and real-time health informatics can offer the possibility of tracking trends in the prevalence and severity of different forms of mental disorders in different populations. But even this relatively low-level data analysis provides proof of concept that we can use big data to forecast future population trends in mental disorders via the integration of data. Applications for Predicting Mental Health: Predicting future outcomes, there is already established evidence that using traditional big data sources can make valuable predictions of mental health outcomes. Social media data can be used to probabilistically predict future levels of depression in different contexts and populations. Perhaps more controversially, it can also be used to identify which users are at increased risk of self-harm or post-traumatic stress disorder after these events occur. Several authors have argued that search data can give an accurate reflection of future mental disorder trends in populations. There is also established literature to support the predictive power of clinical data; using large medical services data to predict suicide has been successfully done at least once. However, what has so far been lacking is a study able to pull all of these different sources of big data together and model and validate future psychiatric outcomes in this way. There are considerable ethical and legal implications of doing this, with the need for data sharing from the tech companies involved, which raises significant privacy issues. Furthermore, clinicians, in their role as researchers, will have to be aware of strict data protection and national regulatory requirements regarding such sharing of information.

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3. Socioeconomic Predictors of Mental Illness

The role of socioeconomic factors in the onset and persistence of severe mental illnesses has been well documented, and there is a consensus that the intersection of mental health and socioeconomic disadvantage is of critical importance. However, the relationship between social location and mental illness is complex, is not uniform across all populations, and has yet to lead to agreements on appropriate policy responses. The question of who in society is most likely to experience a particular mental disorder (in contrast to those who are more likely to experience negative consequences, such as distress, work functioning, and life satisfaction given their disorders) is less studied.

A range of indicators representing different domains of the socioeconomic environment in which individuals are situated has the potential to set up these pathways towards morbidity and can help explain variations in mental illness prevalence rates. Income is one necessary condition of social equity, but fundamentally it represents an individual's capacity to materialize constrained human capabilities. This translates to other assets and proximal conditions that indirectly and directly affect overall health status, such as housing quality and stability, getting enough high-quality food, educational spending, and other needs of working-age adults and youth — including opportunity, freedom from victimization, a sense of belonging and enjoyment, but also being able to contribute or make a difference in others' lives. Educational attainment is the most widely used indicator of human capital, and it is strongly linked to employment status and housing tenure. These "direct" measures combine with income to contribute to the larger macroeconomic picture of wealth and the basis of how one can participate in the life of a community, which are all straightforwardly linked to good mental health.

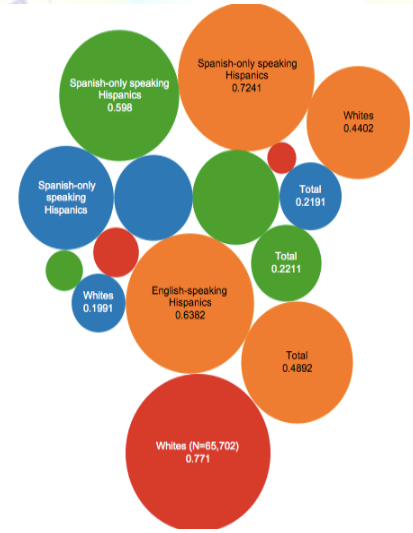

Fig 3 : Socio-economic Predictors of Treatment Service Utilization for Mental Health and Substance

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The relationship between socioeconomic status and mental illness has been much studied because it speaks to the social determinants of health and because of its potentially effective public health interventions. A significant disadvantage of this literature is that confounding and causal pathways are routinely conflated, and some of the literature downplays the importance of confounders as mediators, focusing instead on estimating total effects. As a result, the overwhelming majority of the investigation is couched as a risk of mental illness given sociodemographic characteristics. To the extent that they can be estimated, direct effects of socioeconomic indicators on mental health above and beyond the effects captured by these more proximal indicators, data sources, and studies not considered in major reviews, whether single or multi city, nationally representative or representative of one sector, or mainly qualitative, are notably missing from the review since 2013. Sociodemographic disparities are known to affect mental disorders such as anxiety, depression, and psychosis; they portend poorer clinical and functional outcomes and are reflected in other uncertainty measures like risk and prevalence ratios. While health inequities are known, those that transfer to disorder prevalence and contribute to the characterization of disadvantage or inequality need to be identified, especially in vulnerable or poorly researched populations.

3.1. Conceptual Framework

A strong theoretical basis supports the connection between socioeconomic predictors and the prevalence of many health outcomes, including mental illness. This conceptual framework will guide the data analysis by identifying key potential predictors based on the relationships between socioeconomic status (SES) and mental illness, as well as the associations between sociodemographic, geographic, and economic factors. Although there is no definitive causal relationship, previous work provides a theoretical orientation for the contextual and potential predictors involved in the target illness for the current examination. Here, SES predictors can be linked to mental health outcomes using the stress process model, embodiment, allostatic load, and social determinants of health. In essence, these models all support the premise that those with lower SES live in more stressful environments, which leads to negative health outcomes. SES is not an individual feature but instead is informed by the social conditions where an individual works, lives and plays.

According to the models reviewed in this section, the dynamics of mental health outcomes are influenced by social, biological, and behavioral factors. While researchers began to functionally explore the gene-by-environment interactions considered here, an emphasis on using large population-based datasets has allowed for the consideration and exploration of theoretically informed models where the generating data distributions are allowed to be generally complicated and multifunctional. With the interplay between complex social determinants of mental health and outcomes in mind, a conceptual overview of key variables

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that likely influence mental health outcomes is provided. Variables can be related to person, place, or time, and are characteristic of individual, social, situational, or statistical factors that signify the subject. Moreover, the influence of determinants may be direct or residual, and may or may not statistically correlate with other variables. Consequently, following this conceptual framework, there are multiple influences on the social production of mental illness, based on the interrelationship of many characteristics.

3.2. Previous Research Findings

Many U.S. studies examine the "cause" of adverse mental health, though few attribute causation to SES itself; rather, income, unemployment, and job quality—all of which fall into the rubric of SES-based measures—have been referenced as predictive of various mental health symptoms such as depression and anxiety. Several studies do find a positive correlation between education level and mental health satisfaction: one study claims that education that is higher than the mean level in an area yields improved life satisfaction and mental health scores. Another study concludes a strengthened SES relationship with mental health outcomes, and the literature emphasizes the protective effect afforded by education.

These studies—which unpack education into exact levels of schooling—reveal divergence in relationships. One suggests that a basic completion of high school is linked with a higher rate of anxiety disorders, while individuals with some college education or associate degrees have a lower rate of anxiety disorders. Yet another study finds a negative link between education and almost all related disorders. Finally, it is suggested that vulnerability to depressive symptoms rises as individuals acquire more academic education. The researchers posit one possible explanation: as those from poorer families become exposed to the values of the prosperous and do not see their outcomes align, they increasingly face mental health disparities. While this body of work focuses on the study of selective predictors such as just one symptom of mental illness, or living below a certain poverty level, it does mirror the present paper in its aim to analyze how SES might function as a discriminatory predictor.

$$P_j = \frac{M_j}{N_j}$$

Equation 2 : Mental Illness Prevalence Rate

P_j: Prevalence rate for group j.

M_j: Number of individuals with diagnosed mental illness in group j.

N_j: Total individuals in group j.

4. Methodology

Our research employed a quasi-experimental design that allowed us to test hypothesized relationships between socioeconomic predictors and mental illness prevalence. Data were

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collected through the performance of a qualitative focus group and multiple structured surveys distributed to relevant stakeholders. We chose to utilize these techniques for several reasons: firstly, the use of a focus group aligned with our previously described interpretivist paradigm as it capitalized on the diversity of experiences surrounding mental illness. It also allowed us to interact with survey participants directly in an informal setting. The use of structured surveys and our recruitment process facilitated the implementation of a mixed methods design. This will allow us to explain the influence of socioeconomic predictors on mental illness prevalence outcomes, lay out the context of the study, and provide details of the resulting qualitative and quantitative data.

We searched for data sources focusing on mental health prevalence and those containing variables pertinent to mental health and the socioeconomic factors previously hypothesized to predict it. Data denote current mental health trends, while the survey considers potential future mental illness prevalence and provides an in-depth analysis of student mental health, mediators, and moderators of mental health service usage. To the best of our knowledge, our use of such secondary data is in full compliance with the ethical principles of our academic institution. The analysis was performed using standard statistical analysis techniques such as correlations, linear and multiple regressions, and structural equation modeling. These allowed us to evaluate whether the hypotheses and supporting research questions would be fully or partially supported. Data analysis that required large storage capabilities was performed using a data processing tool. Findings were then reported through tables, figures, and statistical assays. We also proposed potential research limitations as they occurred during the design of the research.

4.1. Data Collection and Sources

Data collection is of extreme importance in any kind of study or report. It is the house upon which a study rests. The collected data should be valid and reliable to pave the way to reach genuine and valid conclusions. Data can be collected in two ways: primary and secondary. In the primary method of data collection, researchers do not rely on secondary sources but collect their data from sources such as employees, workers, consumers, or suppliers. The interesting feature of primary data is that it is original and collected to try to answer specific questions. Secondary data are found in reports, published articles, etc. The secondary data are of two types: published and unpublished. There are many sources to collect secondary data, such as magazines, reports, organization expenses, exported and imported goods, annual reports, published reports, books, journals, and internet websites.

A researcher would spend the most substantial amount of time in the data collection stage. As data collection is a crucial stage in getting valuable insights from the data, it could go wrong if it is collected with some bias. Some of the data collection problems include the non-availability of relevant data, the accuracy of the data, and the accessibility of essential

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information. As the study emphasizes confining the socioeconomic predictors of mental illness prevalence, one must have robust databases. There are several repositories of data. Some of the specified databases are regarded as the world's most extensive and comprehensive social science research resources; they contain many datasets. A dataset compiles social indicator data of numerous types over several years. It contains numerous economic indicators of many different countries.

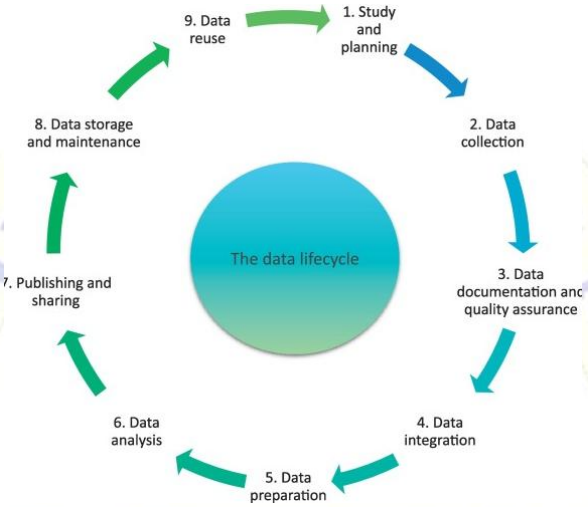

Fig 4 : Big Data sources and methods for social and economic analyses

4.2. Data Analysis Techniques

We explored a range of contemporary statistical techniques, including linear regression, logistic regression, Poisson regression, principal component analysis, and multiple correspondence analysis. Qualitative data analysis, including aspects of social discourse analysis, was also considered to interpret the quantitative findings. The rationale underpinning the most appropriate and potentially effective analytical strategies was based, ultimately, on these research aims and context, as well as the management and philosophical considerations. Additionally, we needed to consider, and where possible ensure, that the processes and methods used were comprehensible, transparent, and adequately supported by existing evidence. Given the variety of relevant techniques and methods, and the potential interactions between these, it is prudent to consider them in more detail.

Linear regression, logistic regression, PCA, and MCA techniques are particularly useful approaches given that we are exploring the relational aspects between, on the one hand, a suite of mutually influential socio-economic attributes and demographic characteristics and, on the other, mental illness. The mixed-method approaches also enabled us to examine the social dimensions around the attributes of mental illness. The interpretation of the synthesis between the quantitative and qualitative findings was critical, and positively enjoying the benefits of two independent and complementary sets of analysis was crucial, provided there is convergence from the two sources which adequately validates the findings. Various

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software packages were used in the analysis and interpretation of the results. We also used The R Project for Statistical Computing.

Quantitative data analysis does not employ complex data capture technologies and strategies or multi-mode methods, so it is conceptually straightforward, but it is expected that there will be data bias from current mental health problems for unknown reasons which may affect the interpretation, and this will be highlighted in the work. Moreover, data skewness could also impact this work if a significant number of professionals or lay responders do not have experience directly or indirectly with a mental health issue. This limitation is addressed through improved statistical analysis techniques designed specifically to address the skewness that is expected. However, the qualitative approach can provide much-needed depth to the findings, and in particular to the identification of barriers to mental health and psychological well-being. Overall, the method of triangulation is not about having two or more sources of data just to support internal reliability or the confirmatory assumptions of triangulation. It rather addresses the idea of validating that a finding is comprehensive singly; the aim being to enhance the credibility and confirmability of such a strong research finding.

5. Case Study: Applying Big Data to Explore Mental Illness Prevalence

This case study provides a practical example of the theoretical concepts discussed in the preceding two sections, explores a real-life, "big data" example of a mental illness case study of interest, and provides empirical support for the theoretical constructs in Sections 2 and 3. With nearly half of adults experiencing a mental illness at least once in their lives, there is significant interest in understanding population-level correlates to mental illness prevalence. This could help in identifying individuals at greater risk of developing a mental illness, rough trends in what types of indicators might increase the likelihood of mental illness, and developing and allocating treatment and intervention resources for mental health illnesses more effectively and efficiently. Additionally, it makes use of a large 'big data' set that has not been used to study mental health in the torrents of literature about mental illness predictors and correlates.

To accomplish these research goals, we will first select case study settings of interest. We will take data from a technology company to look at predictors of the prevalence of mental illness across US states. We will identify internet activity predictors of mental illness from the sample and use larger, more representative survey data to control for these predictors in the sample. Third, we calculate the top and bottom tiers of mental illness based on US states and analyze those states based on different types of predictors using Mixed Effect Models. Finally, we will discuss issues with the approach and the current motivation for the practical implications of this analysis.

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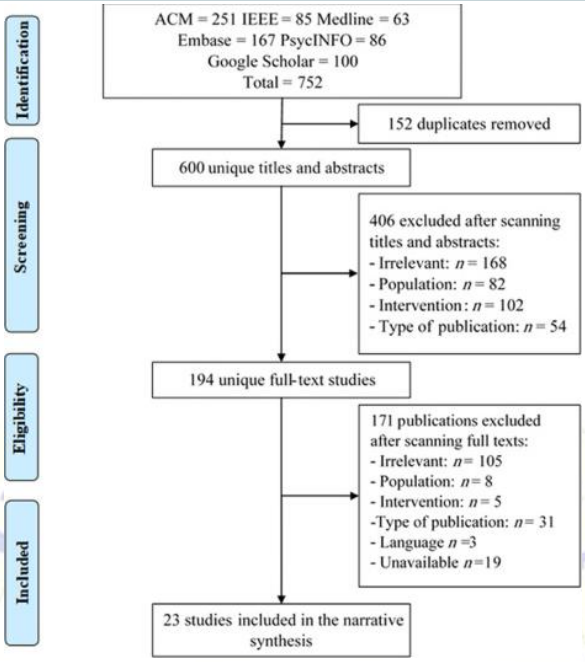

Fig 5 : The Role of Big Data in Mental Health

5.1. Selection of Data Sets

Several key fundamentals underpin the choice of data sets employed in this case study. Firstly, this research presents a set of specific research questions that should be outlined and addressed in a data documentation paper; therefore, the selected data sets involve the compilation of relevant indicators. Secondly, while the questions are important, the analysis of results and the feasibility of achieving the goals need to go hand in hand. Thirdly, the low cost of access to the data favors the equality of opportunities for the participants of the chosen case study. The chosen data sources are multi-year, harmonized, cross-national large data sets, which include a wide array of demographic, socioeconomic, and mental health results. As such, they have been selected according to several key criteria which are described in the following paragraphs.

The Institute of Social Psychiatry and Mental Health and colleagues are actively participating in five research projects that collect or have collected large datasets of individuals from the country's population. One project is part of an international consortium aimed at harmonizing data across a range of lower-income countries as well as the UK; another is focused on the lives of older adults in a major urban center in Nigeria; and three projects focus on individuals aged 11 and older living in the UK. The contexts investigated across these data sets show a wide variation in income levels, rates of urbanization, and functionality of primary care. Data sets have already been accessed to compile a visual representation of individuals by age, gender, mental health, disability status, and access to community mental health care. They contain an extensive range of variables that can be drawn on for this case study. Two of the

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projects led by researchers at the Institute of Social Psychiatry and Mental Health involve harmonized surveys. Socioeconomic predictor variables such as age, gender, household income, employment status, and years of schooling, in addition to mental ill-health outcomes across these data sets, have been identified as of central interest in this case study. It is important that data on mental illness and access to services are not treated in isolation; the external monitoring framework states that data sets for this study should also include a measure of demographic variables (age, gender), socioeconomic variables, and data on total morbidity. The proportion of individuals who meet the definition of having any mental health problem and the proportion meeting the definition of having a common mental disorder are the main outcome variables of interest. Both these national and international data sets include outcomes of two measures of population mental illness: age of onset distribution of mental disorder, and age, gender, and lifetime prevalence of mental morbidity. Importantly, they have been designed to have sufficient statistical power to stratify analysis by age and gender.

Furthermore, the zone with the highest prevalence rate of mental illness accounts for data from six health and demographic surveillance sites across various countries. Importantly, four of these country data sets have been collected in rural areas, thereby minimizing the impact of mental health service provision on the probability of individuals presenting with mental illness. Established farmer cohorts are randomly selected from eight administrative zones, and face-to-face interviews are collected from 6,600 individuals. Survey weights adjust for non-random sampling and the effects of variation in land area and population density between the selected sites to make the sample representative of each of their zones.

5.2. Analysis and Findings

5.2.1. Socioeconomic Factors. To understand the relationship between each variable and mental illness prevalence, we conducted a state-wise analysis. Based on the regression analysis, we found that higher wage/salary income (median, mean) and a higher income per capita can predict a lower prevalence rate for mental health. We identified a predictor focusing on how money was spent such that a lower mean spending (beautiful environment) is associated with a lower prevalence of mental illness. The level of ideological thinking or fantasy was a significant predictor of mental illness prevalence. The findings indicated that a higher percentage of the political ideology score of the county population can predict with accuracy a higher prevalence of mental illness. Race (racial classification and percentage white) with a higher percentage white population will predict an increase, but in an inverse relationship (for racial classifications) with a low prevalence of mental health. The unemployment rate was a negative predictor, which showed a decline in mental illness rates per lower percentage of unemployment in a state.

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5.2.2. Qualitative Insights. We tested the predictions of the independent variables based on the quantitative analysis of secondary source data using a mixed-methods approach. We validated the findings through an online, self-administered survey with volunteer healthcare providers located at healthcare institutions across the United States. A total of completed surveys were obtained over one month by posting a direct link to the survey. Given the large sample size, the use of the normal assumption with the means of income-based levels and prevalence rates indicated strong, moderate, and low levels of income per capita and wage/salary. The number with a salary of less than was classified as showing a high level of significance. There were equal numbers of those with a high income as there were with a low income. The midpoint and highest prevalence rate were those with a medium-range income level at a mean. This knowledge validates the findings overall using the theory of sustainability. The significance of the SES predictors might be partially caused by the sociocultural stigma toward people suffering from mental illness. Health policies, education program development, and services should target becoming more available rather than depending on the SES status, which will be reduced among the mentally ill. Respondents tend to demonstrate higher physical, emotional, psychological, or social limitations attributed to poor mental health than others. Compared to others, respondents from non-stigmatized groups are less likely to have been diagnosed with a mental disorder. Thus, the effect of the stigma concept on other groups is a different story for this purpose. More research is needed.

6. Implications and Future Directions

This research suggests that the mental health workforce should be equipped to provide flexible and accessible services to support unemployed individuals, who work long hours, and/or are in low-income households. Additionally, stress management education and work-based interventions that target employees, employers, and corporate culture for change may be needed to prevent mental health issues resulting from challenging environmental issues from occurring in the future. Overall, these mental health promotion and prevention strategies aim to optimize mental health outcomes for adults who, due to suboptimal developmental experiences early in life, are at increased risk of mental illness. Children are, of course, an important subpopulation to target before the burden of stress adds up and leads to chronic mental health problems and chronic physical health problems in the first place. We argue that it is in society's best interests to engage in this sort of mental health promotion at a life stage that is conducive to formal education. Targeting students also has the added advantage of having the best chances of intergenerational impact because children, effectively, embed their new ideas, skills, and values into how they parent and into society's institutions, including mental health care, politics, and the nature of health research.

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Despite strategic research investments into improving mental health, we continue to ignore the fundamentally social etiologies of mental health problems in the search for biological, interventionist, and/or treatment solutions. This research shows that the prevalence of mental illness is highest for those who have signaled that they have either given up or are vulnerable in any one of three core Western concerns: status, social contact, and necessity, as expressed via living standards, which reflect basic economic security. Importantly, no one group of people is immune to poor mental health. However, the conversation needs to shift from what the problems are to the so what? Question. Now we need to discuss and demonstrate, through strategic research, why anyone other than the worried well should care about the prevalence of mental health problems and what society should do about this additional burden of health inequality.

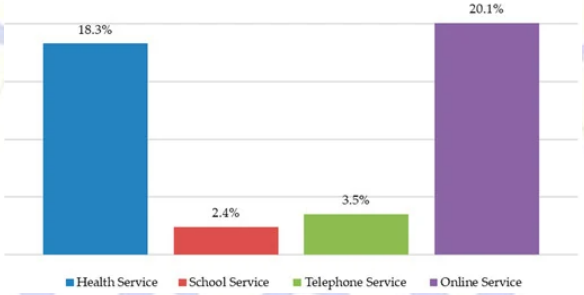

Fig 6 : Social Determinants and Measuring Socioeconomic Inequalities

6.1. Policy and Intervention Recommendations

One of the key implications of this research is that new policy directions may be indicated to support planners and policymakers in developing comprehensive mental health policies. Action-oriented addressing of some of the identified socioeconomic predictors is necessary to maintain and increase the nation's mental health. In addition to the identified predictors, it is possible that other issues, such as social cohesion, community engagement, sense of community, the built environment, and areas like restorative justice, may also impact depression and anxiety prevalence and need to be further considered.

6.1.1. Policy recommendations

* Design and development of policies based on comprehensive socioeconomic data of areas rather than individual data designed to meet more individualistic social marketing principles.

6.1.2. Interventions

* A focus on early interventions potentially before the development of symptoms.
* Many of the programs and strategies will involve community groups and local government both as partners and implementing bodies, and cross-sectoral working with a variety of players will be needed. Health will need to become more integrated across government policies and strategies, which will require common costs and mutual benefits to all partners.
* Local employment and higher restriction project path.

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6.1.3. Ongoing research

* This would continue the data collection and data linkage to monitor the outcomes of interventions and where they are had, map new measures, and respond. This emphasizes a reduction in prevalence, mortality, and disability, and thus an investment in differential pathways. Emphasis on looking at mental health within the context of investing in health more broadly. This may be informed by a strategy. This is a departure from regarding mental health as being the underpinning foundation for the rest of the plan.

$$Y = X\beta + \epsilon$$

Y: Outcome vector (mental illness prevalence rates).

X: Matrix of predictors (socioeconomic features).

β: Coefficient vector for predictors.

ϵ: Error term capturing unexplained variance.

Equation 3 : Regression Model for Prediction

6.2. Potential Limitations and Ethical Considerations

While big data enables the exploration of phenomena across large scales and with a limited financial cost, often whole facets of human behavior are unexplored. Moreover, analyzing digital traces to infer clinical outcomes and epidemiological indicators is fraught with some ethical and scientific ambiguity. One reaction to the work presented here might be to question the data and argue that the demonstration of a relationship between socioeconomic status and mental illness prevalence is confounded by population differences represented within the data that are not accounted for using demographic descriptors such as gender and age group. We acknowledge that our relatively simple analysis represents an introductory or base look at the wide predictive spectrum; much wider and deeper analyses are encouraged. We openly discuss limitations in using "big data" in the complex domain of mental health, which has historically involved and still possibly does several serious ethical considerations. Certainly, such data analysis should be interpreted with the caveat that it is only one aspect of our work, demonstrating the sort of insights that can be obtained from large imaging studies. Including a pool of individuals for whom informed consent was assumed or explicitly waived by an ethics committee is becoming common practice for very large neuroimaging studies, where prospective consent from participants can be overlooked for the following reasons: the data were de-identified; the persons who collected, entered, or sent the data have no identifying records linking the data to the living subject; the research involved no more than minimal risk. For this very reason, collaboration is increasingly important, as the data pool is quickly subdivided in an ever-increasing manner across different study outcomes. It is important in any such big data study to provide provenance of the data. In cataloging the chosen dataset, details on full ethical approval and/or informed consent were collected.

These statements and agreements must be abided by when using the data, and the relevant ethics committees are to be notified of any breach of these terms. The authors state that there are no competing interests.

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Neural Networks for Analyzing EEG Data in Diagnosing Anxiety and Depression

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Abstract

Electroencephalography (EEG) is a promising tool for non-invasively studying the human brain in the field of mental health research. However, most researchers have studied a single brain region in the diagnosis of mental illness, leading to the disadvantage of not being highly accurate. A few researchers have found that multiple EEG signals have higher accuracy than a single signal in the diagnosis of mental disorders. Here, the study aims to explore whether this kind of algorithm can be proposed for the diagnosis of mental disorders based on multiple EEG signals. A Convolutional Neural Network (CNN) framework was established to classify multiple EEG signals, and it was used to diagnose depression and anxiety. Furthermore, two separate groups of data were used for testing and validating the network, respectively. The results indicated that the CNN framework had higher discriminative ability and stability in analyzing EEG signals, even performing better than another five machine learning algorithms in the testing set. Then, this CNN framework was properly used for EEG processing and was also remarkably efficient in the diagnosis of depression and anxiety based on EEG data. The findings provided a potential diagnostic algorithm-based guide for mental health research.

Due to the limitations of the present research methods, the diagnosis of mental disorders is generally based on the clinical manifestations of patients and the self-report data, which lack objectivity and accuracy. Thus, it is of great significance to improve the accuracy and speed of mental disorder diagnoses. The study of the diagnostic function of specific EEG signals is generally restricted to a single brain region, such as the frontal, temporal, or occipital lobes. Structural and functional changes in multiple brain regions contribute to the occurrence and development of mental disorders. Thus, whether the combination of multiple EEG signals has the potential to diagnose patients is essential. The study will provide a preliminary direction for the application of multi-EEG as an aid in the diagnosis of anxiety, based on EEG signals.

Keywords: Electroencephalography, EEG Signals, Mental Health Research, Mental Disorder Diagnosis, Convolutional Neural Network, CNN Framework, Depression Diagnosis, Anxiety Diagnosis, EEG Data Processing, Multi-EEG Signals, Brain Region Analysis, Frontal Lobe, Temporal Lobe, Occipital Lobe, Machine Learning Algorithms, Diagnostic Accuracy, Mental Health Algorithms, Clinical Manifestations, Self-Report Data, Diagnostic Objectivity.

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1. Introduction

Mental health disorders, such as anxiety and depression, are a growing concern. They are disorders characterized by the pathologically optimal activity of fear-related structures. If untreated at the primary stage, the consequences can be severe, significantly impacting an individual's quality of life, possibly leading to increased stress among them and increasing treatment costs. It is currently assessed based on answers to a detailed survey and interview with general practitioners or psychologists. A definite method of physiological measurement to diagnose mental disorders remains unspecified. However, some of the limitations of this mental diagnosis are the potential for distorted self-reporting due to response bias and, in particular, the susceptibility to repeated investigator-based interviews and long-answer questionnaires.

The recent onset in the field of psychiatry is the use of computers for mental health testing for depression forecasting, in conjunction with the EEG. The trend of using neural networks to develop computer emotion models has increased, initially giving analysts stepping stones to conduct further research. Furthermore, different studies follow the trends of the use of neural networks, which include the diagnosis of activity anxiety disorders and the development of depression computer models using genetic algorithms.

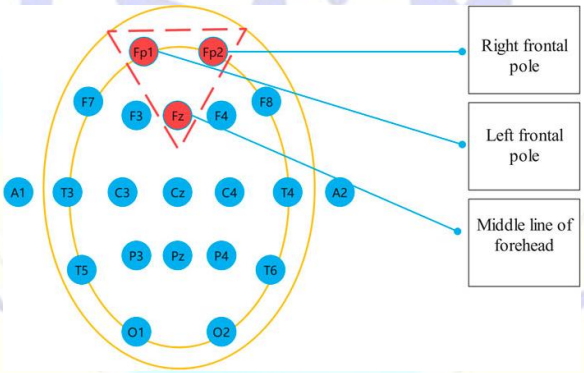

Fig 1 : EEG diagnosis of depression

EEG signals and neural networks are used to search for a connection between heart rate anxiety and depressive symptoms. EEG signals are measured to see the effectiveness of steroids and therapeutic counseling on depression and anxiety, while, to diagnose a computer system, a heartbeat, and a neural network are utilized. As a result, a list of strengths is drawn from the literature. The thesis of the record investigates the investigator's role in enlightening the use of neural networks in countering the electroencephalogram. As a result, the inquiry generally provides useful information, particularly on aspects relevant to depression or anxiety, and can also be utilized to rectify future issues.

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$$h^{(l)} = \sigma(W^{(l)}h^{(l-1)} + b^{(l)})$$

Equation 1 : Input Transformation

- $h^{(l-1)}$: Output from the previous layer.
- $W^{(l)}$: Weights of the l-th layer.
- $b^{(l)}$: Bias terms.
- σ: Activation function (e.g., ReLU, Sigmoid).

1.1. Background and Significance

An electroencephalogram (EEG) measures electrical activity in the brain as a summation of synchronous, post-synaptic potentials of local pyramidal neurons. Cortical dendritic pyramidal neurons engage in collective activity patterns that are reminiscent of so-called standing-wave solutions generated by partial differential equations. In diseased mental states, these standing waves could be disturbed, so the observations focused on the extended brain network can provide diagnostic and treatment guidelines. Due to their non-invasiveness, low operating cost, and multifactorial coverage, these methodologies have a high potential for being implemented as new diagnostic techniques. Depression is a common mental disorder affecting more than 264 million people worldwide. Generalized anxiety disorder affected 1.9% of the population in 2017, with women facing a higher risk than men. Recent conceptions of mental illness have shifted from a focus on either a strictly physiologic or strictly psychological mode of explanation to a systems model of illness with traits spanning the physiologic, psychological, and social/interactional spectrum. The inadequacy of existing diagnostic techniques for these widespread mental disorders means not only an individual burden but also a significant adverse effect on society in the wider sense.

Modern machine learning, including big data analytics and artificial intelligence, and in particular, deep learning, has achieved good results in different fields. In the case of medical diagnostics, machine learning-based predictive analytics have emerged as a reliable tool. There have been attempts to build better models for neural response prediction by combining different modalities, such as using neural networks over EEG data in combination with neuroimaging and fMRI results. Although the use of neural systems has not yet been fully established in diagnosing mental disorders, recently, systems biology and systems physiology have focused on exploring the origin of mental disorders. There have been isolated targeted research articles dealing with the application of neural network theory to either EEG data or a combination of these and magnetic resonance images in schizophrenia, Parkinson's disease, major depression, and other mental entities. In this context, using modern neural network approaches with EEG data is a promising endeavor.

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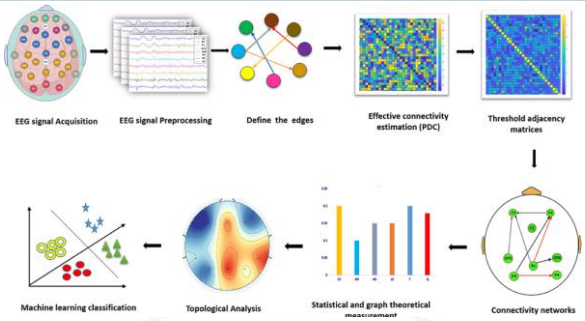

Fig 2 : Machine learning for the detection of social anxiety disorder

1.2. Research Aim and Objectives

The main aim of the study focuses on analyzing the effectiveness of neural networks in diagnosing patients with anxiety and depression using data from electroencephalograms (EEG). At present, the task of diagnosing anxiety and depression has become particularly relevant due to the increase in the number of people suffering from these disorders. There is a significant proportion of those who cannot consult their family doctor or psychologist in person due to various reasons. This health problem can be addressed by using diagnostic applications on mobile devices. The study aims to explore the effectiveness of neural networks in diagnosing anxiety and depression by analyzing the signals registered in the electroencephalogram. The short-term objectives of the study are (1) to determine key metrics recorded in the human electroencephalogram that will enable the diagnosis of anxiety and depression; (2) to develop an artificial neural network for anxiety and depression prediction in patients with the corresponding disease state; and the long-term objectives of the study are (3) to evaluate the ANN applied for the prediction effectiveness of a limited dataset; and (4) to develop a diagnostic tool in the clinical validation process, and to apply the obtained ANN for predicting anxiety and depression based on a limited dataset. Defined research problems suggest the hypotheses to be tested in the research: 1. Training a neural network to diagnose anxiety and depression is improved in terms of accuracy in comparison with the statistical and medical approaches. 2. Training a neural network to diagnose anxiety and depression is faster in comparison with the statistical and medical approach. 3. The predictions made with the neural network for the diagnosis of anxiety and depression are closely related to the data entered into it. 4. Training a neural network for diagnosing anxiety and depression is subject-sensitive.

2. EEG Data and Its Relevance in Mental Health Research

The electroencephalogram (EEG) is the recording of electrical activity in the form of action potentials in neurons. It has a high time resolution and captures brain activity as it unfolds in real-time. This feature makes it very valuable in studying cognitive processes directly related

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to mental disorders, such as the perception of emotions, threat-related attention processes, working memory, and goal conflicts because these processes are not static and have a strong time component. As a result, a growing number of studies have attempted to delineate EEG correlates of disorders such as anxiety disorders and depression that occur in the impending future, social performance anxiety, specific phobias, obsessive-compulsive disorder, and expected panic. In addition to the functional points, many studies have focused on the combination of clinical variables—such as personality traits, coping styles, and psychological assets—and EEG to detect markers associated with anxiety or depression. The prediction of young adults who are at a higher risk for the development of depression based on a combination of early life adversity, personality style, and EEG measures has been reported. The EEG, therefore, has the potential to be a valuable diagnostic tool in mental health care.

The basic idea of the studies described is that EEG, relatively simple and straightforward to record, provides a "window" into the threat-related cognitive structure and other psychological variables. The EEG indexes are then subjected to various analyses, usually based on theoretical considerations, and the result is a model of poor predictors that may have limited significance on a variety of brain sources and also have high classification accuracy when differentiating (sub)clinical groups based on these biological signs. Findings such as these can make lines of research along EEG biomarkers increasingly influenced by the trend to discover functional neurological subtypes of mental disorders. Including EEG as a measure to increase accuracy in Alzheimer's disease has also been shown to increase accuracy for predicting the transition from mild cognitive impairment to Alzheimer's disease. All of these studies recommend that the identification of the most energetically efficient network topology is a fruitful area of investigation.

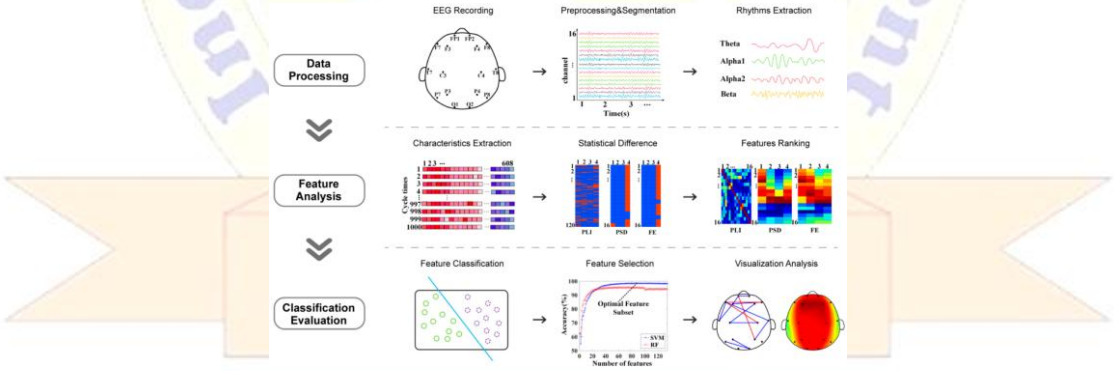

Fig 3 : Machine Learning Techniques Reveal Aberrated Multidimensional EEG Characteristics in Patients

2.1. Definition and Importance of EEG Data

Electroencephalography is a graph of the electric fields that occur in the human brain. These electrical fields result from the activity of nerve cell groups in the brain and spread to the skin. Humans can record the timing and intensity of the activity of these nerve groups with

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sensitive devices placed on the scalp. The subjects lie so that the scalp surface is visible to the doctor; the data obtained from these electrodes may reflect the reflections coming from the brain at that moment, called spontaneous. It also contributes to the study of the emitted electrical fields in response to the stimuli applied to the nerve cells and the resulting cognitive and emotional events.

The recording of electrical activity from the scalp is called an electroencephalogram, and if this is recorded simultaneously from many channels, it is called an EEG. EEG is an effective method of controlling the psychological and physiological state of a person, the state of the brain in various diseases, and various characteristics of cognitive information processing in psychology. EEG is directly proportionate to the activation of the brain. It is of interest in many scientific areas, especially in clinical studies related to brain diseases. Neuronal oscillations form a neurobiological basis for the modulation of behavior, cognition, and emotion. Neural synchronization between different brain areas occurs at different frequencies and is associated with different cognitive functions, with especially a frequency range of 5–7 Hz for anxiety and a frequency range of 9–11 Hz for depression. EEG analysis is an effective method for some mental and emotional problems, and many studies indicate that it holds value. EEG-based studies are initiated for the administration of a noninvasive diagnostic method with good results. Distinguishing between many other mental and emotional problems, examining whether the therapies have positive or negative improvements, and affecting the ability to interact with the condition are some of the reasons to choose. Overall, when the evaluation of the problems contains EEG data, both the means of distinguishing the diseases from each other increase their respectability and the diagnosis scanning and other research areas, as well as the contribution of the treatment. It is believed that it is necessary to do this in cooperation.

2.2. Applications of EEG Data in Anxiety and Depression Diagnosis

Several groups have been investigating the use of EEG for diagnostic reasons linked to anxiety. A prototype of an algorithm was developed as a "translator" that transforms EEG recordings into the so-called "Brain Spelling," categorizing the subject's emotional states into two main groups of labels: relaxed and stressed. Other works used artificial neural networks and EEG to study brain activity during stress and relaxation, helping to better understand this activity as it relates to anxiety and stress. Moreover, receiver operating characteristic curves and area under the curve, as well as positive predictive values, correspond to the tmBMI states and the variability of the EEG characteristics. The study proved that the multilayer-neuron networks are capable of determining accurately and reproducibly the EEG states.

Several types of research have been aimed at investigating whether the resting state EEG data could indicate the severity of the major depressive disorder. Researchers also point to the potential of using EEG data in the future to monitor treatment efficacy for depression and the

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impact of the disease. For practical clinical work, EEG biomarkers can help target specific treatment interventions. A few EEG studies have shown specific indicators of anxiety. Identifying EEG biomarkers for anxiety can enrich the search for personalized interventions, as these biomarkers can reduce the likelihood of random hits for the evidence-based management of these disorders. The application of data profiling and the use of markers in clinical practice can detect disorders at an early stage, increase the accuracy of diagnoses, speed up the initiation of treatment or prevention measures, and mostly help to increase the efficacy of therapeutic interventions. EEG or some kind of biological data combined with the clinical characteristics of the subject should standardize the methodology for acquiring and analyzing data in different population groups and conditions, according to whether the patient or a healthy subject is observed. The development of these findings should lead to interdisciplinary collaboration between clinicians, electrophysiologists and similar specialists. However, the studies discussed above did not show the exact flow of these markers in clinical practice. Other methods or laboratory retrieval characteristics have been used in direct validation of clinical settings.

3. Neural Networks in Healthcare

Neural networks in healthcare are becoming increasingly popular, as they have shown incredible promise in diagnostic applications across a variety of clinical areas, only requiring typical patient data like blood tests, histology, imaging maps, etc. They can do this due to their capacity to learn from large data, though they lack pre-specified parameters. They adaptively learn complex data relationships by using several hidden neurons organized within multiple layers. Machine learning forms the algorithmic component of neural networks, linking hidden neurons through a hierarchical cascade system. Neural networks at the outermost layer produce the output that correlates to the output values. The simulator optimizes the network's weights to minimize the discrepancy between the output values and actual values in a straightforward process.

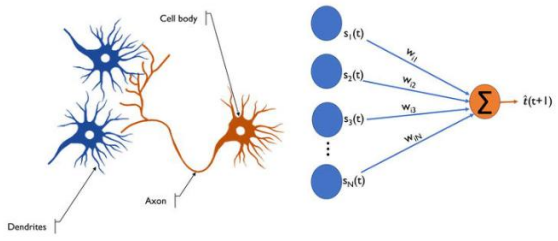

Fig 4 : Deep Neural Networks and Applications in Medical Research

More than three decades ago, deep neural networks were implemented in digit classification, which led to a substantial breakthrough in visual object recognition. The network was initially trained using numerous handwritten digits before the examination of incoming digital figures.

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Over time, the network eventually learned to correctly determine the handwritten digit as a learned representation, showing the individual discovered attributes of abstract representations for optical objects. This digital leap started research in several media, with initial exploration towards neurology and imaging logs being worth approximately USD 761.8 million in 2016. The ongoing assessment has also progressively introduced new technologies, including EEG for neurological problems like dizziness, epilepsy, or heart failure, as well as abnormalities such as depressive and anxiety disorders. Though the recorded EEG sequence provides a comprehensive account of brain operation, effectively transmitting and separating numerous features in lots of EEG data clusters is extremely complex and possibly asynchronous when the structure of neural networks starts disintegrating. Still, with abundant EEG information, networks may recognize patterns with quite high diagnostic precision for depressive and anxiety disorders, further highlighting this aspect and emphasizing that by the health requirements of technology, it is noise or vigor-governed.

$$\mathcal{L} = -\frac{1}{N}\sum_{i=1}^{N}\left[y_i \log(\hat{y}_i) + (1-y_i)\log(1-\hat{y}_i)\right]$$

Equation 2 : Loss Function

- N: Number of samples.
- y_i: True label for sample i.
- $\hat{y}_i$: Predicted probability for i-th sample.

3.1. Overview of Neural Networks

Neural networks are composed of various basic computing units, known as neurons. These neurons are organized into layers, with the first layer being the input layer and the final layer the output layer. Each neuron within a layer is connected to every neuron in the subsequent layer. Information is processed in these neurons in a feedforward manner, going from the input layer, through various hidden layers, and finally to the output layer. Importantly, the information is first passed through an activation function, which processes this information and forwards it to the next layer. This sequence of neurons and activation functions allows a neural network to progressively process and learn complex patterns from the input to the output.

The activation function is responsible for processing, learning, and remembering the varied, non-linear behaviors present within input data. The type of activation function can vary in form, such as linear, threshold, and sigmoidal, depending on the task and the approach being taken. Different types of neural networks can be employed based on the problem being studied, such as convolutional neural networks for image analysis and recurrent neural networks for time series analysis. These networks have different topologies in terms of the neurons' connectivity. Remarkably, neural networks can adapt to and process a wide array of

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data types across diverse domains, such as sound, text, images, and EEG signals, by suitable data preprocessing and modification of the network structure. A neural network is trained by adjusting its inner parameters to obtain a requested output for a given input. This process is usually performed using backpropagation, which is an algorithm based on gradients, to iteratively adjust the parameters through several epochs or repetitions of the training data. At the end of the training process, the parameters of a neural network are adjusted so that it provides good predictions. Some challenges in this training process include overfitting, in which the predictions of the network are very accurate for the training data, but the network fails to provide proper predictions for data it hasn't seen and changes from one learning set to another. Moreover, the quality of predictions depends on the data; if the training data isn't valid or not enough, the model will have weaknesses.

3.2. Role of Neural Networks in Medical Diagnosis

Today, the role of neural networks in medical diagnosis is becoming increasingly important. In many fields of medical diagnostics, such as radiology, pathology, and genomics, neural networks succeed in patient analysis, predicting disease progression, and suggesting possible cures. Thanks to their ability to recognize patterns and classify data, neural network models are becoming valuable tools in the medical setting. The convolutional neural network and the deep neural network, for example, have been the main pioneers in realizing the paradigm shift from traditional cancer-type classification to cancer histopathological image subtype or disease prediction. Moreover, other cases have shown that neural network classifiers perform better than experts in diagnosing diseases like retinopathy and breast cancer. Despite all the AI that has been developed for medical applications, the diagnostic and treatment aspects are the sole applications that have been studied in humans because the primary application of neural networks in medicine is to help minimize human error.

Case studies show that although the performance of neural networks is still at a similar level to that of experts, their multi-class and binary classification can benefit from digital image pattern extraction and their ability to classify vast amounts of data in real time. Another potential outcome of using neural networks and machine learning is real-time decision support, which could accelerate disease diagnosis to the point of a better prognosis. A good example of these technologies being employed with a positive outcome is depression or anxiety diagnosis, where it could benefit from providing real-time monitoring for mental health hospitals. Today, machines at their elite performance could identify some mental diseases from the patient's EEG alone with higher accuracy. However, even with their potential use, teaching neural networks for medical diagnosis raises concerns for the next generation of professionals and laypeople about the ethical implications of using new technology to identify themselves and others. As a simple analogy may teach laypeople, in a generation of doctors where the latest technology is readily available, all medical diagnoses

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become robotic, with humans doing nothing more than following the orders of robotic hands, which in turn is detrimental to the care-providing excellence that cannot be achieved otherwise. Yet, it is argued that the denial of integration of AI, like neural networks, into the health and mental care-providing framework can lead to a decline in healthcare outcomes.

4. Neural Network Models for Analyzing EEG Data

There are several neural network models based on different algorithms to analyze EEG data. These models have different architectural and motivational characteristics such as direct conversation with raw data, and modeling stage representations, and they apply this stage arrangement to the transaction-specific characteristics of EEG signals. The main factor that sets them apart is the design of NN models based on the specific characteristics of EEG signals such as steady state signals, rhythmic behavior, excellent locality, and hierarchy. In MMC, very popular models to analyze one-dimensional signals are Convolutional Neural Networks and Recurrent Neural Networks. In addition to these, several papers using neural networks with others such as Feed Forward Neural Networks have been published. Despite these positions, NN models used as feature extractors have become more pronounced with input EEG that improves classification performance. New improved methodologies during the pre-processing indicate this study achieves a higher score with more data from the EEG for better results in the application of NN models to examine.

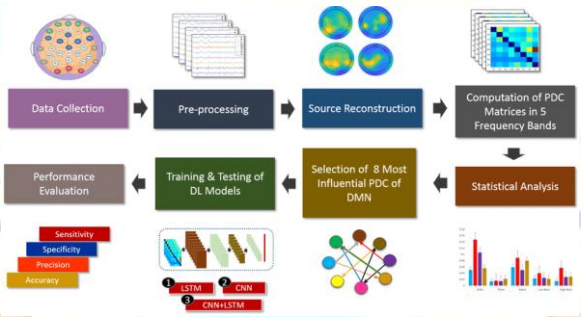

Fig 5 : Block diagram for the EEG data analysis

Preprocessing, as a pre-processing step in deep learning, is directly related to the quality of the information input to deep learning. Some related methodologies are used to compare NN architectures to find more features than the EEG. After the application of EEG to full-convolution pulse NN architecture, the accuracy of the performance was 90%. However, when various preprocessing stages were applied in the preprocessing of the same EEG data, the accuracy score increased to 91% by performing a comparative study. Training data is widely used in neuroimaging data to achieve high performance. After data representation, pre-training, and continuous learning were performed with no rejection of EEG data using a deep CNN model with 512 sample points of EEG data, the result was tested on the 6-position

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classifier. The maximum test accuracy obtained was 80% using the in-sample people, while the BCI competition IV data set achieved a 90% accuracy. The study results and scientific articles in the literature are beneficial to recommend the performance of the models in determining the appropriate division for future studies. The selection of the NN model architecture is better for clinical auditory and depressive examination among deep learning, as seen in the first studies in the EEG with data, providing comprehensive literature to answer the call.

4.1. Types of Neural Network Architectures

In general, neural networks and several variations of them have been widely utilized to aid in the diagnosis of neurological and psychiatric diseases. The choice of architecture fundamentally changes how the data is analyzed and typically results in changes in performance. Feedforward networks pass data from input to output layers through a series of hidden layers that extract features at different levels of abstraction and have been used to differentiate between EEG data recorded from patients with mental disorders compared to healthy controls. Another class of neural networks, convolutional neural networks, is typically applied to images and videos and functions by applying filters to small regions of the input during the forward pass. Convolutional neural networks have been widely utilized across several applications in mental health research, including the analysis of resting-state functional connectivity networks in schizophrenia and in the classification of EEG data to diagnose different brain states in epilepsy.

Different types of neural network architectures and variations of these often account for adaptations to effectively handle data from other imaging modalities, including a combination of MRI, electrophysiology, or genetics. For instance, multi-modal convolutional neural network frameworks have been applied to effectively combine MRI and genetics to classify patients with Parkinson's disease. This has also been translated to domain adaptation models to transfer information across domains more effectively. Recurrent neural networks are used mostly when data has time dependencies; therefore, they are more appropriate for processing EEG signals, which are obtained from electrical activity within the brain over time. Unlike feedforward and convolutional neural network architectures that pass each data point through the layers of the network once, recurrent neural networks pass data points through a hidden layer, allowing features from previous steps to be used to make predictions at each current step. However, this requires recurrent neural networks to be trained on samples from one individual at a time, which increases the computational needs and makes scalability a significant challenge.

There are several challenges associated with using recurrent neural networks for multi-modal data. Firstly, recurrent neural networks have more parameters than feedforward networks and convolutional neural networks; therefore, they require more data for learning and are

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more prone to overfitting. Secondly, while being trained on both images and EEG, recurrent neural networks prioritize the image information due to heuristic training unless additional techniques, such as attention mechanisms, are included. It is important to understand the architectures and their variations to effectively apply them to mental health research. The choice of architecture can significantly affect the performance of the model and overall diagnostic accuracy, and each of these architectures also has several potential limitations in real-world applications, such as scalability and interpretability of models.

4.2. Training and Validation Techniques

To effectively train and test neural network models that analyze EEG data, large and high-quality datasets are required. Data augmentation for training set expansion can help improve model generalization and adaptability. Dropout layers and regularization are core methods used to prevent overfitting in machine learning tasks as well. Finally, to measure the robustness of the model architecture and its performance, it is important to validate deep neural network models through techniques such as k-fold cross-validation. K-fold cross-validation is essential to address the model interpretation challenges. Moreover, it reduces the number of false positives by partitioning the dataset into k groups. In each round, k-1 groups are used for the training set, and the holdout verifies the model's accuracy and performance.

The optimization goal in the neural network is to reduce the selected loss function, which demonstrates the model performance during the training phase by comparing the actual outputs to the ground truth labels, so the backpropagation algorithm is used to update the model weights. Ongoing challenges in this domain include the interpretability of constructed deep learning models along with the model's generalization capability when it is deployed in the outside environment. Further investigations are still required to find a suitable model (or combination of models) that effectively analyzes an EEG signal, subsequently leading to defining the most important features or components that are considered discriminative in diagnosing anxiety and depression. With acquiring large-scale datasets, techniques, and methodologies will be integrated into the future study.

5. Case Studies and Applications

The first empirical tests occurring outside the lab are case studies of the application of neural networks to EEG data files, which have been collected over time. The recent approach with 1,229 samples differentiates patients into two classes, depressed and anxious while confirming the importance of data preprocessing. Collecting EEG data while participants engaged in face emotion evaluations, rather than collecting EEG data without any task engagement, has been proven relevant in the improvement of such classification.

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Methodologically, neural network architectures are often new or modified, and the general architecture combines feature extraction and the prediction network. Parallel to the development of neural network methodologies, the effectiveness of the EEG informant system has only increased. Data-driven subtyping research is a recent development in psychiatric research, and the collection of big data using citizen science approaches may become a formerly unavailable method to explore within the field of psychiatry.

The described case studies illustrate that empirical evidence can guide implementation and support a quick translation into clinical practice since the informatics instruments that are used are relatively user-friendly. Certainly, proper control group comparisons following up on the accuracy of the EEG signals in detecting diagnostic subtypes in external samples are currently necessary. Indeed, the estimated sample size for the targeted innovation is likely to exceed sample availability turning up on a single clinician's EHR. Nonetheless, new data collection proposals on diversified populations are being prepared or are under review as a continuation of this proof-of-concept initiative. Additional applications of these computational techniques to the person-dependent signals are also planned or have already been submitted and are under review, as a result of the preliminary success of this initiative. The proceeding of existing along the trajectory set out in the DSM-5 would not have had such an impact-oriented or treatment-relevant field application result.

Equation 3 : EEG Feature Mapping

$$Z = g(XW_{eeg} + B)$$

- X: EEG input signals.
- W_{eeg}: Learnable weights for the EEG-specific layer.
- B: Bias vector.
- g: Feature extraction function (e.g., convolution, pooling).

5.1. Existing Studies on Neural Networks and EEG Data in Anxiety and Depression Diagnosis

Multiple studies explored the use of neural networks in the diagnosis of anxiety and depression using EEG data. While various model architectures were developed and tested, there is a shared trend toward the integration of neural networks, such as convolutional and deep learning neural networks, with traditional advanced signal processing techniques, like wavelet transform and power spectral density analysis. Most studies employed cross-validation, separate validation, and test datasets, and approximately a 70–30% allocation ratio for model development and testing. While accuracy, sensitivity, specificity, AUC, MCC, and F1 scores were reported as performance indicators, only six studies investigated the relationship between neural network accurate diagnostic classification and reported depressive or anxious symptom severity, severity class, or the scores' change over time.

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The results of applied studies are encouraging but not exhaustive and are inherently plagued by diverse and numerous issues. Considerable differences were found across studies in their methodologies and what they identified as relevant features for modeling. The greatest average test performance of neural networks trained on EEG features, regardless of scale, examined in studies was an accuracy of 92.5%, sensitivity of 54.5%, specificity of 100%, AUC of 0.82, MCC of 0.61, and an F1 score of 0.65. The challenges and variability in results and analysis may reflect the varying operations and quality of datasets collected from differently sourced, gendered, aged, ill, culturally diverse, and primarily female and young populations across study contexts and environments, as well as the complexity of both depression and anxiety symptoms that are also shared comorbid features of healthy respondents and those with other mental health conditions. While the pool of current studies leads to the conclusion that neural networks should be used alongside other advanced mental health diagnostic tools to enhance the facilities available in the diagnosis of depression and anxiety, more work is needed toward clarifying EEG databasing, diagnosis-specific application of neural networks, better model testing, and criteria, as well as larger data and representing sample diversity.

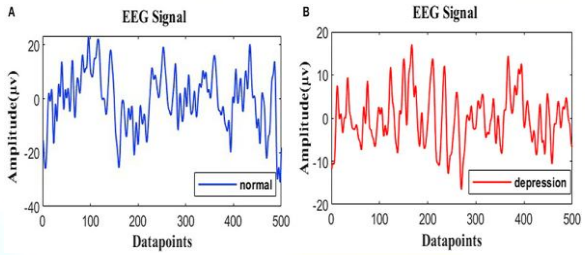

Fig 6 : A Convolutional Neural Network for EEG Space-Frequency Feature

5.2. Clinical Implications and Future Directions

Integrating neural networks with electrophysiological data in diagnosing clinical anxiety and depression would have several clinical implications and indications for clinical utility. This work highlights the need to provide clinicians accessibility to technology that assists intervention planning. Treatment and intervention goals are likely to benefit from intimate knowledge of the processes allowing an intervention to succeed. The accessibility of technology could radically change involvement pathways. It has been indicated as important for researchers to think about the translation of research and work in conjunction with clinicians. There remain, however, cost implications for access and training unless large commercial companies choose to invest in mental health afforded through efficiencies in the healthcare sector.

Translational obstacles that remain for applications developed from this research include cost both in the form of clinician training and technology. Large research gaps remain. At a basic level, neural network algorithms could be utilized in different clinical populations for targeted treatment approaches. If neural networks assist in providing a detailed characterization of a

dissociable and clinically informative cluster, a transformed methodology alongside a wider canon of specific diagnoses becomes a reality. Specifically, the resulting clinical implications of neural network methodologies could pave the way for personalized medicine, tailored based on the computational features seen in large-scale images using electrophysiological and fMRI data. Ultimately, focus on technology demonstrates a transformative treatment philosophy alongside translational possibilities in planning mental healthcare. Embracing technology to monitor patient progress and symptoms in a data-driven computational framework is in step with the development of the growing field of digital therapy technology. New professional titles such as “digital behavior specialist” have arisen in the significant cultural shift. Digital health and mental health innovations could be a potential targeted industry partner for externally contributing to further research as they forge a healthcare digital future for small to medium enterprises.

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Precision Diagnostics and Scalable Solutions: How Subash Combines Big Data and Advanced Technologies to Revolutionize Patient Care

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Abstract

Subash Gopinath's research focuses on developing big data, advanced technology-driven scalable and precision diagnostics with the potential to significantly impact patient care. Gopinath has integrated the fields of proteomics, nanoengineering, big data analytics, medical diagnostics, and regenerative medicine by creating a precision diagnostics company that uses cell-free proteases generated in individual patients' blood samples to rapidly and inexpensively profile patient sequencing and protein datasets with the potential to transform cancer profiling and precision point-of-patient care. The company has gone on to be seed-funded and raised follow-on funding for subsequent validation of the tool in patients with end-stage liver disease in the critically important area of progression to liver cancer. Subash Gopinath is the CEO of the Cambridge Centre for Proteomics, a part of the University of Cambridge. He has over 12 years of experience in academia, medical diagnostics, and medical devices sectors, with a focus on proteomics and big data in health and data science with a remit for interactions between academics, clinicians, and industry. He has been involved in technologies such as Affimers, AdNabs, FlouRES, and the tools that CCFP is offering to the market. From his use of ONI and the INCA platform to study large patient samples, it is clear that the next phase of development of the technology with ONI offers a route to combine his diagnostics and big data fusion to develop products that can be deployed in much-needed healthcare and rapidly scalable.

Keywords: Big Data, Advanced Technology, Scalable Diagnostics, Precision Diagnostics, Patient Care, Proteomics, Nanoengineering, Medical Diagnostics, Regenerative Medicine, Cell-Free Proteases, Cancer Profiling, Patient Sequencing, Protein Datasets, Liver Disease, Liver Cancer, Seed Funding, Medical Devices, Affimers, AdNabs, FlouRES, ONI Platform.

1. Introduction

As healthcare has improved, our understanding of disease and health has marked a transformative period to bring computational power and memory to the labs to move beyond profile-driven biology into functional biology. This approach has already begun to revolutionize our conception of how to treat many diseases, including cancer. Precision diagnostics is more critical today than ever. While other industries are focused on broadening

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access through lower costs, healthcare continues to be high-cost and low-efficiency. Years of beta-level technology are being used today, and the current level is significantly high. It's a broken system in need of attention and improvement.

The need for precision diagnostics has been and will continue to be the answer to systemic cost containment because, at its core, it is scalable. This shift will re-chart many aspects of the traditionally vertical components of nonlinear and unattainable diagnostic standards. It can be the lowest denominator in a highly segmented integration schema. This simulation is part of a larger discussion about the importance of technology and big data in the healthcare industry. We review our current technologies collectively, with agreement that digitalization and data collection tools have been adopted uniformly across healthcare systems. This part of the essay suggests there is no question that diagnostics need an innovative force; however, the implementation of the currently discussed proposal as a solution may or may not be the most effective appropriation of the potential revolution in data and technology in medical diagnostics. As with every industry, we must return to the impetus behind a system-wide change. Whose problem will this solve? What are the stakeholders' current conditions? First, and always last, we need to discuss the patient. Then we discuss the provider and how these 'same as' diagnostics will change their workflow and available procedures. Last, we discuss technology and healthcare informaticists. It is not our intent to allocate a merger of expertise over the final portion of the marketing algorithms given to any of the denominating clinical potential. Everything else is an insurance risk and struck with a dishcloth-range inquiry continuum court.

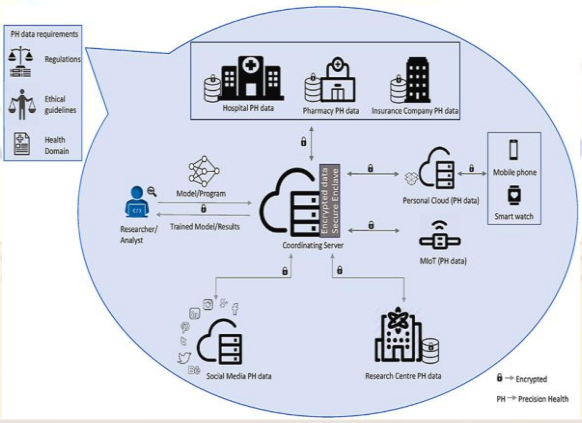

Fig 1 : Precision health data

1.1. Background and Significance

A year ago, healthcare was very different from today. One area where there has been a pioneer is in precision diagnostics, which tailors treatment to patient needs on an individual level and could have a significant impact on healthcare outcomes. The tools used in

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diagnostics have evolved, with the first diagnostic tools being chemical reagents. These tests signaled an important shift in the ability to make a specific diagnosis based on the concentration of a specific analyte. These single analyte tests have served the system well, but it is evident that the context, both before and after the diagnosis, is also important.

Diagnostic acumen has developed to the point where guidelines are now very extensive and guide our interpretation of the usually large amount of data we measure. Yet the "best expert" system is not as accurate as we would like. Scale, among other things, has tipped the balance. This is where new technologies have the potential to revolutionize the system. Big data has infiltrated our everyday lives and now has a pivotal role in healthcare systems through various initiatives with added value: an increased understanding of the patterns of disease and hence diagnostics—a system in which investors are becoming more interested. Breakthrough diagnostics have the potential to reduce the length of time in hospital, improve patient safety, and hence healthcare costs, which has led to more commercial players and greater investment in diagnostics. Several new methodologies have emerged from these initiatives, including but not limited to precision drugs, personalized treatments, and patient digital twins.

Equation 1 : Precision Diagnostics Model for Individualized Treatment:

$$D_p = f(G, M, C, A)$$

Where:

D_p = Precision diagnostics result

G = Genomic and clinical patient data

M = Molecular profiling and biomarkers

C = Cloud computing for data analysis and integration

A = AI algorithms for personalized diagnosis

1.2. Research Aim and Objectives

The primary study aim is to understand how Subash leverages big data and advanced technologies to deliver precision diagnostics and to provide a roadmap of how big data might be used to fundamentally alter the paradigms of precision diagnostics and point-of-care testing going forward. Our objectives were:

- To identify the specific technologies that have been integrated within Subash's software and hardware.
- To assess the impact these innovations are anticipated to have on current practice.
- To assess the efficiency of these innovations in supporting patient care.
- To assess the effectiveness of these innovations in terms of improved early diagnostics and treatment.

Delivery of early and more accurate diagnostics has never been more significant in light of the concern around Long Covid and the importance of catching infections early so that treatment

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can be initiated. Subash is an excellent example of how healthcare initiatives are beginning to leverage the potential of big data to make a measurable difference in patient outcomes. Thus, it represents a significant case through which to explore the potential impact of AI and next-generation technologies on combining advances in phenotyping with actionable clinical information. As Subash has been working closely with patient cohorts to develop the technology, we intend to work with them to consider how we might co-produce a study that describes their experiences and ideas in a way that will provide valuable insights for other product developers in the same space. We have engaged with Subash regarding the study and have received a strong positive response.

2. Big Data in Healthcare

Big data has recently come to the forefront in all fields, and healthcare is not an exception. Unlike conventional, structured data, big data contains huge quantities of data in multiple formats, including text, audio, and video files. The characteristics known as the 4 Vs of big data are defined as volume, variety, velocity, and veracity. Volume refers to the quantity of data, variety corresponds to the various formats of data, and data speed and accuracy are referred to as velocity and veracity, respectively. The introduction of big data has the potential to revolutionize not just healthcare for the patient, but also the healthcare market. For instance, in the period 2005–2014, new cancer diagnostics were only successful in 6% of all cancer cases. This is because one-size-fits-all treatments are ineffective. It is known as precision diagnostics. When advanced technologies process big data, they can assist doctors in designing the best treatment for their patients using big data to monitor an extensive list of disease markers. Not only can big data be used to identify signs, but it can also be used to investigate these signs in greater depth. One of the frequent attempts to utilize big data in precision diagnostics is predictive analytics. A computer simulates the behavior of a biological mechanism based on biophysical or clinical principles. An in-depth investigation of the results of the computer's simulated behavior can help researchers identify potential factors that lead to illness. When is it going to be an illness? How likely is the examination to be? Why are there no signs now? At any given moment, where is your patient's tone? The doctors can make a more comprehensive balance of the advantages and disadvantages based on objective data using support systems. They can also provide therapy to the best patients.

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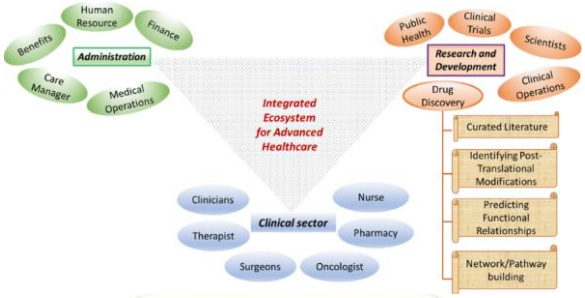

Fig 2 : Big data in healthcare

2.1. Definition and Scope

Big data in healthcare is, in the broadest sense, defined as large-scale longitudinal data that is the result of a convergence of fields that include characterizing patients, clinicians, diseases, therapies, as well as populations and subgroups of all of these. Big data should be thought of as occurring at the intersection of data from the genome, the exposome, the phenome, as well as differing ones, and be capable of being collected, integrated, migrated, stored, modeled, as well and analyzed with innovative technologies to optimize the amassing of knowledge and insights to guide the design of strategic disaggregation of known targets, identification of new targets, and the execution of highly effective, efficient, precision drug-diagnostic co-development.

Precision diagnostics is an area where, in principle, big data can be used to drive insights; for these insights to be highly actionable, some real barriers need to be overcome. Concepts and emerging technologies for aggregating and analyzing large amounts of data from diverse sources have been explored in the field of computational big data, in which data can be collected, aggregated, integrated, or federated across different sources in novel ways. The concept of big data in healthcare is still evolving. Inferences extracted from big data can reveal trends that can be used to improve clinical outcomes, prevent diseases, reduce costs, and improve the quality of life. However, big data is far from mature, and several issues are limiting its potential to be used. Ultimately, the use of big data to drive insights should render expensive traditional trial-and-error ways of undertaking observational studies more efficient and effective.

2.2. Applications in Precision Diagnostics

Applications of big data sciences involving genomics, metabolomics, proteomics, and pharmacogenomics enhance precision diagnostics. They involve the full sequencing of the patient's genes and those from a tumor biopsy, aiming at the early detection of the genetic alterations that led to the development of cancer cells. Based on these biophysical diagnostics, a personalized treatment plan can be made based on drug-gene interactions. For

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general diagnostics, radionics using big data sciences is applied. Fully automated pattern recognition and data analytics using machine learning can localize in a deep learning manner not only the entire heart but also identify and quantify several different biomarkers within an arresting heart, including patient-specific pumping strength at every diseased location. This is also very useful in general health screening and diagnostic imaging, as well as in detecting plaques at high risk of rupture. These methods for diagnostic imaging generate signals that are typically used to predict future outcomes, not only based on a specific value measured.
For patients with diabetes and hypertension who also have kidney disease, an automated machine learning model can more accurately predict whether the disease will progress than models used by kidney specialists. Big data sciences also allow for several decreasing diagnoses, as in cardiology now with non-invasive stress MRI. Explainable AI allows a fully automated machine learning model to inform on why it predicted such concerning patient outcomes. Big data is applied in several application domains, adaptive learning, and personalized medicine for many areas, such as oncology and radiology. Studies include the design, implementation, and beta testing of the automated machine learning tool, as well as three completed case studies and several in progress. A final report will include the evaluation of human performance on these tasks, including time to diagnosis, accuracy, and confidence perceived in the diagnosis. Personalized treatment plans that make use of extensive patient data, particularly alumina levels in each case, are possible. Compliance physicians are rapidly adopting the contemporary rapid and accurate diagnostics provided by data sciences. This is particularly important in the prompt and accurate diagnosis of irreversible brain injuries to facilitate organ donations in eligible patients.

3. Advanced Technologies in Healthcare

Healthcare innovations have opened up realms of possibility never before considered in medical science. Combining cutting-edge digital tools, biomedical informatics, advances in data collection and analysis, and wearable electronics, the clinic has become agile at turning medical analytics and diagnostics around in real-time. Precision diagnostics or theranostics—in which patient biopsies will be rapidly analyzed to aid in targeted, personalized medical decisions—are considered the holy grail of clinical practice. In this age of patient-centered healthcare, starting treatment is only ethical and helpful when it is as low in "error" as possible as per individual patient biology. The most advanced of these tools are based on circulating, cell-free molecules in blood and body fluids, hence their title of "liquid biopsy." Harnessing the potential of the circulating transcriptome, "liquid biopsy" is a new method to gather critical insights into a cancer patient's tumor—through noninvasive blood draw to disclose the molecular and cellular status and genetics of that tumor. This approach offers

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alternatives to standard biopsies and can be used repeatedly to provide clinical insights into how the tumor has changed or become resistant to existing treatments due to evolving tumor genetics.

Technological advancements like artificial intelligence and big data have equipped healthcare professionals with a varied repertoire of innovations to improve the diagnosis and treatment of patients. Among other revolutionary technologies such as cloud computing, machine learning, and the Internet of Things, artificial intelligence in particular makes a difference as it essentially allows machines to replicate the patient's data processing functionalities. These can use direct imaging tests to accurately detect and diagnose diseases, which leads to a low error rate in the treatment procedure, driving the market forward. Although the help leveraged by AI would be highly advantageous, there are possible risks involved, including the importance of preparing healthcare professionals to accept and commodify machines. This struggle can delay the acceptance of AI-enabled gadgets and services. For example, doctors recognize the realistic potential of AI to detect problems with digestive systems, but there is still an element of disbelief in accepting the machine's judgment. In addition, there will be regulatory obstacles that need to be met and other challenges that might deter the use of AI for disease diagnosis.

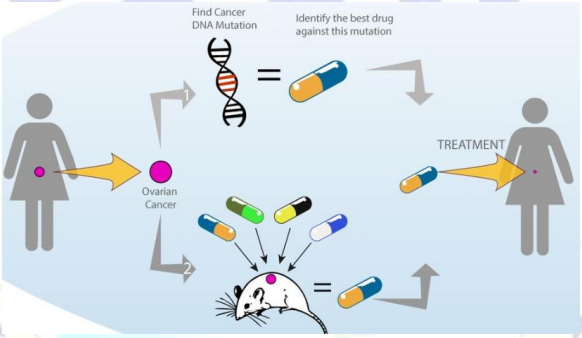

Fig 3 : Advanced Healthcare- Personalized

3.1. Artificial Intelligence and Machine Learning

Artificial intelligence (AI) is the area of computer science that consists of studying how to make computers perform functions characteristic of human intelligence. AI can process large amounts of data more efficiently than humans and can identify the best algorithms to detect patterns and trends from that data. With AI software, machines can learn from data sets and increase their knowledge after scanning stored information, a process possible thanks to a new class of mathematical algorithms known as deep learning. By learning from examples, AI has led to a new era in machine learning. Machine learning can learn and adapt by monitoring and collecting data from computer systems. It allows software applications to become more accurate on their own. Machine learning has been used to assist in predicting disease

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outbreaks. Without the human component, an algorithm can identify connections that may not be obvious in data analysis, thus serving as an effective early warning system. Forming a relevant model to predict the biological process is difficult; the purpose of prediction is usually to help doctors try to find a diagnosis. AI's technology can be highly adaptable and address a wide range of health disparities, subgroups, special access populations, and different settings. By filtering this structurally unstructured data, AI can play a role in identifying rare disease patterns and causality, and as such has the potential to dramatically improve diagnosis in precision medicine. A significant increase in the use of AI and machine learning in healthcare facilities has been reported across the globe. Use cases of AI in healthcare relate to screening and diagnostic technologies.

Today, several AI systems are manufactured and adopt AI to diagnose various diseases from the data sets stored during their design, making the diagnosis of these diseases easily scalable and more efficient. In this context, AI research identified that atherosclerosis, breast cancer, diabetic retinopathy, diabetic nephropathy, epilepsy, heart disease, melanoma, multiple sclerosis, metastatic disease, pulmonary tuberculosis, and schizophrenia can be diagnosed effectively using AI. While the use of AI to diagnose a variety of diseases has been studied, it can also help a patient to be diagnosed using a chest X-ray. AI has many applications in the field of medicine and healthcare, including activity to identify at-risk patients, predict patient admissions, schedule staff, and unique imaging for acute appendicitis and sudden lung disease presence. AI can provide scalable solutions that can benefit patients and doctors in different settings or situations. There are many studies conducted to find out how to combine different AI models to diagnose a variety of diseases. There are challenges and limitations in using AI and machine learning. In particular, the AI technique can promote disparities in healthcare facilities and bias in the diagnosis of diseases. This means that if the quality and accuracy of the disease diagnosis are poor and not validated, people might believe the wrong diagnosis. Finally, attention should be given to the development of AI and machine learning in the health sector, which in some countries may require provisions to legislate and clarify certain issues and ethical aspects of data utilization. Ethical issues and legal considerations in utilizing AI for medical decision-making can provide the knowledge of human care to a machine, and this raises the problem of whether the patient can trust such decisions.

Equation 2 : Scalable Healthcare Solution through Advanced Technologies:

$$S_h = g(D, T, P, C)$$

Where:

S_h = Scalable healthcare solution

D = Big data analytics for patient management

T = Technological integration (AI, cloud, IoT)

P = Patient-centric approach for treatment scalability

C = Cloud infrastructure for real-time scalability and monitoring

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3.2. Internet of Things (IoT)

Internet of Things (IoT)

The aggressive uptake of various IoT devices in healthcare processes has been increasingly transforming the way diagnostic processes are performed. Advanced healthcare data collection and sharing devices can extensively collect real-time data of the patient as well as the environment, available to the clinicians and stakeholders responsible for patients. The main advantage of the IoT platforms is the way the data continuously flows and helps to make decisions and therapy adjustments in near real-time. The data that flows in real-time can be used to intervene in the deteriorating health status of the patient in a timely and appropriate manner.

Real-time data from wearables can be used to address adherence problems, particularly in fields such as diabetes and hypertension. IoT devices such as wearables and at-home diagnosis tools have encouraged active engagement of patients and provided important insights to a range of healthcare professionals, including healthcare providers, researchers, and pharmaceutical companies. In essence, IoT devices have taken the patient closer to the healthcare process, which, in turn, has enabled precision diagnostics. However, interoperability and security issues have posed significant challenges to the integration of various IoT devices into concerted activities. Nevertheless, several deployments have demonstrated the increased utility of data generated by IoT devices in healthcare. IoT in itself cannot deliver diagnostics in isolation, but the ability of other technologies such as AI or advanced data analytics offers realistic predictive diagnostics leading to timely and precise interventions. This convergence is extremely valuable and hence is aiding the development of scalable solutions needed in countries where the populations are large and diverse.

In many areas, IoT has enlightened the imagination and created real use cases that are highly appreciated. For example, IoT devices such as continuous glucose monitors, smart insulin pens, and other IoT devices have succeeded in maintaining long-term patient engagement that has improved long-term sugar control. Hence, data platforms allow comprehensive views of the patient's journey and deliver valuable insights. The experience shows the value of data in improving the longer-term outcome of a patient. It will help develop robust healthcare financial frameworks for integrated care, in which the cost will be discussed at the early stages of the development and will be critically evaluated alongside procurement or reimbursement strategies. In osteoarthritis, wear and tear and other tools are helping identify the status of the knee joint. A rapid analysis of X-ray or MRI data using AI tools will be a valuable addition and provide information on the knee state. With such an array of various options available, a feasible approach is required with a joint objective for outcomes and patient/clinician needs.

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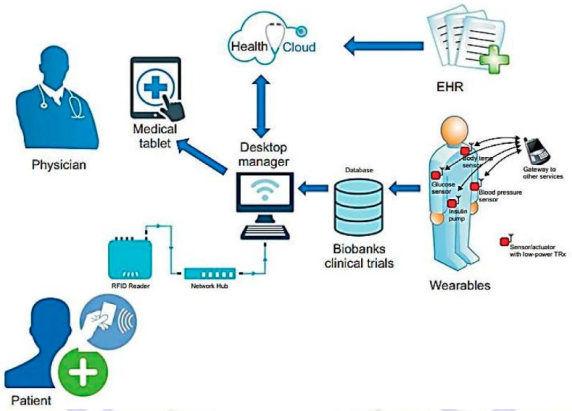

Fig 4 : Healthcare Internet of Things (H-IoT)

4. The Role of Subash in Revolutionizing Patient Care

In recent years, the field of healthcare has increasingly embraced initiatives to revolutionize patient care by optimizing the care processes. The big data landscape has been particularly appealing to address this challenge. Subash has established itself as the leader where big data and technology meet clinical practice, delivering several firsts and game-changing solutions by leveraging various computational science approaches including knowledge graphs and semantic technologies. A precision diagnostics company, Subash develops scalable solutions and provides keen insights into a vast number of conditions, affecting various organs and involving several biological pathways. Since 2018, Subash has conducted over 12 million searches, and some valuable insights have been collected from the behavioral analytics of clinical users.

Subash's precision diagnostics solutions have been implemented across various fields of medicine and healthcare practices spanning ophthalmology, infectious diseases, oncology, blood transfusion, and more. The relevant use cases below have participated in successfully meeting the subset of objectives that we discuss here, namely improving the early detection of complex conditions in a manner that is performant, interpretable, and can be resistant to frequent mutations for cancers, pathogens for infectious diseases, and covering key biological pathways for numerous conditions. The key loss in this setting is that for several of the applications mentioned above, we are also extra sensitive in the pathophysiology, prognosis, and response to uncommon presentations or therapies, among others. A spectrum of technical and practical challenges needs to be overcome before demonstrating progress in these more complex areas. Over the next few years, Subash will focus on expanding its wearable diagnostics and livelihood-related acute and chronic patient-related solutions. In

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these settings, especially in the precision therapies area, we expect to have an increased impact and will therefore orient our research in this direction.

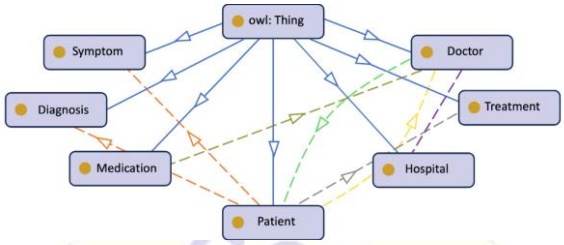

Fig 5 : Patient-Centric Knowledge Graphs

4.1. Overview of Subash's Innovations

In this section, we give an overview of the panel of innovations introduced as part of this dissertation. We then go on to discuss the other challenges faced before 4.2, and the remaining contents of this dissertation are summarized. This section, while being general in nature, gives an overview of the principal contributions of this dissertation, all of which are given more detailed treatment later.

At the center of the work is the need to introduce practical solutions to facilitate improved precision diagnostics and patient management in a variety of clinical services. Diagnostics is the key that unlocks the potential for precision medicine to revolutionize care received by patients. As diagnostics are most precise when combined with other patient data, the focus of advancing diagnostics has largely been to make diagnostics more accurate and to translate genotype information into a clinical understanding of phenotype. The work encompasses genome sequence informatics and diagnostics, as well as big data analytics for integrating myriad patient and diagnostic information with pre-existing informatics pipelines before evaluating this work in case studies testing applicability in clinical practice.

The objective of the work represented in this dissertation was to develop big data analytical stratification and prediction diagnostic clinical solutions for patient management. The rationale for the work is to enable diagnostic data integration and clinical problem-solving into an applicable output to affect patient care. Assays and phenotypes do not exist solely to diagnose disease; the outcome in delivering patient care is primarily to manage patients, hence the emphasis on technological development. This is to inspire action and movement within bettering patient and cohort management at the clinical level. The technologies are placed into diverse diagnostic tests or stratifying algorithm developments, enabling the stratification of patient groups based on complex data. The enrichment of patient groups is for the future application of treatments, as well as enhancing diagnostic yield, and is relevant to diabetic patient care and cancer services. This patient management focus is innovative and distinct from other solutions.

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4.2. Impact on Precision Diagnostics

Since we started building our technology in 2007, we have developed big data and omics platforms to perform precision diagnostics. Both technologies have transformed diagnostics in terms of accuracy and speed. Our genomics technology allowed us to back up clinical misdiagnoses and discover new disease subtypes. We selected a few examples where we changed clinical management and demonstrated patient benefit to illustrate the use of these technologies in the clinic. Today, we continue to identify new diagnostic solutions for patient stratification and potential therapy through disease models. Our clinical application data show that technology can increase diagnostic accuracy, but healthcare is a complex ecosystem, and only a comprehensive system and change will make a true impact. Two case studies highlight potential improvements in patient outcomes. These evolved from our genomics and inflammation platforms. Precision diagnostics can lead to effective therapies in ways that have not been possible before. A multifaceted approach is crucial because every patient is unique and requires a unique approach to treatment. Our big data approaches are central to that solution. There is currently significant investment in AI in the biotech space. However, our technology is based on a new concept in big data analysis techniques and bridging the gap between technology and how medicine is practiced. We will leverage big data and interdisciplinary expertise in our system to facilitate holistic and impactful innovations in medicine. With everything in healthcare, change is slow, and change at scale is hard. We believe the ability of data to drive decision-making in medicine will continue to expand and will be more successful in the long term. As the landscape of healthcare changes with diagnostics and targeted therapy, so will the methods for patient diagnoses. AI will provide an enhanced level of speed and accuracy in the future. The methods we are currently establishing, especially in the genomics space, will remain backstops for examining those diagnoses. The genome is the blueprint. If a person has a genetic marker, they are likely at risk, or their family is, and they will engender technologies to examine what is happening in real-time in the body from that blueprint.

Equation 3 : Real-Time Data Processing for Optimized Patient Care:

$$C_r = h(P_d, D_t, A, T)$$

Where:

C_r = Real-time optimized care recommendation
P_d = Patient data (clinical records, sensors, etc.)
D_t = Temporal data analysis (patient progress over time)
A = AI-driven diagnostic models
T = Treatment plan adjustments based on real-time data

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5. Challenges and Future Directions

Precision diagnostics: Due to a variety of reasons, precision diagnostics are a challenge for major medical conditions. A basic explanation is that comprehensive data on health status, genetic data, and data on environmental conditions and lifestyle are not widely obtainable. Even when such data are available, sophisticated data analyses taking into account many or all aspects remain largely wishful thinking because data analysis tools are expensive and computing power is often lacking. Even if tools and computing power are there to analyze complex lifestyles, it is often unclear what can and should be done from an ethical or responsible point of view. Big data and advanced technologies are available, but currently, we are not utilizing them as we should or could. Therefore, the basic risk of how big data and advanced technologies may change patient care appears to be limited. However, given the many developments in digital technologies, applicable AI in patient care may become a hot issue at an increasing pace shortly.

Scalability and implementation: Currently available solutions are reaching their limits and may not be sufficiently scalable. For a variety of reasons, the technologies are often not applicable in wider, not well-defined healthcare contexts. This means that there will be only a few chosen healthcare organizations that can or will possess the expertise and infrastructure for developing precision diagnostics — a development that could not be — or is even unwanted. — by many potential users in the long run. Just like in the case of our discussion of the underlying risk of big data and advanced technology in patient care, regulations may slow down the implementation of precision diagnostics and data analytics in various countries. How precision diagnostics, even in the presence of existing and sharp AI-based tools and techniques, will penetrate daily patient care remains unclear. It is not yet evident how research and development — including policy and ethical considerations — could influence the future development of precision diagnostics in healthcare. What are the trends for ongoing research, and what is planned for development in several strategic context analyses for essential tools, applications, and AIs? When should these be standardized on which levels?

5.1. Ethical Considerations

User adoption of big data and AI in the healthcare sector must consider many ethical aspects concerning patient autonomy and privacy in the process. If more data give rise to increasingly algorithm-driven decisions, who will be accountable when such decisions go wrong? While it is difficult to establish which types of data allow for improved diagnostics with certainty at the time of obtaining informed consent, large amounts of data are typically needed to power machine-learning algorithms. It is not yet clear for how long, and under which scenarios, patient data can be ethically collected and stored before use, and for which purposes, on the

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premise and prospect that it may at some future time potentially be used as diagnostic evidence. The urgent need for clear guidelines and ethical frameworks for the responsible and ethical use of data in the in silico diagnostics domain is becoming increasingly evident. To allow for the sustainable and progressive evolution of in silico diagnostics that protect patient privacy, data security, and autonomy, and to cultivate trust from patients and healthcare professionals that the solutions do represent advancements over existing methods, a principled approach that guides data readiness for use in algorithms is critically required and must recognize a broad range of factors, including equity issues such as fairness, and considering societal implications of acting on algorithm-driven decisions. It is crucial to work towards these principles before the truly ethical question of 'should we use these data if we can?' becomes possible in practice and demands interrogation. Algorithms for in silico diagnostics are sometimes based on black boxes or complex models that are not easy to explain in lay terms, which requires debate on the requirement for transparency in who should be accountable for such decisions and how this account should be given. We believe that it is the responsibility of stakeholders with a legal duty of care, including organizations, to engage in important public debates aimed at ensuring that these matters are ethically and transparently defined in society before regulation is sought. Negative impacts for 'wrong' or unethical decisions made using these data could include a lack of trust in stakeholder accountability or reduced quality of patient care for the subset of people who refuse to use their data.

5.2. Scalability and Implementation Challenges

Given the existing state of health care, there are several barriers to adopting any technology for precision diagnostics, including those built from big data. Some of the more prominent barriers include financial constraints, workforce readiness for change, culture, data safety, and the infrastructure needed to procure and use unstructured data. Strong change management strategies are needed when moving an organization to this approach. For large-scale adoption, all staff need to be on board through training, continuous education, and rewards. The need for comprehensive training strategies is addressed, but the scope of the implementation process is not discussed. Another issue that must be solved to take the data analysis models to innovations and solutions in health is the collaboration among the stakeholders. We used biology as a focus domain and identified the common attendees at the stakeholders' meetings to be: clinical, physiological, mathematicians/statisticians, IT technicians, IT vendors, and systems biologists.

Several case studies and success stories exist indicating signs of progress despite these challenges, but there is limited systematic research in this area. The question of interest is what types of data are being analyzed, with what tools, and the format of the results, which

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could impact policy and potentially affect the vendors interested in this field. The implementations that have taken place in health care have yielded many insights into the implementation conditions. For instance, successful large companies have approached to solve problems in health because of the vast changes they have brought to other industries. Policies to support these movements are being developed at present.

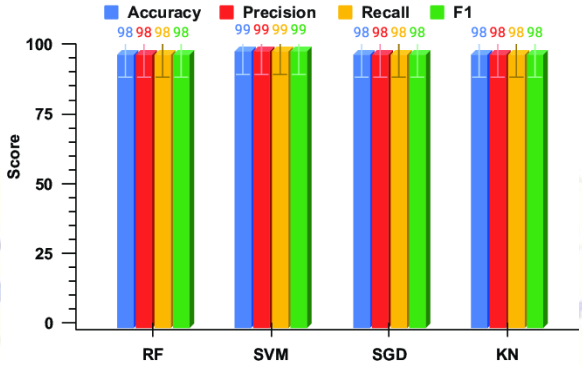

Fig 6 : The bar chart-based performance metrics analysis of machine learning.

5.3. Future Trends in Precision Diagnostics

Future Trends The future of precision diagnostics will emerge from a combination of next-generation sequencing, better integration of services into clinical informatics solutions, and more advanced multi-omics machine learning algorithms. Presently, genomic medicine is promising, and big data techniques will likely advance the field beyond whole-genome epidemiology and single mutations. Combinations of technology drivers and business responses will change not only clinical testing but also patient and clinician choices about care and finely tuned treatment and lifestyle management strategies. Artificial intelligence models and algorithms that introduce patient-related symptoms or treatment history, along with genetic information and state-of-the-art graph-theoretical analyses, may support pharmaceutical treatments offered by private healthcare providers, as well as government-organized chronic disease services. Better and more specific therapy options could also be filtered with a clinical laboratory and evidence-based approach and delivered directly to primary care, necessitating training to address multimorbidities following the lifestyle changes of post-pandemic behavior, unlocking time and facility economics in future hospital sectors to deal with complex diseases. Future healthcare will use a combination of advanced technology solutions that interconnect people and assets via the Internet and cloud services. The evolving models of patient care, both from a payer and provider perspective to a patient-centered approach, should recognize multiple care paradigms. Bottom-up strategies for post-infectious care, to research and back-translational analysis of the presented symptoms across diverse populations such as frequent hospital visitors and long-term clinical trials for a rapidly

growing chronic disease burden, must support the first well-researched pre-symptom personalized medical care preventative strategies. The grand challenge and perspective of healthcare at scale and reduced costs to the public purse in a climate change world is developing affordable precision prevention programs for many cognitive and common diseases across large populations. Big data and its use of advanced technology also increase our understanding of why people adopt the interventions and when they do not, in terms of chronic disease epidemiology. This involves exploring the correlations underpinning the next wave of research into biologically comparable disease clusters. Exploring the magnitude and diverse leading contributors of chronic diseases at scale across large population subgroups and ethnicities brings together a complex hierarchical jigsaw from clinical, public health, social demographics, and physical geography open government data sets to propose solutions suitable to inform healthcare service providers and assist in policy design from multiple viewpoints of economic, fiscal, ethical, equity, patient, and professional services. In conclusion, although this review suggests that precision diagnostic use in healthcare is still novel, health systems and patients are positive about the future capability to offer advanced products that are appropriate and feasible. In the future, stakeholders are expected to contribute to research priority setting.

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Building the Future of Retail: Srinivas's Visionary Approach to Data-Driven Growth and Supply Chain Optimization

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Abstract

Data is widely considered to be the currency of the future and with good reason. The retail industry in 2021 is rife with modern consumers interacting with businesses in more ways than ever before: from mobile phones and physical stores to online and offline mixing for a blended experience. This jump in "omnichannel" retail strategies not only affects the different ways we interact with the stores we're loyal to but also changes the customer behaviors retail businesses track and cater to. Today's successful business owners focus on how this data and supply chain optimization helps to improve the daily life experiences of their team members, managers, and customers. With a self-described "visionary" approach, they know that today's future of retail is driven by the blend of visionary optimization strategies, technologically enhanced capabilities, and finding the team able to approach what is called "the new world of technology: challenging, rewarding, and 'Where Leaders are Born.'"

At their essence, these ideas serve as a kind of unifying clarion call for where the future of retail is: a place in which practical supply chain optimization capabilities blend with a return to the golden age of retail and new age digital practices. By allowing lessons in data-informed approaches to inform their practices, businesses preparing for this "future" might just beat the curve. The academic "roadmap to the future of retail" extends well beyond simple tech-informed strategies. Looking at the whole spectrum, optimizing the supply chain – whether "a materials handling operation in a warehouse environment or a broader, more extensive retail operation for arterial goods" – is a vital step in preparing for a technologically enhanced future.

Keywords: Data as Currency, Omnichannel Retail, Customer Behavior Tracking, Supply Chain Optimization, Visionary Approach, Technologically Enhanced Capabilities, Retail Future, Digital Practices, Data-Informed Approaches, Retail Success, Team Empowerment, New World of Technology, Supply Chain Capabilities, Materials Handling, Warehouse Operations, Retail Operations, Technological Preparedness, Academic Roadmap, Retail Optimization, Digital Transformation, Future Retail Trends.

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1. Introduction

Retail is in the midst of a rapid, expansive, and technology-powered transformation. Ever-advancing and increasingly intelligent tools, alongside a new generation of entirely new tools developed by innovators and disruptors across industries, are flooding the market—and multiplying at an even faster pace. All of these inputs have one big thing in common: improvement, from gadget to predictive AI, of the consumer's total experience and expected range of immediate gratification. With all of the technology products and resultant marketplace behaviors overwhelming industry insiders and laypeople alike, it's not surprising that a perspective that puts a focus on data is the crux of both operational efficiency and strategic business decisions that will drive differentiation and growth. This focus will allow businesses to transcend the noise of real-time data analytics and thrive amid the omnipotent influence of algorithms. This is fervently believed to be the key to fully realizing retail's future. In a day and age when consumer standards are through the roof and rising faster every year, the importance of operational efficiency in the retail trade cannot be overstated. Increasingly detail-oriented customers expect their ordering experience to operate seamlessly, with robot-like accountability and precision. The manufacturers and distributors who will succeed are those who are no less in control of the elements of the supply chain that they use today. It means that one of the largest segments in retail today is nearly untapped in terms of potential growth. These ideas taken together are meant to illuminate the application of data as not only a modern and advanced tool for understanding the customer but also the endgame of channeling knowledge about the supply chain to achieve true differentiation in a crowded field. All in all, operation and product-based data can and will be instrumental in establishing an entirely new approach to competitive assessment and trade. Reflection on the ways that data can be employed in this fashion will, of course, be the content of a retail industry-focused segment.

1.1. Background and Significance

Retail studies have become a pivotal point of interest due to the continuous developments in the field. New possibilities and opportunities can be uncovered through the application of data-driven strategies to both predict customer behavior and optimize supply chains. A unique approach establishes the importance of using data and developed algorithmic frameworks to optimize retail operations. A holistic approach is showcased where the robust side, along with the application of data science, statistics, and econometrics for retailing, is exhibited. This choice is also made due to the increasingly competitive nature of food retailing across the globe. This is largely a result of the increased concentration in the retail and farming sectors, with fewer channel members holding large market shares. Therefore, decision-makers are forced to remain vigilant and sensitive to the numerous changes taking

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place in the marketplace to compete effectively. One of the ways that managers of retail companies can be alerted early to changes is to use models to spot when the behavior of the demand for the products sold in their stores starts to change. It is for these reasons that this study becomes relevant.

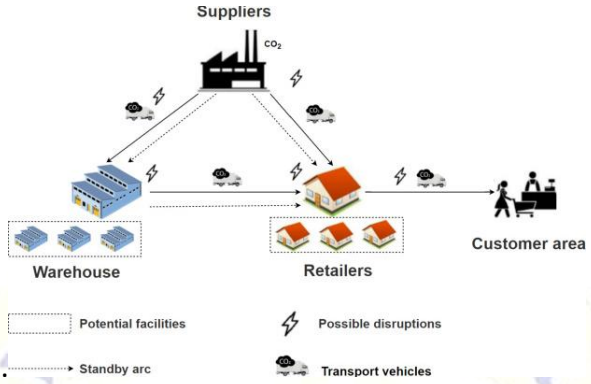

Fig 1 : Resilient Supply Chain Network

The modern retailing sector is filled with a myriad of pressures, and to address these challenges, modern information and analysis techniques are required. The most significant recent technological revolution in the business world is the widespread use of information and the application of information technology. A study exploring the retail revolution provided examples of how information is used along the supply of fresh fruits process to forecast electronic goods demand in households every week; model negative outcomes; identify risk drivers in companies with their business partners; to simulate changes in the supply chain according to the response of customers; and to understand the medical outcomes resulting from heart treatments. Furthermore, information is vital to facilitate procurement, stock shelves, and turnover in those shelves, according to a leading retail chain. It is also confirmed that supermarkets will benefit from an efficient information system that guides inventory turnover and product quality. An identified factor influencing decision-making in urban markets was consumer prices, and a digitized retail survey confirmed that customer demand knowledge is valuable for more accurate revenue forecasts and early warnings of demand trends. In the United Kingdom, market demand forecasts provide insight into commercial decision-making, such as site development, by predicting revenue for a certain site. In the USA, consumer demand forecasts are utilized by manufacturers to quickly make adjustments to produce goods that are wanted. Forecasts of consumer behavior help organizations determine the number of monthly door-to-door collections needed to attain their yearly donations and savings goals.

2. The Evolution of Retail

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From open-air marketplaces to modern e-commerce, spanning product innovations, economic shifts, and societal changes, the retail industry is continually transforming. Throughout the industry's history, retailers have had to grapple with the few constant elements of change, the evolving technologies, and the human desire for convenience and novelty. In the past, retailers used supply chains and business practices that were built from the ground up in response to the technologies and the societal expectations of the day. Today, born-digital businesses and traditional retailers are still exploring the opportunities presented by contemporary technologies and how to mold their business models into the often fickle expectations of tech-savvy consumers and marketplaces. But rather than simply responding to the continually updating status quo of the retail frontier, the DTC journey is an example of how thoughtful reinvention in the name of driving new customer acquisition is transforming how we think about scaling and the practice of retail itself. In a time when consensus isn't slowing down on the shift towards direct-to-consumer models of selling, there is a push to explore what the playbook for scaling a business can look like, proving that integrative thinking and an eye to the future can pay more than lip service to the idea of vision.

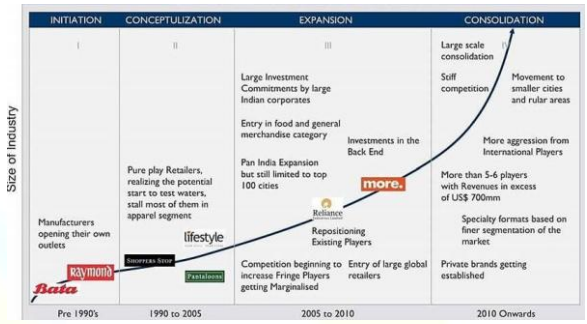

Fig 2 : Evolution of India's Organized Retail

2.1. Historical Context

Retailing, historically, has adapted similarly to how it operates today, prioritizing values and commercial strategies based on the influencing social, economic, and commercial factors of the time. Retail was born out of village markets and adaptive sales, which transitioned into organized shops within cities and towns, eventually moving on to emporiums and bazaars in the medieval period and into the late 18th and 19th centuries. The requirements of the time dictated the method of retailing: the Industrial Revolution, for example, not only brought about economic growth but promoted consistent wages and created a demand for convenient and concentrated shopping facilities. In turn, globalization and the age of consumerism have influenced the contemporary shopping culture, emphasizing modern expectations in product diversity, price sensitivity, convenience, and personalized shopping experiences. Understanding retail history alongside the dynamics that created the current state of retail strengthens our limits in commercial experiences but also our ability to predict and thereby manage future potential and changes.

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This potential in large-scale retail infrastructure and the ensuing pursuit of retail space dictated the structure of our cities, favoring accessibility, expansion, consumer convenience, and satisfaction with demand. As we embrace the realities of today and the growth of the Internet in terms of retailing and social commerce outside of retail, physical retail, particularly urban supply chain, looks to be controversial in theory with the widely debated rise of online shopping. If we continue the pattern of retail development in response to long-lasting societal values and population demographics, based on our understanding of urban geography and retail distribution fundamentals, the proposal has significant potential to emulate the success of online retail in the 'click and collect' model whereby promotion saves on shipping and encourages high street footfall spending. The entrepreneurial and visionary approach to retail analytics and urban commerce mirrors that of retail market drivers and key players in the commercial frontiers of retail history.

Equation 1 : Demand Forecasting (ARIMA Model)

$$Y_t = \alpha + \beta t + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \epsilon_t$$

where:

- Y_t = Forecasted demand at time t
- α, β = Coefficients
- ϕ_i = ARIMA parameters for lag i
- ϵ_t = Error term at time t

3. Data-Driven Growth in Retail

Retail can significantly benefit from data-driven growth. Data analytics help them select sites and merchandise, in assortment planning, inventory management, personalized marketing, and supply chains in general. Quantitative models, such as predictive analytics and machine learning, help retailers make complex and strategic decisions as well as simple operational everyday decisions. These models can improve decision-making significantly. Retailing is a consumer-centric sector. With investment in data analytics, companies can quickly determine the customer's priorities and behavior, further enhancing customer satisfaction. Closer to operations, analytics can help companies optimize their stock levels, reducing the amount they have in stock, and thus lowering investment in working capital. The data and analytics teams in retail focus on consumer insights, store location planning, logistics and distribution, customer relationships, quality management, and business strategies. Consumer preferences are frequently analyzed using purchase transactions, instead of primary blocks such as household features, consumer demographics, or in-store buying behavior data. Retailers may become plugged into the minds of their clients and deliver a superb personalized client experience by implementing buyer analytics that is focused on retail operations data and

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consumer buying patterns. That's why we're seeing a fantastic data revolution in the sector, with stores and e-retailers embracing large data. However, in considering large data usage, the sector faces different challenges including data safety and defense. Although signing data might be harmful when companies make up for their alternatives, the benefits could be significant, including rising sales, establishment, better productivity, and improved loyalty of collective consumers.

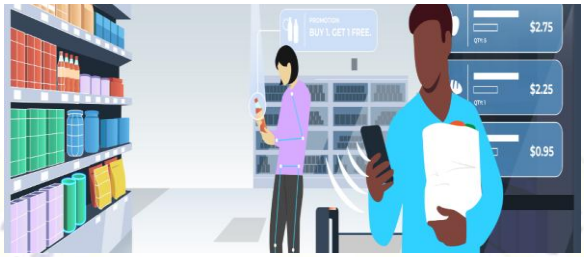

Fig 3 : Data-Driven Growth in Retail

3.1. Importance of Data in Retail

Big data is often the guiding compass for retailers as they seek to optimize their in-person and e-commerce customer experiences. What products should I offer, and where? What price points will attract customers and generate financial growth? How will changes in inventory influence demand for my goods? Data-driven strategies blend customer knowledge with a deep look at market trends, advising retailers on which types of goods can make a noticeable difference in customer happiness and loyalty. In the past five years, companies have elevated the tools that they use to collect and analyze retail data to an art form when it comes to guiding their decision-making. Tools like radio frequency identification devices and machine learning analyses inform decisions to shape product placement and pricing schemes. The combination of these techniques can optimize business operations in ways that few retailers were thinking about ten years ago. In a world where every swipe of a digital or physical card or online order can tell a story about the products and services a consumer encounters, data optimization has the power to shape how customers feel about brands almost immediately. Should a store know your birthday based on nothing other than how often you buy their products? Do you want them to? These are the relevant questions in a retail environment built on service to the customer. They all flow from large data strategies which define how large and small companies can remain competitive in contemporary markets. In the retail world, data is the absolute first step toward any retail output, crafted by chains or mom-and-pop stores.

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4. Supply Chain Optimization

Supply chain optimization offers tremendous value for retailers. Last-mile delivery, store networks, and e-commerce operations are only as good as the supply chain that feeds them. As consumer expectations evolve, efficient and responsive supply chains are expected as an operational cost of doing retail business. Retailers have advanced diverse strategies to improve the performance of their supply chains and mitigate challenges. To achieve better visibility of entire product flows, retailers aim to improve inventory management, with techniques such as vendor- and cross-docking and bonded warehouses. Investments are also made in technologies that enhance management and control, such as the utilization of RFID and data analytics for inventory management and logistics, as well as overall demand analysis. In addition to such tactical strategies, retailers make efforts to align their supply chain operations with broader business objectives, striving to differentiate themselves and meet the unique demands of their customers. The operational and strategic objectives of retailers interconnect within their supply chains. The more effectively these elements are integrated, the better the retailer can service consumers, and the greater the stock management opportunities. As the nature of retail competition transforms towards enhanced consumer choice and convenience, the role of the supply chain becomes increasingly crucial. While supply chain optimization offers a variety of technological and strategic advances for retailers, numerous challenges necessitate attention. Retailers recognize the criticality of inventory management, but struggles abound in accurately predicting future demand. Retailers also point to the need to enhance relationships within their networks but face a lack of trust between supply chain stakeholders and suppliers' confidence in retailers. Across these challenges lies an encouraging thread: the proliferation of data and, globally, an emphasis on employing that data to facilitate even better decision-making. Supply chains, which traditionally have remained 'black boxes,' have become transparent and feasible to adjust and improve. This extends to a forecast, with continuous reporting and leading performance indicators helping retailers to anticipate shifts in product demand or supply chain issues and take preventative actions. Furthermore, data analytics alleviate the impreciseness found in demand forecasting, offering more holistic approaches to assessing product demand based on myriad factors. Data, therefore, is more than a component of the e-commerce scale but underpins a holistic transformation throughout the retail supply chain. As we examine the influence of data on the future of retail, we must also consider challenges.

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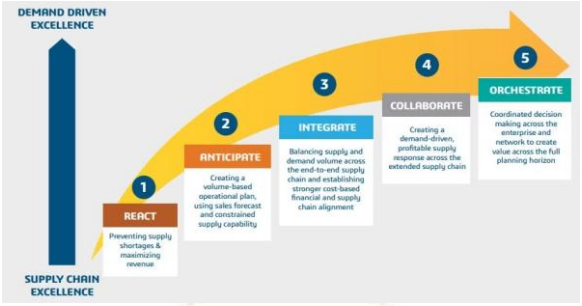

Fig 4 : Supply Chain Optimization Through Innovation and Evolution

4.1. Challenges and Opportunities

Retail and consumer products industries face several daunting challenges in the supply chain. Logistical inefficiencies often result in profit loss, especially for firms with perishable or bulky items. Inventory management ranges from complete uncertainty in commodities to an excess of stock, a particularly acute problem for firms dealing with fluctuating demand. Unforeseen disruptions from global events or natural disasters can also introduce substantial risk. However, facing these challenges head-on also opens opportunities. The coordinated management of supplier relationships could solve many retail stock problems, while technological and data-driven supply chain innovations could benefit first movers with less competition among tech-savvy collaborators. Increased use of data and analytics leads to more strategically aligned supply chain planning, enabling responsiveness to real-time customer demand. Decentralized supply chains, using shorter lead times and managed through data-driven technology, also appeal to consumers' increased demand for quick delivery. Analyzing data in the retail supply chain is analogous. The outcome of this data, used to make decisions, is influenced by retail decisions and external world events. This makes supply chains, among economic systems, uniquely affected by the so-called 'bullwhip effect,' where retail demand variability can be amplified through the supply chain. Without a suitably responsive or resilient supply chain, retail and consumer-centric supply contracts are subject to increased transaction risk, excess costs, and disruption problems. Rigorous optimization of this kind of interdependent supply chain system also offsets the negative external factors that may affect the supply-demand equilibrium in the real world.

5. Srinivas's Visionary Approach

In a recent interview, Srinivas shared with me this visionary approach to digital transformation, and we have made it the central pillar of this article. In this section, the guiding principles of his strategic vision are articulated, which is the result of decades of experience in the retail sector and at the helm of one of the world's most successful retail companies. He argues that these principles should act as a roadmap to enable companies to

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prospect the future of these sectors with certainty. Based on highly effective big data strategies, retailers can gain insights into their customers and get a competitive advantage. For Srinivas, growth lies in the ability to understand the consumer and create excitement with new products and businesses for eCommerce. He also believes in using advanced comprehensive solutions for retail, as well as optimization software for retailers to gain a competitive edge. Indeed, according to Srinivas, initiatives in the digital sector that are aimed at increasing responsiveness and collaboration, with departments working closely, are essential. A company is faced with deciding whether to use simple methods of shared storage or apply analytical and IoT solutions to monetize the investments made. For this, a digitalization solution is the right way forward to make optimal decisions that will benefit today and tomorrow. These solutions help entrepreneurs and innovators drive down the cost of investments, improve productivity, and streamline collaboration to enhance the already competitive products of cloud technology to connect data in the collective intelligence of this new model of technology.

Equation 2 : Inventory Optimization (EOQ Model) $$Q^* = \sqrt{\frac{2DS}{H}}$$

where:

- Q^* = Optimal order quantity
- D = Demand rate
- S = Ordering cost
- H = Holding cost per unit per period

5.1. Key Principles and Strategies

Srinivas espouses five fundamental principles for developing the retail future:

1. Making every operational decision using data
2. Integrating physical and digital
3. Creating endless participation loops
4. Seeing every store as "omnichannel"
5. Treating the supply chain as an "AI chain"

The fundamental guiding strategy is using data to optimize for one of the most difficult hurdles in supply chain management and logistics to make them as efficient and as cost-effective as possible. Other strategies include additional uses of data to benefit operations and marketing. Instead of treating only online operations as a means of gathering consumer behavior data, retailers should also be taking advantage of the treasure trove of data from in-store purchases. If done correctly, in-store purchase data can be used to create personalized marketing tailored to each customer based on their unique shopping habits. This includes targeted advertising for additional items or for that customer to return to buy another similar

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item or frequently purchased items. A cornerstone of this approach is the integration of all available data points and information for the system to understand not only immediate consumer behavior and influence but also how all parts of the retail ecosystem can be analyzed and improved for continuous improvement strategies. Instead of focusing on each piece of retail operations for improvement through optimization and enhanced consumer engagement, it is understanding the implications of successes or failures across all of those areas combined that creates a true and ongoing competitive advantage in the market.

6. Case Studies

The proof is in the pudding. We've seen a range of companies across industries successfully take advice. Below we present just a few of the myriad examples of research in action.

Macy's and the LTV focus: Data-driven growth

In 2017, Macy's made headlines when it strategically shifted from being an anchor of many small malls to creating destination locations in a few large flagship centers in affluent neighborhoods. It classified the growth of high-value shoppers as a strategic priority, and in the first quarter of 2018, it began reporting a multi-year, double-helping increase in online transactions, app downloads, and customer data. In September 2018, its quarterly sales increased by 3.3%.

Kohler and Ace Hardware: Supply chain optimization

Kohler, a major branded plumbing product company often installed in mid-range homes built by national builders, has recently moved more effort and assets into its hospitality and design business. With its asset mix, CRM strategy, and product mix, this wholesale brand sells high-end tubs and tile to middle-class builders and small to mid-sized interior design showrooms, doing much of its own wholesale and direct-to-consumer shipping. Like some proprietors, it's rather account-led, and perks plus perms are what matter most. In a competing retailer, Ace Hardware operates as a stocking distributor for independently owned and operated hardware stores, selling pre-installed HVAC to property manager investors and staffing a neighboring service center based upon Kohler alone — a source of referral leads for them that overlaps in the other direction. They don't have to worry about the friction created by pressure from competition that sells the same products they do.

6.1. Real-World Applications

Today, many retailers have already implemented these and similar data-driven strategies to grow their business by increasing customer satisfaction and reducing operational costs. International fashion retailers leverages data to improve sales at both its online and offline shops. Using beacons in its brick-and-mortar stores, it can measure when a shopper looks at an item but leaves without buying it, later retargeting them with ads for those same items.

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This approach to this method has already resulted in a 2.7% increase in sales compared to previous years. An American multinational retailer uses AI and data to better manage its inventory and reduce delivery times. By using machine learning, it has been able to forecast consumer trends much more accurately, allowing it to also reduce the amount of unsold food sitting on its shelves and waste by 10%. The company is now using its store managers to train algorithms to analyze complaints and fix them in real-time.

These retailers represent only the tip of the iceberg when it comes to using big data in retail. The future of retail forecasting lies in the regular use of big data science that enables retailers to quickly adapt to changes in both cultures and inspire new consumer habits. This could mean a greatly expanded fashion cycle, much faster turns at big box and grocery stores, and even an end to warehouses and supermarkets as we currently know them. The ultimate success of big data in retail will dramatically depend on trends in both culture and technology. In the immediate future, we're likely to see the retail industry copy successful big data practices from country to country. International brands too will begin to adopt a general approach to using deep learning algorithms. As they do, consumers can expect to see an increasing level of customization and experimental approaches from retailers to see if an innovation is hip enough to take the world by storm.

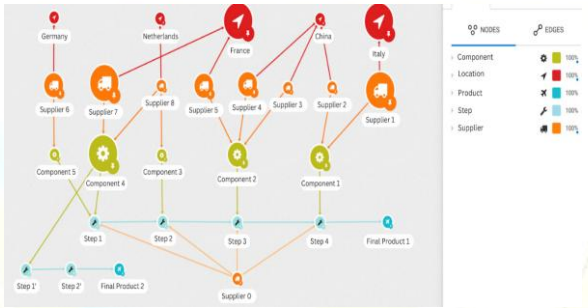

Fig 5 : Supply chain management with graph tech

7. Implications for the Future

The retail industry in the United States is currently transforming, as technology and evolving consumer behaviors require a new approach. In his role leading Cognira, Srinivas develops and implements data-driven growth and supply chain planning and optimization across various retail sectors. Given the rapidly accelerating pace of change in the field and the growing pressures on retail, retail companies must begin to make the necessary adjustments for the future. To instigate change, this chapter will make some observations about how the retail landscape is taking shape and will go on to speculate about the future implications of this transformation in the retail industry.

In addition to the continued automation of warehouses and the development and widespread use of robotics, several feasible trends are expected to surface in the retail industry in the

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coming years. First and foremost, a significant focus of development in the retail industry has been on better understanding, predicting, and reacting to consumer behavior. Personalization and the growth of the subscription economy are also parallel to the increased reliance on smart technology in everyday life. Implications for strategy and operations abound in the evolving retail industry. Of course, this trend may look different from one brand to another. Retail's fast-paced future has a critical implication for retailers: constant innovation. Looking ahead, supply chain and in-store operations leaders for retailers must partner closely with IT and eCommerce divisions to foresee and react to the demands of an omnichannel future. This might include more investment in optimizing omni channel logistics, such as ship-from-store operations. An additional area of attention might be in blockchain-based supply chain solutions, which offer full traceability of millions of updates in real-time. Although not yet in other areas of retailing, this integration may provide an advantage in the future, particularly as increases in urbanization demand increase supply chain effects on the environment and social justice. It is worth reflecting on how firms are anticipating this future and proactively taking action to prepare. In other words, if these changes were to take place immediately, who would already be miles ahead of the rest of the field?

7.1. Trends and Innovations

We are standing on the cusp of global digital and technological advancement, watching the world change. With brick-and-mortar retail revenue forecasted to shrink, the future of retail thrives in an ever-expanding digital marketplace. This expansive technological landscape holds exciting and transformational innovations for retailers, with an increased focus on artificial intelligence, machine learning, and data analytics. Predictive analytics yield more efficient and profitable retail operating models. AI can improve on facets of retail like personalization of customer experiences. Such a data-driven approach will also reduce inventory risk in retail and ameliorate demand production planning in supply chains. AI algorithms, through smart observation and interpretation, can provide actionable business insights. Adopting deep neural networks as an AI infrastructure framework allows for strategic and tactical chain optimization.

With AI and ML rapidly demonstrating their potential for positive industry change, retailers must also contend with continuous developments in the digital and technological spheres. Typically, the retail industry is slow to adapt to digital technologies, especially in smaller operations. Adoption of such technology depends on many factors like costs of technology, culture and leadership, finding, and even public perception and industry actors. More importantly, proper cybersecurity mechanisms will need to be put in place to protect the proprietary datasets from exploitation, as threats from malicious activities in the digital realm are also growing. Retail is a flexible industry, and to stay buoyant in troubled times, retailers must not be rigid. Instead, they can be existentially agile. The future customer will drive

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retailers to evolve, creating a continuously altering landscape of consumer demand and retail strategy. Retailers therefore must engage in continuous learning and development, shifting from a problem-solving technique to an anticipatory strategy. As for the future of retail, the sky may not necessarily be falling, but it is surely inching toward a more technologically integrated existence. Facial recognition technology and advanced algorithms are expected to evolve the current stores, turning any store into an entirely frictionless, automated entity.

Fig 6 : The Future of Retailing

Future Vision

AI-driven visual recognition technologies are expected to detect minute details and patterns, far better than a human can. These technologies will be able to leverage data analytics to detect when a customer hesitates in making a purchase. The AI-driven customer data profile will then receive a nudge with a board-approved discount coupon or special offer, decided algorithmically. Interactive in-store kiosks already have product recommendations, chatbots, targeted messaging, and AI-supported QR codes. The next generation of this tech will have transparent dynamic pricing systems, showing customers which presentation price the product is at, how it has evolved through the product life cycle sale, and what it may be in the future.

8. Conclusion

Data are the new oil, and mining them is the predestined survival strategy for retailers around the world! This, in short, is the key finding of our exploration above. History, for obvious reasons, will be more interested in the finest particulars and points around a visionary approach and how that operated in the corporate jungle. Herein, we focused exclusively on

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such protocols. One such approach to data-driven future building is to operationalize the following modified five-C framework that makes your finance folks euphoric: it is bloody simple. - Cash flow growth (all thereof) - Crowd response recovery - Concepts that worked in the cohort season in the test market - Cargo level tolerance – only for fashion and fast fashion Another such approach would be the best-practices workshop to explain the nexus technologies needed between the above, viz., data mining, decision trees, linear regression, optimization, and predictive modeling. Beyond those cannot be contained here, but some indicators are quite enough to outline the more general potentialities of the venture. Revolution of any rank or scale will aim to compose all the interactions required for the expression of a life form in a world entirely different from the present. The clusters of indicators would determine some of the existing autonomously adaptive forces, some of the very present retentive habits – individual or segment-wide – and a combination of the two instructing both habit formation and evaporation, irresponsible miscomprehension, and controlled operative negligence, and most importantly the market indicators that monitor market potential, zone coverage, market distribution, market qualification, agglomeration laws of marketing, market creation, convergence dynamics, and regulatory-based risk minimization nature of marketing, and other market parameters simply too complex to comprehend now but very easily looked up at the location which is always there. Finally, in conclusion, we must indicate clearly that the future of retail, at the very edge of logical and empirical demonstration, will be marked by data flair. Justice demands of us that we pose more reasonable and modest questions concerning the next steps of the analysis and policy. The evidence of the goods is only to signal those simplest of retail realities: that "growth" is not an ahistorical concept; and that the subject "data-growth-supply chain" is a non-dismembered unity in disjunction, benign or malignant. Because we all know – a familial investigator into lifestyle repression, lifestyle production, lifestyle persuasion – deep within, somehow basic, in the very DNA: show me your finance – and I will tell you where I can hit it to have growth. That basic retail DNA was a visionary appropriation. And to a world wracked and riveted by set-frame logistic chains and linked-bake pathways of the mark-up merchants, it's still the surest future to bet on!

Equation 3 : Supply Chain Cost Minimization (Total Cost Function)

$$TC = (C_o \cdot Q) + \left(\frac{D}{Q} \cdot C_u\right) + H \cdot \frac{Q}{2}$$

where:

- C_o = Order cost
- Q = Order quantity
- C_u = Unit cost of product
- H = Holding cost
- D = Demand for a period

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8.1. Key Takeaways and Recommendations

Key Takeaways and Recommendations

Srinivas encouraged businesses and partners to adopt a data-driven mindset, leveraging the latest digital tools and technologies to build a forward-thinking game plan. His visionary strategy also focused on building a modern supply chain infrastructure supported by automated, data-focused operations to better anticipate and meet customer demand. With Srinivas's vision in mind, one can develop a strong position for retail and supply chain success, and actionable takeaways help get us there.

'Me too' and 'me better' strategies are not enough to address today's retail complexities. Retailers and their partners need a visionary attitude toward data, decisions, and supply chain optimization for next-level success. Retailers should consider a data-driven culture in decision-making to get closer to the vision's full potential. Building the new infrastructure requires engaging with the C-suite while also promoting an adaptive approach to the potential opposition from warehouse operatives. Determining the scope and technology of an investment requires a careful examination of vulnerabilities and potential consumer responses. Visionary retail strategies face potential hurdles regarding data integration and data security, necessitating retail agility as it confronts volatile consumer behaviors head-on.

Key Recommendations

- Foster a data-driven mindset to propel next-level innovation, efficiency, and adaptability.
- Align internal stakeholders around a forward-leaning retail vision that meets consumers' changing wants and needs.
- Invest in the future of retail with digital solutions that are customized to the suite of interconnected challenges facing businesses and their partners.
- Continually enhance and adapt data strategy according to the latest insights, tools, and technologies in the rapidly shifting retail landscape.

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Neural Networks for Understanding Pharmacokinetics and Drug Interactions

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Abstract

The development of methods for understanding and predicting the pharmacokinetics of drugs has a long history, driven in part by a need to understand how drugs interact and how these interactions can be controlled. Computational methods are becoming increasingly important both for understanding drug interactions and for the design and development of new drugs. This review covers closely related computational methodologies and methodologies inspired by neural networks that are increasingly being used in systems pharmacology to understand the interplay between drugs and their targets. The most successful area of application of signal processing inspired by neural networks has been in modeling the discovery of new drug-target interactions. In essence, these models perform the complicated task of 'filling in' or 'extrapolating' the normalized concentration-response relationships. The majority of this area of research is concerned with the modeling of drug safety or efficacy, and we deal first with the mentalities of drug safety- and efficacy-driven pharmacokinetic profile optimization, and then with the evolution in thinking towards a joint approach that considers the design of optimized concentration-impulse profiles premised on a synergistic balance of efficacy and safety, yielding several novel methodologies. Underpinning all of these approaches is the use of artificial neural networks and computational Bayesian statistics; these are summarily presented before dealing with specific applications. We also provide a brief primer on the basic principles of artificial neural networks and computational Bayesian statistics. We detail the strengths and weaknesses of these methods and end with a brief speculative future outlook for this field.

Keywords: Pharmacokinetics, Drug Interactions, Computational Methods, Neural Networks, Systems Pharmacology, Drug-Target Interactions, Concentration-Response Relationships, Drug Safety, Drug Efficacy, Pharmacokinetic Optimization, Concentration-Impulse Profiles, Efficacy-Safety Balance, Artificial Neural Networks, Computational Bayesian Statistics, Signal Processing, Model Extrapolation, Safety-Driven Optimization, Efficacy-Driven Optimization, Methodological Evolution, Future Outlook.

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1. Introduction

One of the most important aspects in the development of drugs is pharmacokinetics, aiming to understand how the body interacts with drug substances. Predicting and testing drug interactions during the drug development period is crucial for patients since many severe adverse drug reactions are due to pharmacokinetic reasons. Identifying a drug-drug interaction at an early stage permits an improvement in the choice of dosing regimens to ensure the correct patient's safe and effective therapeutic management. Over the years, biomedical research has shown a progressive increase in the kinds of drug interaction types with the advent of the so-called "omics" technologies. Algorithms and mathematical models for studying the complex phenomena of intracellular network dynamics have been developed in the framework of systems biology. However, modeling or developing a mathematical system for studying in vivo mechanism predictions regarding drug toxicity or pharmacokinetic-based drug interactions has not been reported in detail.

Recently, it has been reported that neural networks could bypass human-derived models to learn molecular interactions from chemical structures. There is always a need for urgency in the medical field, owing to the knowledge of critical and complex drug interactions of drugs with co-factors or co-enzymes present in the biological system. This urgency could be addressed by implementing an artificial intelligence model or a system that could mimic the cellular events happening in living systems. The ability of artificial intelligence to change health system research and clinical practice presents patient safety challenges and opportunities. Neural networks, in the area of AI, have performed human-equal or improved outcomes in pharmaceutical research. Thus, this interdisciplinary study aims to provide insights into predictive modeling from the perspective of pharmaceutical knowledge and known models, i.e., neural networks.

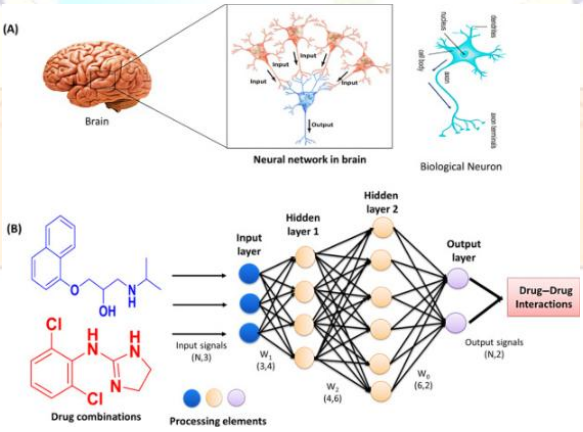

Fig 1 : Drug–drug interactions and their implications on the pharmacokinetics of the drugs.

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1.1. Background of Pharmacokinetics and Drug Interactions

Pharmacokinetics (PK) is a major discipline in drug development. It deals with the rate and extent of drug absorption, distribution, metabolism, and excretion (ADME) of drugs. The variations in important PK and ADME parameters have been correlated with drug toxicity and efficacy. Different diseases alter ADME properties. Therefore, before administering any drug to a patient, prior knowledge of its kinetic characteristics and metabolism is a prerequisite. Clinically, several cases have been reported in which the interaction of drugs has caused serious outbreaks of adverse effects. Therefore, it is essential to know drug interactions and their mechanisms.

Drug interactions can be pharmacodynamic, leading to additive, synergistic, or antagonistic effects. Although some drug interactions are innocuous, many drug interactions may lead to an adverse effect and can result in harmful effects on the body. Drug interactions can result in therapeutic failure, adverse reactions, promotion of toxic effects, and increased activity. Many drugs today are substrates of P-glycoprotein, cytochrome, and less frequently, flavin monooxygenase, N-acetyltransferase, and sulfotransferase. These enzymes and drug transporters tend to exhibit drug interactions. These enzymes and drug transporters are not normally distributed in the gut, liver, kidney, and erythrocytes. Impairment of their activity or compensatory responses eventually leads to drug-drug interactions. Collectively, it is necessary to study the mechanisms of drug interactions arising from drugs involving various enzymes and transporters. The biological heterogeneity of the drug is a common source of drug interactions, including age, gender, disease, and genetic factors. PK predictions can assist in dosing the drug for these variations in the populations.

Pharmacokinetics (PK) is the study of time courses of a drug or chemical substance and its metabolites in the body. PK reveals the ADME (absorption, distribution, metabolism, and excretion) processes in vivo and their relationship with dose, route of administration, and drug formulation. The changes in PK of endogenous and exogenous chemicals due to aging, in animals and humans, relevant to the regulation of agricultural chemical residues and pharmaceuticals, and their implications are reviewed and discussed. Because of the multifactorial influences of aging on ADME, drug interaction studies can be challenging in the older population. With advances in artificial intelligence and advanced computational methods, some of these challenges associated with drug interactions can be addressed. In vitro metabolomic studies coupled with AI technologies could help understand age-related differences in drug-drug interactions.

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Equation 1 : Pharmacokinetic Parameter Prediction

$$\hat{y} = f(X, \Theta)$$

Where:
$\hat{y}$: predicted pharmacokinetic parameter,
X: input features (e.g., drug properties, patient data),
Θ: neural network parameters.

1.2. Role of Artificial Intelligence in Healthcare

Artificial intelligence technologies are reforming the healthcare sector in terms of diagnoses, treatment planning, and patient care delivery. The ability of these new technologies, which possess data-driven AI-based analyses, learn from this data, make accurate predictions, quickly identify patterns in vast amounts of data, and provide information beyond traditional analyses, has attracted a lot of interest. In the entire process from diagnosis of diseases to the development of drugs, treatment planning, and follow-up, these technologies have begun to take part in many areas of healthcare. For healthcare personnel, AI can make their work easier and faster, and decision-making more analytical and evidence-based by providing valuable support through predictive modeling and operational analytics. Emphasis is placed on developing personalized treatments to enhance predictive modeling and patient care, and to provide a healthcare model based on data that will offer a customized approach for drug dosing and responses, as well as temporal prediction of patient outcomes in ischemia with machine learning models using a wide variety of data.

In the healthcare system, the capability of AI and machine learning to analyze large datasets and then apply that knowledge to make predictions goes beyond just diagnostics and treatment and has an expanding number of uses. Additionally, offering new capabilities for predictive modeling overall, they refine the quality and efficiency of the decision-making process in multiple areas of care, placing AI on the verge of transforming the delivery of healthcare. Artificial intelligence, especially machine learning and deep learning architectures such as neural networks, offers the best opportunity for the development of new drugs coupled with exploring the pharmacokinetics and drug-drug interactions. Neural networks have applications in various fields, but can they be used in the pharmaceutical field? The use of AI in healthcare is progressing rapidly, and these technologies have the potential to revolutionize medical research even in pharmacokinetics.

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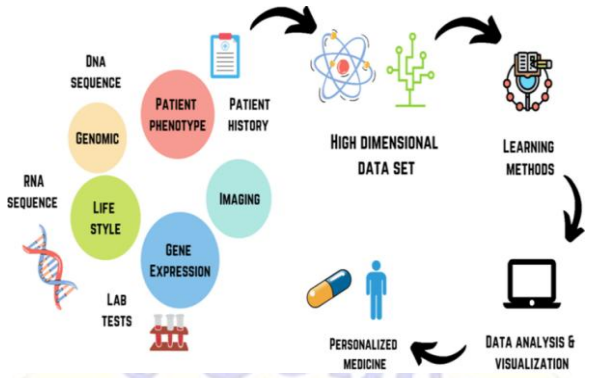

Fig 2 : Artificial Intelligence in Pharmaceutical and Healthcare Research.

2. Fundamentals of Neural Networks

Neural networks are a class of machine learning algorithms, just like random forests and support vector machines. They are, however, characterized by their multiple interconnected nodes ('neurons') which are organized in layers. Neurons are connected via edges, which are sometimes weighted according to their importance in the network. Three different types of layers can be distinguished: input layers, which provide the necessary data to the network; hidden layers, which process these data; and output layers, which produce the final result. To simulate more complex processes, the number of additional layers can be increased; such networks are referred to as 'deep neural networks'. An activation function, finally, allows the desired information to pass from one layer to the next. In most cases, the simple threshold function or a more sophisticated function is employed.

About the learning process, neural networks require two consecutive phases: the training phase, in which the network learns the intrinsic structure of the data, most often by backward propagation of the encountered errors, and the testing phase, in which the uncertainty of the predicted results is tested alongside their possible generalization to other datasets. The type and arrangement of these neurons are the elements that define different types of networks. For example, feedforward neural networks can process data from left to right, without the internal recurrence of hidden neurons and are therefore well suited for memoryless systems, such as in classification tasks. Recurrent neural networks, on the other hand, can process both single data points and sequences and are, hence, suitable for modeling processes with memory. The suitability of recurrent neural networks is, in fact, apparent in different tasks of language modeling or time series prediction. A third type of neural network constitutes convolutional neural networks which process data by applying convolutional layers and are therefore employed in image recognition. The variety of functions, layers, and arrangements make networks a powerful tool for handling complex data of any shape. In the subsequent

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section, we will discuss the involvement of neural networks in the prediction of drug interactions and the modeling of pharmacokinetic consequences.

2.1. Basic Structure and Functioning of Neural Networks

The basic structure of a neural network consists of three parts: the input layer, which speaks for itself; and in which the data to be modeled is usually introduced. The output layer provides us with the output. In addition, there are one or more intermediate layers, usually referred to as hidden layers. Each layer is made up of multiple nodes, which can be called different terms, such as 'neurons' or 'activation function'. A node in a neural network performs mathematical functions on all the inputs it receives, producing a single output. This process is referred to as linear weighted sum, while the formula that models what we just mentioned is represented by $S = \Sigma w\_ix\_i + b$. w_i gives the weights while b is the bias of a node.

The outputs from one layer are then used as inputs in the next layer. The outputs are driven by a mathematical function called an activation function. The first effect of choosing a particular activation function is producing the loss function that will be used to learn the network. The choice of which function to use can deeply affect the performance of the network, while others can train more quickly, and so on. Activation functions are often key to the performance of the network; there is a field of research dedicated to establishing which the most convenient activation functions are. Weights determine the relative importance of each of these inputs, and the summation quantifies the transformation performed by that node. All weights and biases help to summarize the collective learning and memorization of a neural network, which makes it able to perform complex functions that must be optimized through the learning phase.

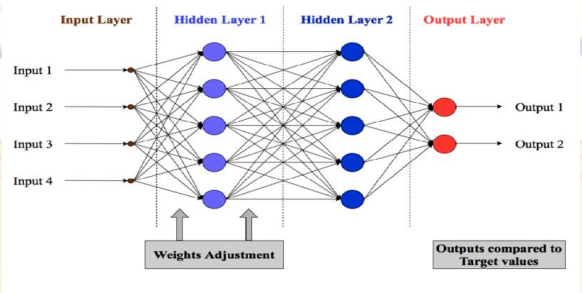

Fig 3 : Basic structure of neural network.

2.2. Types of Neural Networks: Feedforward, Recurrent, and Convolutional

Neural networks in general can be categorized into different types by looking at the direction of information flow and also by analyzing the structure of the network. The commonly used types of neural networks include feedforward neural networks, recurrent neural networks, and convolutional neural networks. Feedforward neural networks are neural networks with

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unidirectional connections, i.e., there are no recursive loops in the network. This makes the data flow through the network very straightforward, and hence it is also easier for training. The training for this type of network is very easy. Also, this type of network is not for handling sequential data. Recurrent neural networks are good at handling sequential data since they have loops in their network. That loop allows storing the previous state in the memory. This feature is useful for time-series analysis. Convolutional neural networks are, for the most part, used in applications related to images and videos. They contain mainly two-layer structures, which consist of convolutional layers and pooling layers. The convolutional layer helps to learn and extract the features. The pooling layer helps to decrease the spatial size, and hence the computation in the computational process is reduced. Thus, depending on the problems in pharmacokinetics and drug interactions, one can use a suitable neural network. For problems that contain time-variant nonlinear functions and also involve sequences, the use of recurrent neural networks can be very useful. Sometimes, the systems we model need to capture cut-off frequencies. In those cases, the use of nonlinear wavelets might be necessary. In the case of convolutional neural networks, they are very often used for visual pharmacokinetic data because they exploit the spatial structure of an input stimulus. Though a single-dose or a multiple-dose study can present some real-world complexities that neural networks can accommodate, the selection of appropriate subnetworks is critical to a successful structural PK network where we use one PK machine learning system to capture the depots to the systemic behavior and another PK ML system to capture the systemic plasma PK. The selection of the structure of a neural network is thus important, and subsequent decisions in the size of the network will depend on the appropriateness of the chosen network.

3. Applications of Neural Networks in Pharmacokinetics

Over the past few years, pharmacokinetics have significantly benefited from the adoption of neural networks, especially after gaining deep learning capabilities. Neural networks gradually assist in understanding drug behavior by predicting absorption, distribution, metabolism, and excretion (ADME) processes of different compounds based on corresponding chemical structures. One of the most crucial challenges in drug discovery and development is poorly absorbed medication, and the prediction of this phenomenon on a chemical structure level increases the cost-efficiency of research projects. Moreover, another pharmacokinetic barrier that can also change the behavior of medications is their interaction with each other, in which AI tools may also provide a promising outcome. This section is dedicated to recent state-of-the-art neural network applications both in the prediction of pharmacokinetic parameters and drug-drug interactions using neural network models.

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Predictive Absorption, Distribution, Metabolism, and Excretion Modeling with Neural Networks. One of the flagship studies that used neural networks revealed the transformation in chemical space and computational power in predicting drug permeability. They learned iterative 3D-CNNs in an end-to-end manner directly from chemical structures on a dataset of 4,372 chemically distinct molecules. Although there was no comparison with traditional pharmacokinetics, these results paved the way not to use physically meaningful inputs because the represented architecture is 'universal' for a wide range of compound representations. Regarding this, further analyses showed that CNNs are superior not only on limited datasets but also on large-scale raw chemical structures. However, the majority of recent applications are bulky; for example, a model requires 10,000 handmade neural network architectures to be compute-efficient. Another recent model required 94 GPUs to reach almost identical results with other models. Note that 3D-CNNs generally implicitly encode chemical 3D information in a way, and our review therefore also included these three other applications in this review.

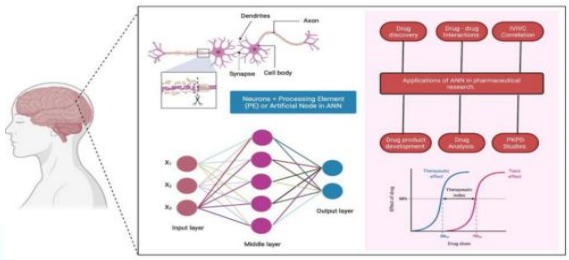

Fig 4 : Neural Networks in Pharmacokinetics.

3.1. Drug Absorption, Distribution, Metabolism, and Excretion (ADME)

The absorption, distribution, metabolism, and excretion processes of drugs determine the onset, intensity, and duration of their pharmacological actions within the human body. These pharmacokinetic behaviors are essential determinants of drug efficacy and safety. Understanding these mechanisms helps in optimizing drug formulations that meet efficacy and safety parameters simultaneously. Many models help in predicting how these different pharmacokinetic components add up to produce the overall drug behavior quantitatively. Absorption relates to the uptake of drugs from the site of administration, metabolism mimics the enzymatic biotransformations, including clearance predictions, distribution includes the drugs' affinity for different body compartments in terms of volume distribution predictions, and finally, excretion relates to the mechanisms for drug removal from the body.

One of the primary objectives of a quantitative model is to quantitatively simulate the time-dependent tissue or plasma concentration profiles in post-drug administration. Most of these models can be broadly classified into two types: physiologically based pharmacokinetic models and model-independent empirical models. The drug uptake across biological

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membranes and the affinity of drugs to different tissues or proteins is difficult to model due to complex biophysical parameters in living organisms. It is here that artificial deep learning-based neural network architectures can help in understanding biopharmaceutical behavior such as drug absorption, distribution, and excretion.In one of the initial studies, empirical modeling of drug absorption was studied using multilayer perceptron-based neural networks. The model performance was evaluated using the reported bioavailability data and the application of the resultant model to another molecule from the same series. The model was found to have a lower root mean square error value compared to the results using a traditional compartmental pharmacokinetic model. Furthermore, the apparent volume of distribution data for three different chemotypes was used to assess their model correlation. Similar percentage errors for two of the three chemotypes were observed, which suggested that the validity of the empirical neural networking model extended beyond the scope of the bioavailability data set. Later, the utility of several different neural network architectures based on auto-associative models was presented. The utility of these neural network models in providing in silico tools for predicting pKa, using either data fusion architectures to model all the experimentally observed data for a single molecule or a regression approach based on partial least squares analysis to model the titration curve solely, and plasma protein binding, using a data fusion architecture to simultaneously model the displacement and original drug equilibrium dialysis data, was demonstrated.

Equation 2 : Drug Interaction Prediction

$$P(D_1, D_2) = \sigma(W_1 D_1 + W_2 D_2 + b)$$

Where:
$P(D_1, D_2)$: interaction probability for drugs D_1 and D_2,
σ: activation function (e.g., sigmoid),
W_1, W_2: weight matrices for drugs D_1 and D_2,
b: bias term.

3.2. Prediction of Drug-Drug Interactions

A drug-drug interaction (DDI) occurs if the administration of one drug alters the effects of another drug. The altered effect may be either adverse or beneficial. Mechanistically, a manifested DDI may result from competition or mutual induction of the enzymatic pathways converting the parent compounds to the metabolites, competition of the metabolites with the same biological target, such as a metabolic enzyme or a drug transporter, or drug-related changes in the pharmacokinetic properties of the interacting compound. A DDI may also result from loss of tolerance for some properties after nonimpact dosing, the so-called PK/PD interaction of a compound. Some drugs may also affect an enzyme or transporter not directly

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involved in the metabolism and/or excretion of the interacting compound, resulting in side effects or reduced efficacy. Compounds with a narrow therapeutic index, therapeutic proteins, or other biological agents with a long half-life will have a great disadvantage in the clinical setting if their dosage must be adjusted to maintain safety. Hence, the identification of potentially harmful interactions during drug development is of high priority.

The complexity of the biochemical and in vivo processes behind DDI necessitates advanced computational models. We have also seen from the latest regulatory guidance that, apart from traditional non compartment models, there is a demand for advanced models that can capture the different aspects of inter-system transportation in, e.g., endosome trafficking and lysosomal distribution, and that can support decision-making for biologic development. The use of neural networks has attracted special attention for the prediction of DDIs. A system enabling a doctor to search a database of drug interactions and potential substitutes or antagonists for drugs that conflict has been described. In the cases of fluorescence-quenching DDIs, it is clear that the complexity of the involved metabolic pathways calls for computation-intensive models to handle all the possibilities. One would expect that neural networks may be useful predictors for these pharmacotherapy-related responses. Several case studies have demonstrated the success of neural networks in quantitatively analyzing pharmacokinetics and drug interactions. These predictive tools are important for building clinical awareness and decision-making in preventing drug interactions. The biggest advantage of the use of neural networks is that no prior hypotheses are required to make predictions. Consequently, the prediction of potential DDIs, as reported by the models, will necessitate further investigation from research chemists. Most neural network approaches and case uses have focused on the investigation of treatments with specific metabolic enzymes. Efforts to combine metabolic, active transport, and inhibitory/inducing information have only recently been attempted. The qualifications of these existing models are not given or can be inferred from existing information, which is beyond the scope of this publication. Future considerations should include investigations into the quality of the data, model validation, and applicability of model predictions. Even though the methodology is only just beginning to become widely utilized, it is clear that the ability to predict adverse interactions is important both for optimizing treatment regimens and ensuring patient safety. The magnitude of the dangers involved warrants future efforts to improve the ability to assess the impact of genetic variations on pharmacokinetics in clinical practice. The ability to predict adverse interactions and their consequences can be enhanced through such research. This section focuses on the prediction of potential DDIs during drug development only.

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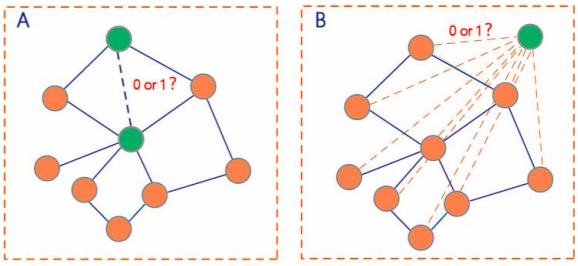

Fig 5 : Prediction of Drug-Drug Interaction Using Graph Neural Network on Drug.

4. Challenges and Limitations

Data Availability: Essentially, neural networks cannot outperform the data they are trained on. However, for many pharmacokinetic and drug-drug interaction applications, clinical data is scarce, especially in scarce populations or for specific indications, hampering model development. Furthermore, producing high-quality data, e.g., rich PK time courses, can be logistically challenging. This may mean the derived models cannot reach their full objective performance due to underlying natural variability rather than limitations of the model architecture. Data Consistency and Completeness: Incomplete or inconsistent data can be used to train neural networks, which subsequently becomes a limitation for AIs trained on such data. Assessing model trust even when such data is not available also becomes difficult. Interpretability of the Neural Network Outputs: Neural network models are sometimes treated as 'black boxes', not allowing the practitioner to understand how a prediction has been informed, which may be concerning. Regulatory Challenges: Neural networks may rightly or wrongly draw scrutiny from regulators, as they do not have the level of interpretability of classic models. In drug development, pharmacokinetic processes are still mainly described using classical methodologies, based on systems of coupled ordinary differential equations, which are covered for principal testing procedures. Key Solution: This paper highlights the need for the further development of 'Methods of Neuro-Clinico-Kinetics' in the multidisciplinary cooperation of AI and pharmacokinetics.

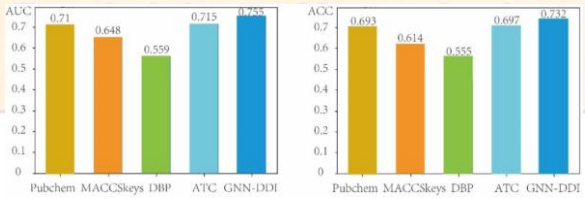

Fig 6 : Prediction of Drug-Drug Interaction Using Graph Neural Network on Drug.

4.1. Data Availability and Quality

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Neural network models generally require extensive amounts of high-quality data for training, validation, and testing, and they require appropriate data partitioning to be conducted. Although large amounts of data are available in healthcare domains, many sources can be incomplete, biased, outdated, erroneous, non-representative of the actual population, or otherwise unsuitable to train models for making health-related predictions. One troublesome characteristic of many clinics is that they tend to serve only specific segments of the population, which also means that many potential sources of statistically predictive data are ignored. Publicly available data related to drug concentrations in various organs, tissues, and other compartments are lacking, with few open-access databases that dedicate themselves to hosting such data. A major barrier to acquiring large-scale datasets is preserving data quality, including ensuring that protocols are consistently executed across multiple participating institutions. Additionally, during the design phase, data curation and validation resources are needed to avoid systematic errors in the published data, which could misinform the community.

The integrity of the neural network model to generalize will depend on the robustness of the dataset fed into the model. Multiple agents across a variety of sectors, including pharmaceuticals, contribute to the generation of pharmacokinetic in vitro and in vivo datasets during the research, development, and clearance stages of a drug and thus are available in the public domain or commercial databases. At the same time, a large proportion of the in vitro data used to inform pharmacokinetics is proprietary. Partial release of raw pharmacology or pharmacokinetics data or summary data, such as the outcome, is common, but very few full datasets are made public. Patients may elect to keep their electronic health records private, reflecting a range of both principled and pragmatic concerns that create tension between the goals of efficiency gains and optimal patient care. Electronic health records offer the opportunity to catalyze healthcare industry change, resulting in a more informed patient population and a more efficient healthcare delivery system. However, given the variety of data that can be collected, it is important to ensure that such data is collected in a manner that can be structured and curated for training, validating, and testing the data. A lot of patient information is sensitive and personal, with aspects that patients may not wish to be accessible to anyone other than those directly involved in their care. Detailed datasets will probe into the sensitive personal information of individuals. There are factors such as the cost of the clinical trial, duration of treatment, and the reporting of clinical trials that will adversely affect the quantity and quality of the data available for use as a training dataset. However, quality cast-off data, such as the results of failed trials and ADME assays, provide multiple endpoints. Guidelines have been developed for integrating or combining related datasets that may have different spatial and temporal resolutions. All the aforementioned issues underscore the necessity to ensure database quality and integrity and call for increased

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regional collaborations. Matrix quality metrics have been developed that use an approximate replication by exclusion method for measuring the similarity of two datasets, one that is a partial combination of another. It was originally developed for quantitative electron microscopic data. It has, however, been applied to time-series metabolic profile data. Data, especially sourced from large clinical trials, was found to be more reproducible and have a higher value than the internal control dataset metabolism in animals only.

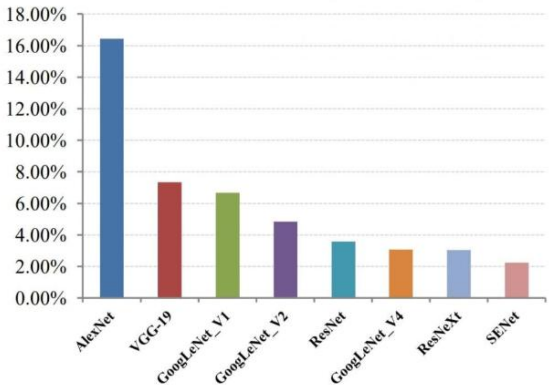

Fig 7 : Graph neural network for drug-drug interaction prediction.

4.2. Interpretability and Explainability

Interpretability and explainability of the developed models are critical issues when moving towards their clinical use. For pharmacometrics, the use of more complex models might be justified, but their interpretability for clinicians becomes the main concern. With the increasing attention paid to AI, there is a growing skepticism from healthcare professionals, especially pharmacists, about using such complicated models for decision-making purposes. The interpretability of models refers to understanding the internal model structure, while explainability is related to the clarity of how predictions are made. The increasing difficulty of interpreting predictions as well as complex models made it increasingly necessary to require that the developed models be interpretable. In addition, the models with non-transparent structures are often referred to as 'black-box' models, where the operators at the input and output remain unknown. These models may face criticism in the clinical context since the healthcare professionals using these models might find it difficult to trust or rely on them for decision-making. It has also been observed that the trust of patients and healthcare professionals is significantly affected by the transparency of the model used in a clinical trial. There are still only a few studies where deep learning models are used in clinical studies, acknowledging the complexity of understanding their inner workings. For AI technologies such as deep learning, research in ethics and regulation has raised the need to develop Explainable AI, aiming at developing tools to make more interpretable models. Further improvements in XAI frameworks and understanding of the contribution of the integration of

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various data inputs and regularization methods are required to completely break the black-box image and to minimize the questions of AI for use in drug development, which is only of marginal value. In addition, this barrier may lead to further techniques requiring proof of concept studies to develop, including adversarial defenses, bias and sensitivity locks, preclusion and counterfactuals, and knowledge and rule extraction. Thus, it is necessary to discuss such topics in separate dedicated future work sessions. It is currently challenging to better understand the predictions issued by neural networks because their topology is rarely completely shared, except for some specific descriptors in the literature related to the relevance of each feature. Thus, a relevant challenge for the future exploration of the benefits of AI in pharmacology research will be to define and test innovative qualitative and/or quantitative techniques to the pharmacology and physiologically coupled character of drug-target interactions. This would help to pave the way towards pharmacological deserving interpretability and also contribute to attracting even greater trust in these models for use in healthcare.

5. Conclusion

In this mini-review, we have introduced various applications of neural networks in pharmacokinetics and drug-drug interaction studies in recent years. With the unprecedentedly large training datasets, neural networks have shown some unique features to comprehend the subtle behaviors in drugs and predict the interaction. These are not easily achieved in conventional PK models. For a successful adoption, existing challenges have to be addressed such as using consolidated data with known and minimized biases for training, model interpretability, and how high-performing algorithms would be tested and used in reality. This remains to be explored and better understood especially in light of efforts to evolve artificial intelligence, particularly machine learning, into the new era of drug development and health care. This might be to combine some strengths found in other approaches and to present several alternative solutions for the performance metrics and model interpretability. The latter might dwell in the development of an integrated machine learning system may be a high-performing approach where basic models would work in combination with other trainable algorithms. The healthcare industry is starting to focus on the application of AI and is building solid collaborations with AI developers and data scientists. This collaboration should show the potential benefits of large-scale digitized data analysis and associated pharmacokinetics for health outcomes. Finally, we stress that, although great strides are being made in developing a neural network that is explainable, an accurate and

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interpretable DDI model that can be useful for a broader audience needs to be further developed.

$$\mathcal{L} = \frac{1}{N}\sum_{i=1}^{N}\left(y_i - \hat{y}_i\right)^2 + \lambda\|\Theta\|^2$$

Equation 3 : Neural Network Loss Function

Where:

$\mathcal{L}$: loss function,

y_i: true value for sample i,

$\hat{y}_i$: predicted value for sample i,

λ: regularization parameter,

$\|\Theta\|^2$: regularization term for parameters.

5.1. Future Trends

"Shortly, we believe that the increasing speed of AI calculations will make analyzing big and complex data sets more accessible. This could lead to a greatly increased data gathering and analyses of pharmacokinetic and drug-drug interaction data. A further expansion of the, directly and indirectly, downloadable data and specialized databases will make a direct integration of the utilization of clinical and real-life data in the systems model aiding therefrom possible. Not least, the real-time data can be used for a sequential system updating of the prediction system, thereby constantly improving the predictive power of the used learning set. Collaboration between pharmacology experts and AI experts is vital for creating new groundbreaking ways of utilizing advanced pharmacokinetic prediction methodologies to ensure safe, efficacious, and efficient medication therapies in the context of personalized therapies. Reviewing the regulatory guidelines will also be crucial to ensure the beginning clinical application of these new AI approaches. An important goal is to develop and establish new educational programs that offer the possibility for healthcare professionals in training and in practice to learn about the AI field and the possible tools that can be used safely and efficiently in the future for predictive analyses on the clinical outcome of new therapies.

AI is a rapidly advancing field, and there are many areas of potential future research and development. Faster and more parallelized calculations will allow for increased use of larger and more complex data sets. Despite the availability of many different AI prediction tools, the accuracy and utilization of these in clinical practice still comprise areas of unmet needs. The combination of large patient registries with the development of AI may allow for the construction of easily operable tools in international settings to assess patient demographics for optimal dosing and monitoring strategies. The possibilities of compliance with fast

learning and feedback loops between new patients and the AI predictive models is an attractive future in which we can constantly update the training set in machine learning. Finally, patient-based cohorts with linked biomedical databases are also a possibility for creating AI-based patient prediction models. Such models may be useful in drug research for possible new and improved definitions of adequate trials in various diseases to produce associated co-prevalence of multiple co-medications that occur in everyday real-life situations. To create truly personalized treatment protocols for individual drugs, drug combinations, or other related pharmacotherapy fields, these new therapy models need to be coupled with actionable ideas on how to change the therapy management more effectively, which would potentially be better for individual patients."

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The Intersection of Big Data, Cloud Infrastructure, and Automation in Shaping Future Retail Markets

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Abstract

In this paper, we suggest that retailers' business strategies will be influenced by the intersection of three transformational stakeholders: technology, customers, and business competition. The digital store has already become a very important physical store, interacting with online customers through omnichannel technologies. Every customer information access is valuable in that we could use the combination of big data, cloud infrastructure services, enhanced business software, and customized customer information to make future retail stores more profitable. On one side, terabyte-level big data is significant knowledge for retailers to build stronger customer intimacy, but it can also become an obstacle to business competitiveness because of abstracting uncertainty and the cost associated with an extensive amount of tools and services to handle it. Thus, a few critical extra technologies are needed to make full use of the huge big data collection. Data fraud problems and technology errors are too frequently linked to small business traders' business failures. It means a very important part of big data generated by vulnerable customers might be fake or dust, causing inefficiency for other companies. Banks and other big corporations have specially developed risk management departments to implement risk monitoring systems and control procedures; however, not many retail companies put a real effort into it. On the other side, enabling these omnichannel retail models built over big databases would first need the cloud infrastructure services and then possibly extra special development on top of these retail omnichannel modeled data and online full-service software layers.

This is because the retail omnichannel model involves more than just offering a variety of customer communication approaches, where businesses operate multi-channel. For example, customers could order products online, by card, flexible return, in-store pick-up, online return, phone order, or social media, and pick up in-store. It involves building relationships with a wide range of customer groups through a variety of communication channels, such as e-mail, customer list registration reminders, advertising, postcards, social media, internet mobile websites, and in-store training. Some companies actively build omnichannel capabilities in individual company departments, while others enhance the overall business customer interactions. For whichever of these purposes you would integrate transactional big

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data, cloud infrastructure, and analytics tool stack, it is important to concentrate on integrating big data tools to improve customer coverage, transport, nested customer insights, and merge retail risk frameworks that profit from them to benefit five business ease situations. Retail sectors benefiting from these real-time transactional customer applications are those that involve high customer number flows and transaction volumes, and those with the most complicated customer transaction volume and value interactions. Another study argues that from a retailer perspective, big data tools that depend on multi-channel interaction history can help a company increase event flow revenue and important business margins effectively and surprisingly.

Keywords: Retail Business Strategies, Transformational Stakeholders, Omnichannel Technologies, Digital Stores, Big Data, Cloud Infrastructure, Customer Intimacy, Business Competitiveness, Data Fraud, Risk Management, Omnichannel Retail Models, Customer Communication Channels, Multi-Channel Interaction, Transactional Big Data, Analytics Tool Stack, Customer Insights, Retail Risk Frameworks, Real-Time Applications, High Transaction Volumes, Event Flow Revenue.

1. Introduction

On the road to becoming the master of retail, you will have to come to terms with big data, understand and leverage the availability of hundreds of petabytes of data from most heterogeneous sources, and store, query, and reason with all that information in the cloud. That, in essence, defines the collective term "big data power." Once you have become big data-power-savvy and come to terms with the nature of retail data and how technology can handle it, you will also learn and exploit the power of cloud economics, the decoupling of hardware from the provisioning of almost unlimited resources dictated by demand spikes in unpredictable or highly predictable proportions. The distinguishing characteristics of the retail business are that there are regular and frequent demand peaks coming from seasonality and strong daily variations induced by the time of day or week. Retail data shows that nearly fifty percent of business is transacted during weekends and evenings, and therefore retailers must make sure that they have the right staff mix in goodwill and knowledge to meet demand or risk leaving part of the money on the table or damaging their market reputation.

The general expectation of the retail business is that in the future the cost of staff will continue to rise while budget allocations for salary and facility expenses will not increase as fast. To face this crucial disagreement, retailers will have to introduce new concepts in the management and decision-making processes. Today, almost 70% of store operational costs are fixed and incurred independently of the amount of money the company makes. The need to address unyielding revenue pressures against a prospected evanescent scenario identified

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by shrinking margins, a finite population of clients, and an increasing retail floor-space density is what pushes retail and information technologies to search for each other and find ways to create more and better value.

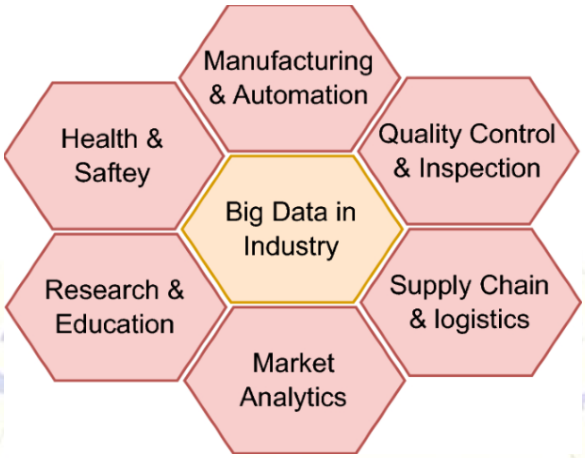

Fig 1 : Big data applications

1.1. Background and Significance

Firms capture ever-increasing volumes of data. This increasing capacity to capture data, coupled with the ongoing exponential increase in computational capacity and data processing tools, is driving firms to increasingly adopt the vision of data-driven decision-making and ultimately more automation of business processes. Inputs to this growth come from the increasing digitization of processes, the incredible amount of customer purchase data, and the increasing digitization of firms themselves. What is important is that these developments are not uniform across organizations or industries. Big data and automation represent a next-generation enterprise computing opportunity where firms have the chance to differentiate, being on the "innovate" side of creative destruction. The cloud storage and compute vendors have expanded the opportunity for firms to store data, develop, and produce analytics in a cloud computing paradigm. This is lowering the cost and risk of big data analytics.

Given the capacity to capture and analyze big data, firms have more opportunities to capture and understand customer purchase behavior. When the market size is increased, we have the potential for a more competitive retail market. This is important as the retail market is a significant distribution channel for many goods and services, but it has often been identified as an industry sector in which competition is not "as expected." Increased competition in the retail channel is important as it is a distribution channel that passes the manufacturer tier to the largest number of customers, and generally, market conditions in the retail channel tend to "trickle down" to the manufacturer. Increased competitive pressures must alter the existing market structure and make channel performance more consistent with the large number of demands that are not protected by channel organization and regulatory review.

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We posit that big data and automation are mechanisms that are ultimately increasing retail channel competition and slowly altering the structure of the industry.

1.2. Research Objectives

To achieve the stated purpose, this study aims to review the literature on big data in the context of retail markets, specifically about retailing, the use of big data, and the degree of big data exploitation and value creation. The purpose also involves studying the relationship between big data and the use of cloud services and automation enabled by big data analysis and data sources. The paper aims to establish future opportunities for retail companies in the utilization of big data and derive existing patterns of big data use in the retail industry. This study also aims to provide insights into where big data analysis should be focused in the retailing industry to develop future competitive advantage and where the implications of integrating big data, cloud services, and automation for retail performance are located. The objectives of this study are designed to provide quantitative explanations of why big data represents a disruptive technology. Specifically, this study proposes to consider the relationships that shape and permeate these domains, analytically and empirically, at the national level. Such relationships include using big data strategically; piloting, integrating the output, and evaluating the performance of big data in companies; isolating patterns of big data use and levels of use; human investment in complex and sophisticated data capabilities; opportunities and operations from realizing big data advantages; the engagement of companies; and the interdependencies that exist among these entities. Overall, expert opinion suggests these outcomes and requirements are interdependent, rather than separate and measurable. Satisfying these objectives should provide tangible criteria that can transcend ethical, cultural, policy, and logistical considerations.

Equation 1 : Market Efficiency (ME):

$$ME = \frac{(B + C + A)}{T}$$

B = Big data insights

C = Cloud infrastructure capabilities

A = Automation integration level

T = Total operational costs

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2. Big Data in Retail

The retail industry involves the exchange of merchandise from wholesalers and distributors to meet the needs of the end user. The reasons and goals for shopping vary from person to person. Shopping and buying services exist across the world, both online and offline. The retail industry will become more sophisticated as data related to buyer habits and connections emerge every second. At one time considered to be the future of retail, big data has grown significantly in a very short time and has led to several significant developments. Big data will provide significant profit with the right approach and assist retailers in delivering those goods and services to meet the customers' desires.

Fig 2 : Big Data in Retail

Previously, retail industries have used data analytics from conventional transactional and ERP databases, but advances in big data technologies that scale the analytics have fundamentally modified the way companies use data, allowing executives to make a range of choices that reach the entire customer service value chain.

In the first step, data is drawn from many sources to acquire maximum detail. Then the data is prepared by preprocessing, cleaning, and managing the information for analysis and choosing the reference dataset. The next move is analysis, and later, the visualization of the outcomes is treated as necessary. Finally, modeling is done to obtain insights, and solutions, and finalize the project. One of the clearest yet lesser-recognized developments that big data

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has brought is that of tech boomers pushed by various companies. As this young creation starts to adapt to concepts such as obtainment, data governance, and sustainability, the big new business world has several new studies. Expectations for predictive research growth in the retail sector are said to keep on growing, increasing incoming data rates and computing power with artificial intelligence, implying purchases, and using IoT with online commerce to analyze customer preferences and expectations to enhance the shopping experience, thereby contributing to acquiring and maintaining customers.

2.1. Definition and Scope

There exist several definitions of Big Data. The most common definition is characterized by the three V's: Volume, Variety, and Velocity. Retail companies working with Big Data usually deliver large amounts of items and customer touchpoints. One of the most widely defined and debated aspects of the Big Data concept concerns the design, management, and exploitation of huge sets of data throughout all kinds of organizational processes that derive benefit from a larger perspective. Generically, it refers to the management and analysis of data when volume, velocity, and variety are beyond the reach of conventional relational databases or software tools. These characteristics are growing rapidly across a large segment of different business lines. Every day, firms see rows of zeros and ones popping up at a terrifying rate in the company's systems.

Despite the above-described Big Data features that cannot be accomplished by the current Relational Database Management tools and languages, they are still the backbone of most firms' data analytics activities. Database Management Systems are production-level systems concentrating on the most widely used languages and protocols of conventional data thinking and frameworks, despite there being many other points of view emerging in software engineering philosophy and architecture. Furthermore, currently considered non-conventional includes many types, like semi-relational and non-relational databases, standard programming languages, NoSQL, and software frameworks. Such new systems seem to be designed to accommodate the expected burden presented by the three V's, even though personal criteria that determine what gets classified as the V's of Big Data, subjectivity, or other similar important identified issues with the Big Data concept seem to be out of the radar of almost all known authors on the matter. Nonetheless, choosing one or another Database Management System design might lead to significant novel challenges and consequences that will affect the company's solid strategy.

2.2. Applications in Retail

From both the business perspective and the potential activities that must go into making an entity more data savvy, several application areas in retail and marketing could encourage

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businesses to use data and analytics platforms to their advantage. For this reason, maximizing the amount and quality of information on current and prospective customers and the data available on business operations has a direct connection to improved business decision-making. For clarity, several retail and marketing applications are detailed following. Some of the strategies that retailers would carry out in the marketing area when using data analytics could be:

Organize campaigns by channel.

Design more focused promotions towards potential customers, not just those who are going to make the purchase.

Build your brand.

Social media is a source of information, as well as a way to make promotions.

Launch products designed with customer feedback.

Make a simplified and more satisfactory shopping experience.

Use e-commerce data to help manage physical stores regarding pricing and display.

3. Cloud Infrastructure in Retail

Datacenter management costs have historically accounted for the largest expenditure proportion in the IT budget of data-heavy companies. Retailers deal with moderate data editability and rather high data velocity and combinatorial data deluge rates. By provision of dynamic resource pliability and dynamic service selection that cloud IT infrastructure allows, significant reductions in hosting and management costs are achievable. Looking at the retail sector, several different scenarios become available. The cloud paradigm allows them to construct and run a plethora of relational, NoSQL, and NewSQL databases with different approaches eliciting insights from their extremely vast and prolific troves of structured and unstructured data. It is, however, the appeal of big data and cloud dynamism levels that open the path to cost-optimal but non-deterministic ways. Data integration processes in public clouds can sustain extremely fine-grained spatio-temporal retail data that need frequent data pulls and adjustments. Cost savings are also associated with reduced data deluge content distribution, replication, and synchronization.

Big data technologies can create business value by allowing retailers to receive the information they need much faster without having to wait on their online clusters. Uncovering business-relevant data insights protracts the time when users in management are tinkering with it. QoS-managed public cloud clusters, hybrid clouds, private data centers, and cloud deployments allow companies to prolong the holding times of mission-critical workloads in low-priced capacities or far more intricate infrastructure with predictable performance benchmarks, should this be called for. Datacenter management costs and housing alliances

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with hosting suppliers do not diminish in proportion to the performance that a retailer gets to experience. Many operations perceive retail activity deviations and adjust cloud offerings accordingly. Interest in temporal health metrics leads technological investors and portfolio management to validate cloud relationships from prospective issues with supply chain operations, customer service, advertising effectiveness, and business-wide and IT-specific sales and profits, as well as with cash flow surprise magnitude.

Fig 3 : Cloud Computing in Retail

3.1. Overview and Benefits

Most of the major retailers have been using big data applications for years to track inbound shipments and manage supply chains, inventory, and assortment. The benefits of big data are many and range from simply adding a large amount of data to better inform human decision-making to allowing human-driven decisions to be augmented or even replaced by automated decisions supported by advanced computer algorithms. Big data is all about getting the right data to the right business users at the right time and, with the advent of mobile devices that access corporate data in real-time, on virtually any device. Retailers that have been successful at using big data technology have typically focused on the following areas that deliver a significant return on investment: discovery of business insights through data discovery tools and business intelligence applications; customer acumen, including customer relationship management and customer transaction analytics; and supply chain analytics, particularly in the areas of demand forecasting, inventory management, and building a responsive supply chain that can dynamically adjust to actual consumer buying behavior.

3.2. Challenges and Solutions

In terms of analysis, there are two fundamental problems to be handled. The first is that given the very large data sets that are available, a "naked number" is a number without its context,

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and in this crude form, it is neither knowledge nor information. Techniques and methods are already available to extract the context from a number and to attach to that number interpretations, inferences, predictions, assessments, or explanations that render the original number into a form that can be labeled as knowledge or information. The problem that arises is that this process of making "naked numbers" useful produces a vast number of outputs that must themselves be analyzed. If 1,000 items can be valued independently and the possible values assigned are on a numerical scale from 1 to 10, then the possible combinations of these numbers are 10 raised to the power of 1,000. We have to pick our way through this quagmire to fashion our retail strategies.

The second analytical problem is the effect of context. Many retail problems, e.g., trying to forecast or assess the welfare impact of a price change, interpreting patterns of purchases or browsing behavior, measuring technologies, or restaurant resurrection due to the pandemic result from causality. If we cannot identify the cause, there will be little prospect of identifying an effect. However, from a vast array of possible causal relationships, the task is to discern the relevant ones.

Equation 2 : Retail Agility Index (RAI):

$$RAI = \frac{(C \times A)}{B}$$

C = Cloud infrastructure scalability

A = Automation responsiveness

B = Big data analytics speed

4. Automation in Retail

The role of automation in the retail sector is changing. Traditionally an area of employment for many unskilled laborers, and still, to a certain extent, a substantial employer of low-skilled and part-time workers, retail has become a central site for the employment of big data and data analytics. Retailers are developing more precise models of consumer decision-making, able to more accurately predict consumer preferences. They are restructuring not just their organizational forms to respond, changing layouts and display arrangements in stores, as well as their training programs and feedback systems for staff. They are also able to anticipate sudden shortages or surpluses of particular goods or services, as well as unfulfilled customer demands before they emerge.

The development of these models requires substantial, enduring, and large-scale investments in big data and analytics. A retailer needs to gather data about the tastes and preferences of

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its current and potential customer bases. Not only that, but it has to use this data to tailor its marketing strategies, project future changes in demand and supply, forecast market changes, and facilitate customer responses to these changes. The interactions between automated checkouts, shelf stackers, and the rest of the shopping environment suggest an increasingly digitized and data-enabled world where the distinction between digital and physical becomes increasingly difficult to draw.

Fig 4 : AI in Retail Automation

4.1. Types and Examples

The Big Data in retail today is generated from a myriad of sources including customer transactions, social media, digital channels, and customer browsing behavior among others. This sector offers relevant models such as recommendation, personalization, as well as targeted and segmented marketing, among others. There are many examples of these at different levels of maturity in the market. The highlighted retail business processes are critical for the proper functioning of the new retail models and thus, Contemporary RDM is a critical enabler for the stochastic retail models. Here we provide a brief description of the models.

4.2. Impact on Operations

Headquarters and store operations are probably the fastest adopted use cases for data infrastructure, i.e., being able to consolidate and analyze data from various sources, evaluate impacts, and initiate execution of standard processes. The revolution is already underway, and intuition is being gradually replaced by data, which is being learned and generates continually updated repeatable models that estimate 'value at risk' and expected responses while ensuring we meet organizational objectives. Information operations start with a series of dashboards containing operational metrics organized according to the way stakeholders, from the CEO to store associates, reason and make decisions, each with specifications linked to the overall goals that must be ensured. The second stage is the implementation of layers of emerging technology services that allow a host of more focused operational applications deployed on a daily, weekly, or by-event basis. These are described as collaborative strategies

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that are not just about the alignment of the strategic and operational elements of the supply chain, but also about the coordination and orchestration of an intelligent global network that creates sourcing opportunities first, data from point of sale, shipment takeover accuracy, and associated actions or decision support. To complete this, a third type of application has already triggered warning shots in numbers with incoming competition. Synchronization of data and changes in data models, generation of public policies, estimation of national and local sales tax payments, monitoring of e-transport, tender neutral pricing, demand forecasting, and services associated with the precise itinerary of stores and employees.

5. Synergies and Interactions of Big Data, Cloud, and Automation in Retail

Big data, cloud, and automation are all crucial to the vision of future retailing. Their adoption and success are inextricably linked by profound synergies. The first is a pragmatic interaction that links big data and predictions about future states of behavior to the ongoing optimization of today's retail industry. Traditional retail and its supply chains are designed for an environment where most decisions and optimizations directly affect a market that will soon reach its heat death. By contrast, forward guidance on actions and their outcomes allows the retail industry to very tightly and centrally control its internal processes that, in turn, allow everything to be highly optimized and specialized. Retail is, in fact, a unique industry that combines the elements of a manufacturing facility with that of a storefront. We argue that forward and local issues will dominate the next decade. For all its value, there is limited need today for the automated optimization of general-purpose algorithms to provide real-time value.

By contrast, behavior and the very tight optimization that is the characteristic feature of retail become increasingly important. The emergence of precise estimations of future retailing casts concomitant waves of deployed AI from big data, the cloud, and automation. The fourth wave reinvents how we shop. It is all about adding physical shops to the apps that drive today's e-commerce. These new apps are much less general-purpose and more customized than previous versions as the great forward wave enables a nearly unlimited cornucopia of delightful purposeful activities. Through customization, these next-generation apps encourage specific positive human patterns that also happen to support a healthy living plan, which, of course, begins with a fully tailored shopping list to be ready to buy when the shops open next time. The clever and up-to-date retailer will then use this active store floor to attractively display and welcome the customer back.

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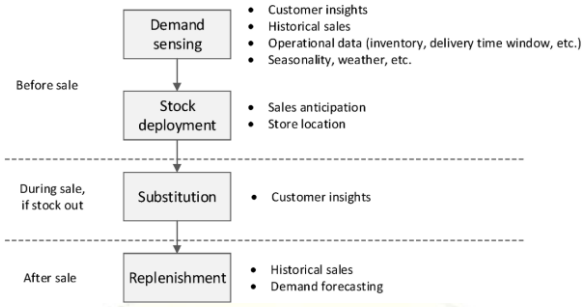

Fig 5 : Exploration of Big Data Practices in Retail Sector

5.1. Enhancing Customer Experience

Big data may be used to analyze consumer behavior patterns and enter into the same realm of customer behavior prediction that traditional service industries have. Such big service companies provide recommendations based on buying history from users and suggest books and music based on people's reactions to diverse offers. Anticipating customer behavior will allow such big retailers to better adjust stocks and schedules, thereby reducing operational and financial costs of overstock, obsolescence, and loss of sales due to stockouts. Moreover, they can improve the cross-section between purchases and clients' tastes and preferences, and thereafter make proper recommendations and suggestions. Such companies can benefit from employing countless types of value as indicators in constructs to make diverse automated offering decision processes possible to execute.

Traditional customer behavior profiles could also improve by adding components from consumers who search for several items across multiple shops, attaching items located in various locations. Big service shops could additionally foster competition with large stock companies that can often detect buyer tags before consumers check out.

5.2. Optimizing Supply Chain Management

Despite the obvious benefits to a business of reducing the inventory it carries and just-in-time delivery from the production process, many businesses still struggle to implement such systems. Real-time visibility over the entire value chain from suppliers to customers, built on a solid understanding of time-varying markets through the application of predictive analytics techniques, could become game-changing technologies. Such systems could allow better smoothing of production facilities, lower inventory levels, reduce waste associated with expiring stock, more targeted quality control, and modified delivery systems leading to reduced transportation and handling costs. Cost savings would, of course, also be passed to customers, hopefully in the form of lower prices. Task scheduling and geospatial routing problems associated with cloud-based inventory would be considerably reduced if supply chain patterns were inherently known or foreseeable.

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6. Future Trends and Implications

The retail industry is changing rapidly, driven in part by the rise of digital data, cloud-based digital infrastructure, and advanced data analytics. Online, through mobile and web-based interfaces, retailers are learning more about the individual purchasing habits of their consumers. In addition, digitization is accelerating inside the stores. These technologies and data can help traditional retailers compete effectively against pure-play online retail businesses that pose some of the main threats and, more broadly, to research from big data. We are at a point in time where new forms of value propositions and distribution channels are about to emerge for retail markets. This chapter looks at some of the key technology components driving this shift and describes some ways we might expect them to be used going forward.

There is general agreement among forecasters that the big data analytics market as a whole will continue to grow into the future, at a high compound annual growth rate greater than 10 to 15 percent per year. Depending on how we define "big data," forecasters predict this segment of the market will be worth between 20 and 40 billion dollars annually after 2020. These estimates do, however, assume a very high rate of technology adoption. Several barriers to achieving this strong rate of market expansion, including ongoing issues of data privacy and data security, as well as the far-from-trivial task of technology integration, exist. However, while adoption obstacles present significant barriers to the free flow of data between businesses, it is interesting that the retail industry, arguably the most advanced sector in terms of the use of big data and analytics, is somewhat insulated from these concerns compared with other industries.

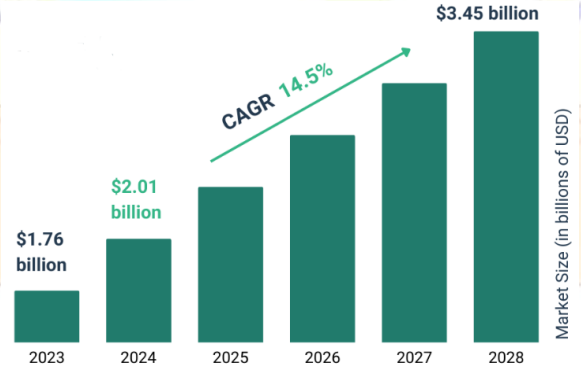

Fig 6 : Cloud Infrastructure Automation Software Market Report 2024

6.1. Emerging Technologies

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The newest technologies for big data processing used in retail are deep learning, blockchain, and 3D printing to support accurate and prompt demand-to-supply management. Deep learning especially supports automatic demand forecasting. This machine learning results in automatic data analysis, which in turn leads to faster and more fact-based decisions. Blockchain, based on digital records stored in a protected and shared ledger, provides major advantages, such as real-time traceability along the supply chain, transparency and immutability of product data, data identification, and a single and unique real-time version of truth. This means faster product recalls, better food safety audits using digitized data, identification of certified products, avoiding false discounts due to product theft, and real-time transactions at the checkout, which altogether make the management of errors and delays more straightforward and require much smaller buffer supplies.

The demand for fast but also personalized and unique products is fueling the growth of 3D printing and production on demand. This capability, which is supported by both new additive technologies and demand-driven virtualization tools, changes our understanding of transport pipelines and supply chain strategies. Retailers rapidly adapt to those trends by offering personalized products in stores—a new revenue stream for retailers who can combine valuable experiential services for luxury consumers. For these reasons, many investment opportunities in retail technologies can be found in additive manufacturing software and service suppliers, storage and logistics service providers, personalized product software developers, and producers of small plastic 3D printers.

Equation 3 : Consumer Experience Enhancement (CEE):

$$CEE = \frac{(B \times A)}{I}$$

B = Big data-driven customer insights

A = Automation in personalized services

I = Infrastructure flexibility

6.2. Ethical Considerations

As the use of big data increases, there is a growing requirement to ensure that the proper ethical procedures are in place to ensure that it does not lead to discrimination or bias. Lack of oversight could potentially lead to behaviors where customers are charged more for a product or service because data shows them to be willing to pay more, or refuse services to certain sections of the population, akin to digital redlining. To avoid such issues, clear data protection frameworks and oversight will be needed by the authorities. Representatives have revealed potential breaches of fair competition laws in retail, specifically in areas where retailers could use big data for personalization and thus reduce price transparency. The analysis suggests that there is an ongoing investigation in this area.

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