MAIMS JOURNAL OF MANAGEMENT

Volume 19, No. 1, March 2024 ISSN- 2249-0116

A Peer- Reviewed Journal of Maharaja Agrasen Institute of Management Studies

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MAIMS Journal of Management

Volume 19 **No.1** **March 2024** **ISSN 2249-0116**

"MAIMs Journal of Managment" is a bi-annual peer-reviewed journal of Maharaja Agrasen Intitute of Management Studies. The journal covers a wide range of issues in the field of management and commerce including finance, marketing, human resource, international business, information technology and other allied disciplines. All correspondence relating to the publication of the journal should be addressed to :

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MAIMS Journal of Management

Volume 19 **No.1** **March 2024** **ISSN 2249-0116**

STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS OF MAIMS JOURNAL OF MANAGEMENT

FORMS

(RULE 8)

1.	Printer's Name	:	**Dr. Nand Kishore Garg**
	Nationality	:	**India**
	Address	:	**Maharaja Agrasen Technical Education Society** 10/4, East Punjabi Bagh, New Delhi-II 0026
2.	Place of Publication	:	**Delhi**
3.	Perodicity of Publication	:	**Half Yearly**
4.	Publisher's Name	:	**Dr. Nand Kishore Garg**
	Nationality	:	**Indian**
	Address	:	**Maharaja Agrasen Technical Education Society** 10/4, East Punjabi Bagh, New Delhi-II 0026
5.	Editor-in-Chief's Name	:	**Prof. (Dr.) Rajni Malhotra Dhingra**
	Nationality	:	**Indian**
	Address	:	Maharaja Agrasen Institute of Management Studies Maharaja Agrasen Chowk, PSP Area Sector-22, Rohini, Delhi-II 0085
6.	Name and address of the individuals who own the newspaper and Partners or share-holders holding more than one percent of the total capital	:	**Founder Chairman & Chief Advisor** **Maharaja Agrasen Technical Education Society** 10/4, East Punjabi Bagh New Delhi 110026
7.	Printed at	:	Integrity Education Publishing New Delhi, India

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Convergence of Stock Spot and Futures Markets in India – An Evidence from Individual Securities

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Abstract

The study seeks to assess the convergence of spot and futures markets in India. The study uses spot and futures market closing data for analysing the study and to examine the long term relationship between the spot markets. Johenson co-integration test and Unit Root Test have been used for analysis. The study found that there was an existence of long run relationship between the two markets for the period of the study during the calendar year 2010 to 2019. The study also explicated that futures markets were having more returns than spot markets.

Keywords: Spot, Futures, Unit Root Test, Johansen Co-integration Test

JEl Classification Code: G1, G14

Introduction

Derivatives Market (DM)

As financial instruments, derivati-ves have become extremely popular over the last two decades. While the practice of using derivatives instruments has been there even centuries, the formal application of these instruments in day by day financial management came out only in recent decades (Parasuraman, 2011)

The markets for derivatives have been growing at a exceptional pace. The variety of derivatives in terms of nature of products as well as underlying asset too has extended deeply (Srivastava, 2010). Derivatives described that the financial markets have produced their own technique for offering assurance against financial defeat in the form of agreements. The derivative is a financial tool whose worth is derived since the price for further essential benefits known as underlying (Gurusamy and Jain, 2009).

Derivatives in India

The Indian market trades on various classes of securities in both Exchange Traded and Over the Counter Derivatives, including

equity, debt commodities and currencies, etc. The derivative exchange market com-prises where people can trade through exchange in standardized contracts. In India, National Stock Exchange (NSE), Bombay Stock Exchange (BSE), Multi Commodity Exchanges (MCX) and National Commodity and Derivatives Exchange (NCDEX) are the traded securities (Gurusamy and Jain, 2009).

Spot Markets (SM)

A spot market is a cash market is where the financial instruments are traded which can be settled immediately. Stocks and currencies are the nearly every person known as spot market instruments. In spot market, the right of an asset can transfer immediately once the buying and selling transaction has done (Gurusamy and Jain, 2009).

A spot market or cash market is a consign of financial instruments like securities and commodities which include agriculture product or value immediate delivery. In a spot market, there are sections like equity and debts. Equities like shares can be traded. Debts like government bonds and mortgage bonds can be traded.

1. This can be traded in an Over the Counter or an exchange. It is a place for buying and selling the securities or other financial instruments for the general public, or government or even firms. The exchange can be BSE and NSE or Commodity Exchange or Foreign Exchange. Without the help of exchange, the trade can be done between two parties is Over the Counter (Spot Market).[Retrieved from https:// tradingsim. com/ blog/ 6-key-differences-spot-market-futures-market/ on August 2018 (21)]

Future Market (FM)

FM means where participants the buying and selling the contracts can be delivered on a specified date in the future. In FM, there are different types of instruments presents like stock indexes, currencies, selected stocks and commodities. FM contracts are focus on underlying C market instruments (Lazar, 2012)

Stock Futures (F)

Stock F contracts on individual stocks are traded in F. In India, the stock future trading introduced in November 2000. F stock contract is a contract to buy or sell a given company's assumed number of shares at a particular price at an assured future date. Stock F is mostly settled with cash however physical delivery of stock is not allowed. The stock F are traded in NSE and BSE(Gurusamy and Jain, 2009).

Convergence of Spot and Future Market

The FP and SP must converge at the maturity date and irrespective of market is regular standard or reversed. Today's FP is expected SP on the maturity date. The relationship between the SP and FP denoted as S_1. In short, the value of FP agreement will be equal to SP contract with adding the net cost sustained in delivering the asset till the date of maturity of F contract. These may perform under two categories viz. cost of carry model and expectancy model (Srivastava, 2010)

FP = SP + Cost of Carry r – Benefits of ownership d

Cost of carry = Interest cost of stock index/ financial asset

For discrete compounding

$$F = S(1 + r/m)^{mt}$$

For continuous compounding

$$F = S_e^{(r-d)t}$$

Where, r is the annual interest of rate, number of compounding intervals per annum, d dividend yield, t time of maturity in years

Generally the SP is less than the FP. This can be stated as 'Contango' and the position of FP is lower than the SP it can be stated as 'Backwardation'. Contango is common for non-perishable goods with some significant storage cost. On the other side, the situation of the price of S exceeds the price of F, there is backwardation. But, in either situation, the FP is finally converging with the current market price (Gursamy and Jain, 2009). The difference between FP and SP is called basis. At the time of maturity, it reduces with time and becomes zero i.e. SP and FP must converge (Srivastava, 2010)

In addition, at the end the FP must converge with the SP. The FP is normally higher than the SP, we can call it "Contango". Contango means the premium avail for holding an asset. Where the FP is smaller than the SP, we can call it as "Backwardation". Backwardation means discount for holding an asset (Varma, 2008).

Review of Literature

Background Reviews for Spot and Future (S&F) Markets

The assumption of asymmetry that fundamental has been using high to low return as a proxy for extreme intraday price changes. The Finnish option markets having scope for setting the process and by the means of increasing the possibility of the Finnish F market (Both *et al*., 1997). The FM performance is positively guaranteed (Rojer, 1997). The relationship found between chance of arbitrage and the dimension of the bid ask spread in the F and Options (O) markets (Bae *et al.*, 1998). The linear lead lag correlation continues following the return series were used for volatility persistence (Abhayankar, 1998).

Stock Index Future (SIF) and Cash Markets (CM) across has dealt with the costs and price discovery. Index Future (IF) contracts have the peak predictive power (Minho *et al*., 1999). Australian price index FM by using 5 minutes intraday information of S&F from Australian Derivatives Exchange and found that increased volatility in Future Prices (FP) (Tarkington and Walsh, 1999). The apparent mis-pricing could rise because of inadequacies in the cost of carry model in determining theoretical FP(Gerald and Dae, 1999).

The permanent transitory component composition with all parameters statistically significant high frequency returns data for alternative assets (Alan, 2000). The International equity market had the German market mostly establish the random walk mechanism of international price of firms all along with the self-governing responsibility of shocks in exchange rate to price influence in derivatives market (Joachim *et al*., 2000).

The evidence for intraday inefficiencies is consistent with traders' actions, however it's also possible that there are additional variations (Laurance *et al.*, 2001). A strong multi-directional influences among Australia, New Zealand and Sydney markets. The volatilities of return in markets are varying in time and the Volatility (V) across the series

are extremely simultaneous in over the time period (Sang, 2001).

F and underlying index are having pricing relationship on tracking the stock. The results revealed that positive relationship exists between F trading and the number of FP boundary violations frequently (Alexander and Donnis, 2002). The study found S&PDR's and S&P 500 index F are having a positive relationship (Quentin and Wen, 2002). The introduction of Mexico FM have a positive response in price discovery (Mason and Rafael, 2003). The FM might be utilized as Price Discovery (PD) and that is specified a significant position of F in Greek capital markets (Dimitris, 2004).

The variation in the S&F markets differs slightly with F returns showed marginally higher variance (Bose, 2007). The unpredicted F trading signifying when the FM include the entrance of latest information, the Spot (S) amount leads the greater Spot Price (SP) fluctuations (Illueca and Lafuente, 2007). The F&C markets have a strong as well as stable relationship (Gupta and Singh, 2008)

Volume of trading, time execution and lower volatility period were frequently confines to large amount of arbitrage opportunities (Nivine *et al.,* 2008). FM plays a PD role, involved that FP contains expensive information in relation to SP. The FM are further informally resourceful than Greece market underlying stock (Floros and Vougas, 2008). The FM leads the SM for Nifty. The Nifty F acts as a PD for underlying stock price. Trading in FM gives an additional profits to the market participants (Singh and Agarwal, 2009).

The Indian equity FM observes the new information and flows the information immediately when compared to SM(Gupta and Singh, 2009). The dominance of individual investors in the FM leads PD took place in SM mostly (Martin *et al*., 2010). There is an evidence of lead lag relationship in Multi commodity Exchange in India and the study found there is an affiliation between spot and futures market in India (Shobana *et al*., (2012). The hedging effectiveness is lower in majority of the commodities during the study period (Agarwal *et al*., 2014).

The spot and Futures markets are having significant impact on prices of two markets. Moreover, the study also revealed that there is a positive relationship between both the markets. This shows that the spot and futures are interrelated with each other (Ram, 2017). Both the markets are having an efficient convergence in physical delivery and persistence of contracts however related to cash settled single stock futures (Lazar and Jahira, 2019). The information of futures market is transmitted to spot market through arbitrageurs. Hence, the futures market confirms the direction on spot futures (Ameur *et al*., 2022).

The price discoveries of soybean options in China are having stable in tend and it increases gradually. Although, the study found that the significantly the price discovery ability will get fall after the main delivery of contract in quickly(Hao *et al*., 2021).The process of price discovery function is self-organised process and the investors are utilising the market trade with maximum intention. The trading behaviours are generated through pricing. Both the spot and futures prices are converging and getting

the stable state (Gong et al., 2021).

The futures market leads the spot market in bidirectional response between two markets. The futures market statistics is communicatingto spot market. Hence, the futures market confirms the trendh appening in spot futures (Ameur *et al*., 2022). The futures and spot markets are positively correlated with the output gap. The predictors are significant not only statistically and also economically in case of spot and futures returns. Hence the study confirms the same signs and magnitude (Jian and Sang, 2022). Nifty spot and futures markets are co-integrated and also having bidirectional casual relationship. Futures markets plays a superior role in price discovery process. The spot and futures markets are having two-way volatility spill over during COVID-19 (Khan *et al*., 2022).

Objective of the Study

To find out the convergence of the single stock F and the underlying cash (CM) (spot) markets in India.

- To examine the relationship between the S&F markets of individual securities in National Stock Exchange.

Hypotheses

H_0^1: There is no relationship exists between S&F markets in India

1 Sub Hypotheses Developed for Top Companies

- H_0^{1a}: There is no relationship exists between S&F markets in Indian Top Companies of Natio-nal Stock Exchange.
- H_0^{1b}: There is no relationship exists between S&F markets in Indian Middle Companies of National Stock Exchange.
- H_0^{1c}: There is no relationship exists between S&F markets in Indian Bottom Companies of National Stock Exchange.

Research Methodology

The Data and the Analytical Tools

The study of convergence of spot and futures market is entirely based on secondary data. The monthly closing price of Spot and Futures Market are taken from NSE and Bloomberg website. The study has taken 10 years of monthly closing price form January 2010 to December 2019. In India, while consi-dering the futures market there are about 382 securities are traded in the market. Whereas, the study has having 113 complete data based on futures market, the study has taken a spot market data. In case of taking data in Spot market, the study has having only 86 full-fledged data. Accordingly, the study has taken 86 individual securities traded in both the S&Fmarkets in NSE for the period of 10 years' calendar period from January 2010 to December 2019. After collecting the data, the companies are categorised based on the turnover of the individual companies traded in both S&F markets in National Stock Exchange. The analysis of the study has categorised into three parts namely top, middle and bottom companies. The top and middle companies are having 29 individual securities. And the bottom companies are having 28 individual securities respectively.

The following statistical and econo-metrics tools have been used to find out the convergence of S&F markets in India.

1. Unit Root Test (Augmented Dickey-Fuller Test and Phillips-Perron Test) has been applied to examine the stationary for data arrangement.
2. Johansen Co-integration Test was applied to find out the long term relationship between the *S&F* markets.

Limitations of the Study

- The study is limited to 10 years data i.e. from January 2010 to December 2019 over the duration of 10 calendar years. The study has considered monthly data for the analysis during the study period.
- The study purely is based on the secondary data in nature. The secondary data has been collected through the Bloomberg and www.nseindia.com.
- The sample size of the study has been confined to the 86 firms which are traded in Stock and *F* markets in India.

The study has taken data only before the COVID-19

List of Individual Securities Traded in both S&F Markets in India

Top Companies		
Sl. No.	**Name of Securities**	**Abbreviations**
1	State Bank of India	SBIN
2	Reliance Industries Limited	RELIANCE
3	ICICI Bank Limited	ICICIBANK
4	Tata Steel Limited	TATASTEEL
5	Tata Motors Limited	TATAMOTORS
6	Axis Bank Limited	AXISBANK
7	Larson And Tourbo Limited	LT
8	Reliance Capital Limited	RELCAPITAL
9	Maruti Suzuki India Limited	MARUTI
10	Yes Bank Limited	YESBANK
11	DLF Limited	DLF
12	HDFC Bank Limited	HDFCBANK
13	Reliance Infrastructure Limited	RELINFRA
14	Hindalco Industries Limited	HINDALCO
15	JSW Steel Limited	JSWSTEEL
16	Housing Development Finance Corporation Limited	HDFC
17	Tata Consultancy Services Limited	TCS
18	Bharti Airtel Limited	BHARTIARTL
19	Punjab National Bank	PNB
20	Sun Pharmaceutical Industries Limited	SUNPHARMA
21	Reliance Communications Limited	RCOM
22	Aurobindo Pharma Limited	AUROPHARMA

23	ITC Limited	ITC
24	Jindal Steel And Power Limited	JINDALSTEL
25	Mahindra And Mahindra Limited	M&M
26	Bank of Baroda Limited	BANKBARODA
27	Kotak Mahindra Bank Limited	KOTAKBANK
28	Canara Bank	CANBK
29	Bharat Heavy Electricals Limited	BHEL
Middle Companies		
Sl. No.	**Name of Securities**	**Abbreviations**
1	Ashok Leyland Limited	ASHOKLEY
2	Jai Prakash Associates Limited	JPASSOCIAT
3	LIC Housing Finance Limited	LICHSGFIN
4	IDFC Limited	IDFC
5	Titan Company Limited	TITAN
6	Century Textiles And Industries Limited	CENTURYTEX
7	Hindustan Petroleum Corporation Limited	HINDPETRO
8	Lupin Limited	LUPIN
9	Oil And Natural Gas Corporation Limited	ONGC
10	Bharat Petroleum Corporation Limited	BPCL
11	Hindustan Unilever Limited	HINDUNILVR
12	Dr. Reddy's Laboratories Limited	DRREDDY
13	Sun TV Network Limited	SUNTV
14	Bank Of India Limited	BANKINDIA
15	Steel Authority of India Limited	SAIL
16	Tech Mahindra Limited	TECHM
17	Idea Cellular Limited	IDEA
18	HCL Technologies Limited	HCLTECH
19	Cipla Limited	CIPLA
20	Biocon Limited	BIOCON
21	Rural Electrification Corporation Limited	RECLTD
22	Bharat Forge Limited	BHARATFORG
23	Voltas Limited	VOLTAS
24	Union Bank Of India	UNIONBANK
25	Indian Oil Corporation Limited	IOC
26	IFCI Limited	IFCI
27	Gail (India) Limited	GAIL
28	The Federal Bank Limited	FEDERALBNK
29	IDBI Bank Limited	IDBI

Bottom Companies		
Sl. No.	**Name of Securities**	**Abbreviations**
1	Power Finance Corporation Limited	PFC
2	NTPC Limited	NTPC
3	ACC Limited	ACC
4	Reliance Power Limited	RPOWER
5	Asian Paints Limited	ASIANPAINT
6	The India Cements Limited	INDIACEM
7	Wipro Limited	WIPRO
8	Divi's Laboratories Limited	DIVISLAB
9	Grasim Industries Limited	GRASIM
10	Zee Entertainment Enterprises Limited	ZEEL
11	Oriental Bank of Commerce	ORIENTBANK
12	Ultra Tech Cement Limited	ULTRACEMCO
13	Ambuja Cements Limited	AMBUJACEM
14	GMR Infrastructure Limited	GMRINFRA
15	Power Grid Corporation of India Limited	POWERGRID
16	Tata Communications Limited	TATACOMM
17	Dish TV India Limited	DISHTV
18	Tata Chemicals Limited	TATACHEM
19	Petronet LNG Limited	PETRONET
20	Hindustan Zinc Limited	HINDZINC
21	Allahabad Bank	ALBK
22	The Tata Power Company Limited	TATAPOWER
23	Syndicate Bank	SYNDIBANK
24	CESC Limited	CESC
25	Siemens Limited	SIEMENS
26	Dabur India Limited	DABUR
27	Colgate Palmolive (India) Limited	COLPAL
28	Oracle Financial Services Software Limited	OFSS

Source: Compiled Data from www.NSE.com

Results and Discussion

Table 1:

Results of Augmented Dickey-Fuller Test and Phillips-Perron Test for Top Companies

Companies	ADF Test		PP Test	
	At Level	1st Difference	At Level	1st Difference
SBINS	0.021**	---	0.018**	---
SBINF	0.600	0.000***	0.606	0.000***
RELIANCES	0.973	0.000***	0.682	0.000***
RELIANCEF	0.048**	---	0.049**	---
ICICIBANKS	0.334	0.000***	0.380	0.000***
ICICIBANKF	0.282	0.000***	0.321	0.000***
TATASTEELS	0.106	0.000***	0.067*	---
TATASTEELF	0.146	0.000***	0.146	0.000***
TATAMOTORS	0.286	0.000***	0.289	0.000***
TATAMOTORF	0.437	0.000***	0.226	0.000***
AXISBANKS	0.835	0.000***	0.824	0.000***
AXISBANKF	0.122	0.000***	0.172	0.000***
LTS	0.181	0.000***	0.071*	---
LTF	0.011**	---	0.009***	---
RELCAPITALS	0.101	0.000***	0.088*	---
RELCAPITALF	0.083*	---	0.099*	---
MARUTIS	0.914	0.000***	0.868	0.000***
MARUTIF	0.916	0.000***	0.922	0.000***
YESBANKS	0.368	0.000***	0.011**	---
YESBANKF	0.245	0.000***	0.237	0.000***
DLFS	0.113	0.000***	0.108	0.000***
DLFF	0.082*	---	0.097*	---
HDFCBANKS	0.991	0.000***	0.996	0.000***
HDFCBANKF	0.454	0.000***	0.461	0.000***
RELINFRAS	0.372	0.000***	0.312	0.000***
RELINFRAF	0.375	0.000***	0.361	0.000***
HINDALCOS	0.201	0.000***	0.144	0.000***
HINDALCOF	0.304	0.000***	0.269	0.000***
JSWSTELS	0.862	0.000***	0.836	0.000***
JSWSTELF	0.155	0.000***	0.098*	---
HDFCS	0.955	0.000***	0.925	0.000***

HDFCF	0.238	0.000***	0.270	0.000***
TCSS	0.957	0.000***	0.950	0.000***
TCSF	0.425	0.000***	0.423	0.000***
BHARTIARTLS	0.006***	---	0.004***	---
BHARTIARTLF	0.005***	---	0.010***	---
PNBS	0.000***	---	0.000***	---
PNBF	0.650	0.000***	0.670	0.000***
SUNPHARMAS	0.503	0.000***	0.519	0.000***
SUNPHARMAF	0.072*	---	0.104	0.000***
RCOMS	0.036**	---	0.493	0.000***
RCOMF	0.150	0.000***	0.197	0.000***
AUROPHARMAS	0.874	0.000***	0.878	0.000***
AUROPHARMAF	0.874	0.000***	0.878	0.000***
ITCS	0.483	0.000***	0.496	0.000***
ITCF	0.128	0.000***	0.185	0.000***
JINDALSTEELS	0.766	0.000***	0.663	0.000***
JINDALSTEELF	0.023**	---	0.028**	---
M&MS	0.236	0.000***	0.237	0.000***
M&MF	0.087*	---	0.088*	---
BANKBARODAS	0.006***	---	0.007***	---
BANKBAORDAF	0.464	0.000***	0.464	0.000***
KOTAKBANKS	0.985	0.000***	0.997	0.000***
KOTAKBANKF	0.343	0.000***	0.286	0.000***
CANBKS	0.169	0.000***	0.124	0.000***
CANBKF	0.218	0.000***	0.184	0.000***
BHELS	0.700	0.000***	0.750	0.000***
BHELF	0.747	0.000***	0.719	0.000***

******, ** and * denotes significance level at 1%, 5% and 10% respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

Table 1 shows the result of Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test. From the table the ADF results showed that the BHAR-TIARTLS, BHARTIARTLF, PNBS and BANKBAR-ODAS are having a stationarity at level with 1% level of significance. Whereas, SBINS, RELIA-NCEF, LTF, RCOMS and JINDAL STEELF are having a stationarity at level with a 5% level of significance. RELCAPITALF, DLFF, SUNPHA-RMAF and M&MF are having a stationarity at level with a 10% level of significance.

SBINF, RELIANCES, ICICIBANKS, ICICIBANKF, TATASTEELS, TATAS-TEELF, TATAMOTORSS, TATAMOTORSF, AXIS-BANKS, AXISBANKF, LTS, RELCAPITALS, MARUTIS, MARUTIF, YESBANKS, YES-BANKF, DLFS, HDFCBANKS, HDFCBANKF, RELIN-FRAS, RELINFRAF, HINDALCOS, HINDALCOF, JSWSTEELS, JSWSTEELF, HDFCS, HDFCF, TCSS, TCSF, PNBF, SUNPHARMAS, RCOMF, AUROPHA-RMAS, AUROPHARMAF, ITCS, ITCF, JINDALSTELS, M&MS, BANKBARODAF, KOTAKBANKS, KOTAKBANKF, CANBKS, CANBKF, BHELS and BHELF are having a stationarity at first difference with 1% level of significance.

PP Test result shows that the LTF, BHARTIARTLS, BHARTIARTLF, PNBS and BANKBARODAS are having a stationarity at level with 1% level of significance. SBINS, RELIANCEF, YESBANKS and JINDALSTELF are having a stationarity at level with 5% level of significance. TATASTEELS, LTS, RELCAPITALS, RELCAPITALF, DLFF, JSWSTEELF and M&MF are having a stationarity at level with 10% level of significance.

SBINF, RELIANCES, ICICIBANKS, ICICIBANKF, TATASTEELF, TATAMO-TORSS, TATAMOTORF, AXISBANKS, AXISBANKF, MARUTIS, MARUTIF, YESBANKF, DLFS, HDFCBANKS, HDFC-BANKF, RELINFRAS, RELINFRAF, HINDALCOS, HINDAL-COF, JSWSTEELS, HDFCS, HDFCF, TCSS, TCSF, PNBF, SUNPHA- RMAS, SUNPHAR-MAF, RCOMS, RCOMF, AUROPHARMAS, AURO-PHARMAF, ITCS, ITCF, JINDAL STELS, M&MS, BANKBARODAF, KOTAKBANKS, KOTAKBANKF, CANBKS, CANBKF, BHELS and BHELF are having a stationarity at first difference with 1% level of significance.

From the above table, all the 29 top companies are having a stationarity on both S&F. As a result of this, the study executes a further analysis of S&F markets in Indian National Stock Exchange.

Table 2:
Results of Augmented Dickey-Fuller Test and Phillips-Perron Test for Middle Companies

Companies	ADF Test		PP Test	
	At Level	1st Difference	At Level	1st Difference
ASHOKLEYS	0.668	0.000***	0.651	0.000***
ASHOKLEYF	0.704	0.000***	0.662	0.000***
JPASSOCIATS	0.669	0.000***	0.628	0.000***
JPASSOCIATF	0.508	0.000***	0.492	0.000***
LICHSGFINS	0.443	0.000***	0.452	0.000***
LICHSGFINF	0.025**	---	0.097*	---
IDFCS	0.033**	---	0.014***	---
IDFCF	0.562	0.000***	0.466	0.000***
TITANS	0.991	0.000***	0.992	0.000***
TITANF	0.214	0.000***	0.212	0.000***
CENTURYTEXS	0.590	0.000***	0.586	0.000***
CENTURYTEXF	0.546	0.000***	0.559	0.000***
HINDPETROS	0.410	0.000***	0.003***	---
HINDPETROF	0.157	0.000***	0.232	0.000***
LUPINS	0.521	0.000***	0.527	0.000***
LUPINF	0.290	0.000***	0.283	0.000***
ONGCS	0.015**	---	0.006***	---
ONGCF	0.578	0.000***	0.496	0.000***
BPCLS	0.794	0.000***	0.764	0.000***
BPCLF	0.189	0.000***	0.206	0.000***
HINDUNILVRS	0.999	0.000***	0.999	0.000***
HINDUNILVRF	0.999	0.000***	1.000	0.000***
DRREDDYS	0.231	0.000***	0.231	0.000***

DRREDDYF	0.317	0.000***	0.323	0.000***
SUNTVS	0.337	0.000***	0.337	0.000***
SUNTVF	0.415	0.000***	0.418	0.000***
BANKINDIAS	0.624	0.000***	0.627	0.000***
BANKINDIAF	0.579	0.000***	0.652	0.000***
SAILS	0.635	0.000***	0.623	0.000***
SAILF	0.645	0.000***	0.639	0.000***
TECHMS	0.829	0.000***	0.791	0.000***
TECHMF	0.215	0.000***	0.173	0.000***
IDEAS	0.463	0.000***	0.511	0.000***
IDEAF	0.553	0.000***	0.577	0.000***
HCLTECHS	0.762	0.000***	0.784	0.000***
HCLTECHF	0.311	0.000***	0.355	0.000***
CIPLAS	0.292	0.000***	0.301	0.000***
CIPLAF	0.338	0.000***	0.340	0.000***
BIOCONS	0.996	0.000***	0.996	0.000***
BIOCONF	0.277	0.000***	0.184	0.000***
RECLTDS	0.026**	---	0.026**	---
RECLTDF	0.160	0.000***	0.142	0.000***
BHARATFORGS	0.557	0.000***	0.011***	---
BHARATFORGF	0.495	0.000***	0.430	0.000***
VOLTASS	0.865	0.000***	0.881	0.000***
VOLTASF	0.886	0.000***	0.902	0.000***
UNIONBANKS	0.500	0.000***	0.466	0.000***
UNIONBANKF	0.557	0.000***	0.545	0.000***
IOCS	0.066*	---	0.195	0.000***
IOCF	0.059*	---	0.063*	---
IFCIS	0.297	0.000***	0.297	0.000***
IFCIF	0.325	0.000***	0.325	0.000***
GAILS	0.300	0.000***	0.318	0.000***

GAILF	0.012**	---	0.012**	---
FEDERALBNKS	0.499	0.000***	0.499	0.000***
FEDERALBNKF	0.727	0.000***	0.652	0.000***
IDBIS	0.202	0.000***	0.197	0.000***
IDBIF	0.211	0.000***	0.246	0.000***

******, ** and * denote significance levels at 1%, 5% and 10%, respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

Table 2 shows the outcome of ADF Test of Middle Companies. The companies LICHS-GFINF, IDFCS, ONGCS, RECLTDS and GAILF are having a stationarity at level with 5% level of significance. The companies IOCS and IOCF are stationarity at level with 10% level of significance.

The companies ASHOKLEYS, ASHOKLEYF, JPASSOCIATS, JPASSO-CIATF, LICSGFINS, IDFCF, TITANS, TITANF, CENTURYTEXS, CENTURYTEXF, HINDPETROS, HINDPE-TROF, LUPINS, LUPINF, ONGCF, BPCLS, BPCLF, HINDUNILVRS, HINDUNILVRF, DRRED-DYS, DRREDDYF, SUNTVS, SUNTVF, BANKINDIAS, BANKINDIAF, SAILS, SAILF, TECHMS, TECHMF, IDEAS, IDEAF, HCLTECHS, HCLTECHF, CIPLAS, CIPLAF, BIOCONS, BIOCONF, RECLTDF, BHARATFORGS, BHARATFORGF, VOL-TASS, VOLTASF, UNIONBANKS, UNIONBANKF, IFCIS, IFCIF, GAILS, FEDERALBNKS, FEDERALBNKF, IDBIS and IDBIF are having a stationarity at first difference with 1% level of significance.

Phillips-Perron Test result dep-icts that the IDFCS, HINDPETROS, ONGCS and BHARATFORGS are having a stationarity at level with 1% level of significance. Similarly, RECLTDS and GAILF are having a stationarity at level with 5% level of significance. And, the companies LICSGFINF and IOCF are having a stationarity at level with 10% level of significance.

ASHOKLEYS, ASHOKLEYF, JPASSOCIATS, JPASSOCIATF, LICSGFINS, IDFCF, TITANS, TITANF, CENTURYTEXS, CENTURYTEXF, HINDPETROF, LUPINS, LUPINF, ONGCF, BPCLS, BPCLF, HINDUNILVRS, HINDUNILVRF, DRRE-DDYS, DRREDDYF, SUNTVS, SUNTVF, BANKINDIAS, BANKINDIAF, SAILS, SAILF, TECHMS, TECHMF, IDEAS, IDEAF, HCLTECHS, HCLTECHF, CIPLAS, CIPLAF, BIOCONS, BIOCONF, RECLTDF, BHARATFORGF, VOLTASS, VOLTASF, UNIONBANKS, UNIONBANKF, IOCS, IFCIS, IFCIF, GAILS, FEDERALBNKS, FEDERALBNKF, IDBIS and IDBIF are the companies having stationarity at first difference with 1% level of significance.

Table 3:

Results of Augmented Dickey-Fuller Test and Phillips-Perron Test for Bottom Companies

Companies	ADF Test		PP Test	
	At Level	1st Difference	At Level	1st Difference
PFCS	0.002***	---	0.001***	---
PFCF	0.439	0.000***	0.407	0.000***
NTPCS	0.084*	---	0.229	0.000***
NTPCF	0.164	0.000***	0.272	0.000***
ACCS	0.073*	---	0.065*	---
ACCF	0.108	0.000***	0.137	0.000***
RPOWERS	0.664	0.000***	0.664	0.000***
RPOWERF	0.815	0.000***	0.703	0.000***
ASIANPAINTS	0.961	0.000***	0.998	0.000***
ASIANPAINTF	0.338	0.000***	0.320	0.000***
INDIACEMS	0.235	0.000***	0.249	0.000***
INDIACEMF	0.186	0.000***	0.186	0.000***
WIPROS	0.010***	---	0.020**	---
WIPROF	0.100	0.000***	0.111	0.000***
DIVISLABS	0.924	0.000***	0.877	0.000***
DIVISLABF	0.145	0.000***	0.172	0.000***
GRASIMS	0.026**	---	0.000***	---
GRASIMF	0.216	0.000***	0.205	0.000***
ZEELS	0.574	0.000***	0.574	0.000***
ZEELF	0.714	0.000***	0.719	0.000***
ORIENTBANKS	0.443	0.000***	0.365	0.000***

ORIENTBANKF	0.475	0.000***	0.412	0.000***
ULTRACEMCOS	0.740	0.000***	0.674	0.000***
ULTRACEMCOF	0.747	0.000***	0.814	0.000***
AMBUJACEMS	0.152	0.000***	0.162	0.000***
AMBUJACEMF	0.249	0.000***	0.294	0.000***
GMRINFRAS	0.590	0.000***	0.606	0.000***
GMRINFRAF	0.294	0.000***	0.236	0.000***
POWERGRIDS	0.696	0.000***	0.770	0.000***
POWERGRIDF	0.683	0.000***	0.735	0.000***
TATACOMMS	0.717	0.000***	0.717	0.000***
TATACOMMF	0.669	0.000***	0.667	0.000***
DISHTVS	0.275	0.000***	0.247	0.000***
DISHTVF	0.152	0.000***	0.161	0.000***
TATACHEMS	0.630	0.000***	0.663	0.000***
TATACHEMF	0.711	0.000***	0.773	0.000***
PETRONETS	0.922	0.000***	0.922	0.000***
PETRONETF	0.314	0.000***	0.336	0.000***
HINDZINCS	0.544	0.000***	0.544	0.000***
HINDZINCF	0.340	0.000***	0.310	0.000***
ALBKS	0.475	0.000***	0.475	0.000***
ALBKF	0.501	0.000***	0.494	0.000***
TATAPOWERS	0.548	0.000***	0.275	0.000***
TATAPOWERF	0.695	0.000***	0.629	0.000***
SYNDIBANKS	0.283	0.000***	0.147	0.000***
SYNDIBANKF	0.208	0.000***	0.229	0.000***
CESCS	0.588	0.000***	0.553	0.000***

CESCF	0.628	0.000***	0.597	0.000***
SIEMENSS	0.157	0.000***	0.153	0.000***
SIEMENSF	0.272	0.000***	0.269	0.000***
DABURS	0.994	0.000***	0.997	0.000***
DABURF	0.916	0.000***	0.916	0.000***
COLPALS	0.849	0.000***	0.915	0.000***
COLPALF	0.204	0.000***	0.187	0.000***
OFSSS	0.088*	---	0.088*	---
OFSSF	0.053*	---	0.048*	---

******, ** and * denote significance levels at 1%, 5% and 10%, respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

Table 3 revealed the result of ADF Test and PP Test for Bottom Companies. From the table the Augmented Dickey-Fuller Test result shows that the PFCS and WIPROS are having a stationarity at level with 1% level of significance. GRASIMS having a stationarity at 5% level of significance. NTPCS, ACCS, OFSSS and OFSSF are having stationarity at level with 10% level of significance.

PFCF, NTPCF, ACCF, RPOWERS, RPOWERF, ASIANPAINTS, ASIANPAINTF, INDIACEMS, INDIACEMF, WIPROF, DIVISLABS, DIVISLABF, GRASIMF, ZEELS, ZEELF, ORIENTBANKS, ORIENTBANKF, ULTRACE-MCOS, ULTRACEMCOF, AMB-UJA-CEMS, AMBUJACEMF, GMRIN-FRAS, GMRINFRAF, POWERGRIDS, POWE-RGRIDF, TATACOMMS, TATA-COMMF, DISHTVS, DISHTVF, TATACHEMS, TATACHEMF, PETRONETS, PETRONETF, HINDZINCS, HINDZINCF, ALBKS, ALBKF, TATAPOWERS, TATAPOWERF, SYNDIBANKS, SYNDIBANKF, CESCS, CESCF, SIEMENSS, SIEMENSF, DABURS, DABURF, COLPALS and COLPALF are having a stationarity with 1% level of significance at first difference.

Phillips-Perron Test result shows that the PFCS and GRASIMS are having a stationarity at level with 1% level of significance. WIPROS are having a stationarity at level with 5% level of significance. ACCS, OFSSS and OFSSF are having a stationarity at level with 10% level of significance.

PFCF, NTPCS, NTPCF, ACCF, RPOWERS, RPOWERF, ASIANPAINTS, ASIAN-PAINTF, INDIACEMS, INDIACEMF, WIPROF, DIVISLABS, DIVISLABF, GRASIMF, ZEELS, ZEELF, ORIENTBANKS, ORIENTBANKF, ULTRACEMCOS, ULTR-ACEMCOF, AMBUJACEMS, AMBUJACEMF, GMRINFRAS, GMRINFRAF, POWER-GRIDS, POWER-GRIDF, TATACOMMS, TATACO-MMF, DISHTVS, DISHTVF, TATACHEMS, TATA-CHEMF, PETRONETS, PETRONETF, HINDZINCS, HINDZINCF, ALBKS, ALBKF, TATAPOWERS,

TATAPOWERF, SYNDI-BANKS, SYNDI-BANKF, CESCS, CESCF, SIEME-NSS, SIEMENSF, DABURS, DABURF, COLPALS and COLPALF are having a stationarity with 1% level of significance at first difference.

From the above table, all the 28 companies are having a stationarity on both S&F markets in India. As a result of this, the study proceeds the further analysis of S&F markets in National Stock Exchange.

Analysis of Johanson Co-integration Test

Table 4:

Result of Johansen Co-Integration Test for Top Companies

Companies	Hypothesized No. of CE(s)	Eigen Value	Trace Test		Maximum Eigen Value Test	
			T Test	P Value	T Test	P Value
SBIN	0	0.095736	12.29279	0.143	11.57287	0.127
	1	0.006241	0.719917	0.396	0.719917	0.396
RELIANCE	0	0.092847	13.52668	0.096*	11.20612	0.144
	1	0.019977	2.320555	0.127	2.320555	0.127
ICICIBANK	0	0.101897	12.43188	0.137	12.35905	0.097*
	1	0.000633	0.072830	0.787	0.072830	0.787
TATASTEEL	0	0.116886	19.95324	0.009***	14.29467	0.049**
	1	0.048014	5.658568	0.017**	5.658568	0.017**
TATAMOTORS	0	0.076340	12.24637	0.145	9.132334	0.275
	1	0.026715	3.114041	0.077*	3.114041	0.077*
AXISBANK	0	0.118929	14.69234	0.065*	14.56096	0.044**
	1	0.001142	0.131377	0.717	0.131377	0.717
LT	0	0.115804	14.34757	0.073*	14.15384	0.052*
	1	0.001683	0.193726	0.659	0.193726	0.659
RELCAPITAL	0	0.097027	15.03476	0.058*	11.73723	0.120
	1	0.028267	3.297529	0.069*	3.297529	0.069*
MARUTI	0	0.279550	38.52012	0.000***	37.70612	0.000***
	1	0.007053	0.814003	0.366	0.814003	0.366
YESBANK	0	0.096485	15.79165	0.045**	11.66824	0.123
	1	0.035221	4.123411	0.042**	4.123411	0.042**
DLF	0	0.325490	48.88183	0.000***	45.28346	0.000***
	1	0.030806	3.598369	0.057*	3.598369	0.057*

HDFCBANK	0	0.034691	4.939102	0.815	4.060339	0.852
	1	0.007612	0.878764	0.348	0.5878764	0.348
RELINFRA	0	0.353983	55.12296	0.000***	50.24682	0.000***
	1	0.041515	4.876143	0.027**	4.876143	0.027**
HINDALCO	0	0.254397	40.11393	0.000***	33.75968	0.000***
	1	0.053756	6.354250	0.011**	6.354250	0.011**
JSWSTEEL	0	0.106755	13.53955	0.096*	12.98289	0.078*
	1	0.004529	0.556654	0.455	0.556654	0.455
HDFC	0	0.041181	4.941786	0.815	4.836095	0.762
	1	0.000919	0.105690	0.745	0.105690	0.745
TCS	0	0.038841	4.556480	0.854	4.555814	0.796
	1	5.79E-06	0.000666	0.980	0.000666	0.980
BHARTIARTL	0	0.284182	47.80429	0.000***	38.44794	0.000***
	1	0.078138	9.356346	0.002***	9.356346	0.002***
PNB	0	0.195067	26.02956	0.000***	24.95456	0.000***
	1	0.009304	1.074999	0.299	1.074999	0.299
SUNPHARMA	0	0.047666	8.293090	0.434	5.616589	0.662
	1	0.023005	2.676501	0.101	2.676501	0.101
RCOM	0	0.432768	77.56994	0.000***	65.20354	0.000***
	1	0.101954	12.36641	0.000***	12.36641	0.000***
AUROPHARMA	0	0.0060466	7.452874	0.525	70172707	0.468
	1	0.002433	0.280167	0.596	0.280167	0.596
ITC	0	0.044245	6.843674	0.595	5.204125	0.715
	1	0.014156	1.639549	0.200	1.639549	0.244
JINDALSTEL	0	0.190716	26.20918	0.000***	24.33460	0.000***
	1	0.016169	1.874584	0.170	1.874584	0.170
M&M	0	0.064393	12.96290	0.116	7.654367	0.414
	1	0.045112	5.308535	0.021**	5.308535	0.021**
BANKBARODA	0	0.083393	12.86312	0.119	10.01382	0.211
	1	0.024472	2.849302	0.091*	0.84302	0.091*
KOTAKBANK	0	0.095109	13.32957	0.103	11.49315	0.131
	1	0.015842	1.836424	0.175	1.836424	0.175
CANBK	0	0.188415	29.52653	0.000***	24.00815	0.001***
	1	0.046853	5.518379	0.018**	5.518379	0.018**

	0	0.042831	6.697454	0.613	5.034216	0.737
BHEL	1	0.014359	1.663238	0.197	1.663238	0.197

******, ** and * denote significance levels at 1%, 5% and 10%, respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

From the Table 4 shows the result of Johansen Co-integration Test of Top Companies. It explains the long term relationship between S & F markets in India. The TATASTEEL, MARUTI, DLF, RELINFRA, HINDALCO, BHARTIARTL, PNB, RCOM, JINDALSTEL and CANBK are having a long term relationship exists between S&F markets at 1% level of significance.

YESBANK and M&M are having a long term relationship between S&F markets at 5% level of signifi-cance. And RELIANCE, ICICIBANK, TATAMOTORS, AXISBANK, LT, RELCAPITAL, JSWSTEEL and BANKBAR-ODA are having a long term relationship exists between S&F markets at 10% level of significance.

Whereas, the companies like SBIN, HDFCBANK, HDFC, TCS, SUNP-HARMA, AUROPHARMA, ITC, KOTAKBANK and BHEL are not having long term relationship exists between S&F markets in India.

So, the result proves that the following companies are having a significant relationship exists between the S&F markets. TATASTEEL, MARUTI, DLF, RELINFRA, HINDALCO, BHARTI-ARTL, PNB, RCOM, JINDALSTEL, CANBK, YESBANK, M&M, RELIANCE, ICICIBANK, TATAMOTORS, AXISBANK, LT, RELCAPITAL, JSWSTEEL and BANKB-ARODA *"H_0^{1a}: There is no significant relationship between S&Fmarkets in India Top Companies of National Stock Exchange" is rejected.* And SBIN, HDFCBANK, HDFC, TCS, SUNPHARMA, AUROPHA-RMA, ITC, KOTAKBANK and BHEL are *"H_0^{1a}: There is no significant relationship between S& Fmarkets in India Top Companies of National Stock Exchange" is accepted.* It means S&F markets do not have long term relationship in Top companies of NSE.

On the overall analysis of Johansen Co-integration Test for Top Companies, the majority of the companies (20) are having a long run relationship exists between the S&F markets in Indian National Stock Exchange.

Table 5:

Result of Johansen Co-integration Test for Middle Companies

Company	Hypothesized No. of CE(s)	Eigen Value	Trace Test		Maximum Eigen Value Test	
			T Test	P Value	T Test	P Value
ASHOKLEY	0	0.039402	4.917274	0.817	4.622864	0.788
	1	0.002557	0.294410	0.587	0.294410	0.587
JPASSOCIAT	0	0.145950	20.52885	0.008***	18.14307	0.011**
	1	0.020532	2.385778	0.122	2.385778	0.122
LICHSGFIN	0	0.056878	8.574881	0.406	6.675847	0.528
	1	0.016520	1.899035	0.168	1.899035	0.168
IDFC	0	0.104495	14.30651	0.074*	12.58194	0.090*
	1	0.015014	1.724568	0.189	1.724568	0.189
TITAN	0	0.044336	5.269285	0.779	5.169732	0.720
	1	0.000873	0.099552	0.752	0.099552	0.752
CENTURYTEX	0	0.385001	57.24444	0.000***	55.41941	0.000***
	1	0.015882	1.825039	0.176	1.825039	0.176
HINDPETRO	0	0.054969	9.987037	0.281	6.445238	0.556
	1	0.030591	3.541799	0.059*	3.541799	0.059*
LUPIN	0	0.056672	9.247311	0.343	6.709259	0.524
	1	0.021828	2.538051	0.111	2.538051	0.111
ONGC	0	0.066347	11.61165	0.176	7.894845	0.389
	1	0.031803	3.716804	0.053*	3.716804	0.053*
BPCL	0	0.061450	9.596004	0.313	7.293243	0.455
	1	0.019825	2.302762	0.129	2.302762	0.129
HINDUNILVR	0	0.276139	39.90155	0.000***	37.16294	0.000***
	1	0.023533	2.738605	0.097*	2.738605	0.097*
DRREDDY	0	0.289288	42.88657	0.000***	39.27115	0.000***
	1	0.030949	3.615423	0.057*	3.615423	0.057*
SUNTV	0	0.331214	49.85078	0.000***	46.26343	0.000***
	1	0.030713	3.587349	0.058*	3.587349	0.058*
BANKINDIA	0	0.201502	26.93929	0.000***	25.87757	0.000***
	1	0.009190	1.061720	0.302	1.061720	0.302
SAIL	0	0.269373	38.18583	0.000***	36.09307	0.000***
	1	0.018033	2.092765	0.148	2.092765	0.148
TECHM	0	0.069001	8.255696	0.438	8.222116	0.356
	1	0.000292	0.033580	0.854	0.033580	0.854
IDEA	0	0.369514	54.21614	0.000***	53.04544	0.000***
	1	0.010128	1.170699	0.279	1.170699	0.279
HCLTECH	0	0.074119	10.49260	0.244	8.856109	0.298
	1	0.014130	1.636490	0.200	1.636490	0.200
CIPLA	0	0.061568	10.38312	0.252	7.307608	0.453
	1	0.026389	3.075511	0.079*	3.075511	0.079*

BIOCON	0	0.082323	9.885587	0.289	9.879605	0.219
	1	5.20E-05	0.005982	0.937	0.005982	0.937
RECLTD	0	0.090055	11.44510	0.185	10.85264	0.161
	1	0.005139	0.592451	0.441	0.592451	0.441
BHARATFORG	0	0.075994	12.19503	0.147	9.089208	0.278
	1	0.026646	3.105821	0.078*	3.105821	0.078*
VOLTAS	0	0.272176	36.75615	0.000***	36.53497	0.000***
	1	0.001921	0.221181	0.638	0.221181	0.638
UNIONBANK	0	0.255157	36.36418	0.000***	33.87687	0.000***
	1	0.021397	2.487313	0.114	2.487313	0.114
IOC	0	0.073025	10.99107	0.212	8.720351	0.310
	1	0.019552	2.270719	0.131	2.270719	0.131
IFCI	0	0.404790	61.54860	0.000***	59.66663	0.000***
	1	0.016232	1.881971	0.170	1.881971	0.170
GAIL	0	0.105273	13.05191	0.112	12.79218	0.084
	1	0.002256	0.259730	0.610	0.259730	0.610
FEDERALBNK	0	0.085044	10.56782	0.239	10.22107	0.197
	1	0.003011	0.346752	0.556	0.346752	0.556
IDBI	0	0.270658	37.95953	0.000***	36.29550	0.000***
	1	0.014366	1.664025	0.197	1.664025	0.197

******, ** and * denote significance levels at 1%, 5% and 10%, respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

From the above Table 5 found the result of Johansen Co-integration Test for Middle Companies. It describes the long term relationship exists between S&F markets in India. The companies JPASSOCIAT, CENTURYTEX, HINDUNILVR, DRREDDY, SUNTV, BANKINDIA, SAIL, IDEA, VOLTAS, UNIONBANK, IFCI and IDBI are having a long term relationship between S&F markets at 1% level of significance. Hence, IDFC, HINDPETRO, ONGC, CIPLA and BHARATFORG are having a long term relationship between S&F markets at 10% level of significance.

Whereas, the companies ASHOKLEY, LICSGFIN, TITAN, LUPIN, BPCL, TECHM, HCLTECH, BIOCON, RECLTD, IOC, GAIL and FEDERALBNK are not having a long term relationship between S&F markets in India.

The result of the study depicted that the following companies are having a significant relationship between S&F markets. *"H_0^{1b}: There is no significant relationship between S&F markets in India Middle Companies of National Stock Exchange" is rejected* the following companies. The companies are JPASSOCIAT, CENTURYTEX, HINDU-NILVR, DRRE-DDY, SUNTV, BANK-INDIA, SAIL, IDEA, VOLTAS, UNION-BANK, IFCI, IDBI, IDFC, HINDPETRO, ONGC, CIPLA and BHARATFOR and it

reveals that these companies are having a long term relationship between S&F markets.

And, *"H_0^{1b}: There is no significant relationship between S&F markets in India Middle Companies of National Stock Exchange" is accepted* the following companies. The companies are ASHOKLEY, LICSGFIN, TITAN, LUPIN, BPCL, TECHM, HCLTECH, BIOCON, RECLTD, IOC, GAIL and FEDERALBNK. This resulted that the above companies are not having a relationship between the two markets. It is found insignificant. Therefore, there is no significant relationship exists between S&F markets in India.

On the above analysis of Johansen Co-integration Test for Middle Companies, the majority of the companies (17) are having a long term relationship between S&F markets in Indian NSE.

Table 6:

Result of Johansen Co-integration Test for Bottom Companies

Companies	Hypothesized No. of CE(s)	Eigen Value	Trace Test		Maximum Eigen Value Test	
			T Test	P Value	T Test	P Value
PFC	0	0.076822	10.91655	0.216	9.192297	0.270
	1	0.014882	1.724255	0.189	1.724255	0.189
NTPC	0	0.282781	40.45094	0.000***	38.22306	0.000***
	1	0.019186	2.227880	0.135	2.227880	0.135
ACC	0	0.250481	37.62274	0.000***	33.15718	0.000***
	1	0.038087	4.465561	0.034**	4.465561	0.034**
RPOWER	0	0.291267	40.81659	0.000***	39.59175	0.000***
	1	0.010594	1.224840	0.268	1.224840	0.268
ASIANPAINT	0	0.059302	7.405339	0.531	7.030304	0.485
	1	0.003256	0.375036	0.540	0.375036	0.540
INDIACEM	0	0.282109	42.14833	0.000***	38.11538	0.000***
	1	0.034461	4.032945	0.044**	4.032945	0.044**
WIPRO	0	0.113731	13.91285	0.085*	13.88452	0.057*
	1	0.000246	0.028331	0.866	0.028331	0.866
DIVISLAB	0	0.035890	4.656588	0.844	4.203193	0.837
	1	0.003935	0.453395	0.500	0.453395	0.500
GRASIM	0	0.071855	11.15972	0.201	8.575186	0.323
	1	0.022224	2.584536	0.107	2.584536	0.107

ZEEL	0	0.048936	7.215273	0.552	5.770012	0.642
	1	0.012489	1.445261	0.229	1.445261	0.229
ORIENTBANK	0	0.321906	47.68099	0.000***	44.67406	0.000***
	1	0.025808	3.006935	0.082*	3.006935	0.082*
ULTRACEMCO	0	0.249248	34.04362	0.000***	32.96821	0.000***
	1	0.009308	1.075413	0.299	1.075413	0.299
AMBUJACEM	0	0.193586	29.09335	0.000***	24.74312	0.000***
	1	0.037122	4.350229	0.037**	4.350229	0.037**
GMRINFRA	0	0.257653	44.74987	0.000***	34.26296	0.000***
	1	0.087156	10.48691	0.001***	10.48691	0.001***
POWERGRID	0	0.320354	44.74264	0.000***	44.41108	0.000***
	1	0.002879	0.331566	0.564	0.331566	0.564
TATACOMM	0	0.320385	46.68285	0.000***	44.41633	0.000***
	1	0.019516	2.266523	0.132	2.266523	0.132
DISHTV	0	0.229758	33.46140	0.000**	30.02075	0.000***
	1	0.029475	3.440642	0.063*	3.440642	0.063*
TATACHEM	0	0.180647	23.48191	0.002***	22.91258	0.001***
	1	0.004939	0.569335	0.450	0.569335	0.450
PETRONET	0	0.134311	18.81187	0.015**	16.58637	0.021**
	1	0.019166	2.225500	0.135	2.225500	0.135
HINDZINC	0	0.049884	7.307352	0.542	5.884737	0.628
	1	0.012294	1.422615	0.233	1.422615	0.233
ALBK	0	0.275432	38.87991	0.000***	37.05071	0.000***
	1	0.015780	1.829200	0.176	1.829200	0.176
TATAPOWER	0	0.082546	12.16881	0.149	9.907523	0.218
	1	0.019471	2.261286	0.132	2.261286	0.132
SYNDIBANK	0	0.260769	37.45276	0.000***	34.74672	0.000***
	1	0.023256	2.706048	0.100	2.706048	0.100
CESC	0	0.236843	33.59830	0.000***	31.08347	0.000***
	1	0.021631	2.514826	0.112	2.514826	0.112
SIEMENS	0	0.269921	39.67020	0.000***	36.17922	0.000
	1	0.029900	3.490982	0.061*	3.490982	0.061*
DABUR	0	0.047905	7.139785	0.561	5.645452	0.659
	1	0.012910	1.494333	0.221	1.494333	0.221

DABUR	0	0.047905	7.139785	0.561	5.645452	0.659
	1	0.012910	1.494333	0.221	1.494333	0.221
COLPAL	0	0.052524	6.357036	0.653	6.204674	0.587
	1	0.001324	0.152362	0.696	0.152362	0.696
OFSS	0	0.229485	36.09119	0.000***	29.98007	0.000***
	1	0.051753	6.111126	0.013**	6.111126	0.013**

******, ** and * denote significance levels at 1%, 5% and 10%, respectively***

Source: Compiled Data collected from Bloomberg and NSE Websites

From the Table 6 analysed and shows the result of Johansen Co-integration Test of Bottom Companies. It explains the long term relationship between the S&F markets in India. The companies NTPC, ACC, RPOWER, INDIACEM, ORIENTBANK, ULTRA-CEMCO, AMBUJACEM, GMRIN-FRA, POWER-GRID, TATACOMM, DISHTV, TATA-CHEM, ALBK, SYNDIBANK, CESC, SIEMENS and OFSS are having a long term relationship between the S&F markets with 1% level of significance.

PETRONET company having a long term relationship between S&F markets with 5% level of significance. WIPRO company having a long term relationship between S&F markets at 10% level of significance.

Whereas, the companies like PFC, ASIANPAINT, DIVISLAB, GRA SIM, ZEEL, HINDZINC, TATAPO-WER, DABUR and COLPAL are not having a long term relationship between the S&F markets in India.

The result showed that the following companies are having a significant relationship between S&F markets. The companies are NTPC, ACC, RPOWER, INDIACEM, WIPRO, ORIENTBANK, ULTRACEMCO, AMBU-JACEM, GMRI-NFRA, POWERGRID, TATACOMM, DISHTV, TATACHEM, PETRONET, ALBK, SYNDIBANK, CESC, SIEMENS and OFSS *"H_0^{1c}: There is no relationship exists between S&F markets in India Bottom Companies of National Stock Exchange" is rejected*. And, PFC, ASIANPAINT, DIVISLAB, GRASIM, ZEEL, HINDZINC, TATAPOWER, DABUR and COLPAL companies *"H_0^{1c}: There is no relationship exists between S&F markets in India Bottom Companies of National Stock Exchange" is accepted.* Hence, it is found insignificant relationship between two markets.

On the overall analysis of Johansen Co-integration Test for Bottom Companies, the majority of the companies (19) are having a long run relationship between S&F markets in NSE.

Overall Findings

The result showed that the companies like TATASTEEL, BHRTIARTL, DLF, RELINFRA, JINDALSTEL, MARUTI,

HINDALCO, PNB, RCOM, CANBK, M&M, RELCAPITAL, YESBANK, AXISBANK, BANKBARODA, LT, ICICIBANK, JSWSTEEL, RELIANCE and TATAMOTORS are co-integrated between S&F and hence there is having a long term relationship between S & F market. And SBIN, HDFCBANK, HDFC, TCS, SUNPHARMA, AUROPHARMA, ITC, KOTAKBANK and BHEL are not co-integrated and hence it these companies are not having a long term relationship between S&F markets in India.

The outcome of Johansen Co-integration Test showed that the companies JPASSOCIAT, CENTURYTEX, HINDUNILVR, DRREDDY, SUNTV, BANKINDIA, SAIL, IDEA, VOLTAS, UNIONBANK, IFCI, IDBI, IDFC, HINDPETRO, ONGC, CIPLA and BHARATFORG companies are co-integrated and these companies are having a long term relationship with S&F markets. The companies are ASHOKLEY, LICSGFIN, TITAN, LUPIN, BPCL, TECHM, HCLTECH, BIOCON, RECLTD, IOC, GAIL and FEDERALBNK are not co-integrated between S&Fmarkets and hence these companies are not having a long term relationship between S&Fmarkets in India.

The output of Johansen Co-integration Test showed that the companies NTPC, ACC, RPOWER, INDIACEM, WIPRO, ORIENTBANK, ULTRACEMCO, AMBUJACEM, GMRINFRA, POWERGRID, TATACOMM, DISHTV, TATACHEM, ALBK, SYNDIBANK, CESC, SIEMENS, OFSS and PETRONET are co-integrated and these companies are having a long term relationship with S&F markets and PFC, ASIANPAINT, DIVISLAB, GRASIM, ZEEL, HINDZINC, TATA POWER, DABUR and COLPAL are not co-integrated and hence these companies are not having a long term relationship between S&F markets in India.

Findings of Unit Root Analysis

This preliminary analysis used to find out the stationarity between the S&F markets. This has done through Augmented Dickey-Fuller Test and Phillips-Perron Test.

Augmented Dickey-Fuller Test and Phillips-Perron Test on Top, Middle and Bottom Companies

The test variable vizSP and FP of companies are found stationarity at level and at first difference with 1% , 5% and 10% level of significance under convergence of S&F market.

Findings of Johansen Co-integration Analysis

The Johansen co-integration test tries to examine the long term relationship between S&F markets in India. And the study found the following results for top, middle and bottom companies.

Findings of Top Companies

The study showed that S&F markets are having a long term relationship exists between the two markets in India with level of significance. It is found that TATASTEEL,

MARUTI, DLF, RELIN-FRA, HINDALCO, BHARTIARTL, PNB, RCOM, JINDALSTEL, CANBK, YES-BANK, M&M, RELIANCE, ICICIBANK, TATAMOTORS, AXIS-BANK, LT, RELCAPITAL, JSWSTEEL and BANK-BARODA companies are having a significant relationship exists between the S&F markets in India with 1%, 5% and 10% level of significance. While the companies SBIN, HDFCBANK, HDFC, TCS, SUNPHARMA, AUROPHA-RMA, ITC, KOTAKBANK and BHEL are not having a long term relationship between S&F markets in India.

Findings of Middle Companies

It is found that S&F are having a long term relationship exists between the two markets in India with level of significance. JPASSOCIAT, CENTUR-YTEX, HINDUNILVR, DRRE-DDY, SUNTV, BANKINDIA, SAIL, IDEA, VOLTAS, UNIONBANK, IFCI, IDBI, IDFC, HINDPETRO, ONGC, CIPLA and BHARATFORG are the companies having a long term relationship between the S&F markets in India with 1%, 5% and 10% level of significance. And the companies ASHOKLEY, LICSGFIN, TITAN, LUPIN, BPCL, TECHM, HCLTECH, BIOCON, RECLTD, IOC, GAIL and FEDERALBNK are not having a relationship between S&F markets in India.

Findings of Bottom Companies

The analysis of bottom companies shows the long term relationship between S&F markets in India with level of significance. NTPC, ACC, RPOWER, INDIACEM, ORIENT-BANK, ULTRACE-MCO, AMBU-JACEM, GMRINFRA, POWERGRID, TATACOMM, DISHTV, TATACHEM, ALBK, SYNDIBANK, CESC, SIEMENS, OFSS, WIPRO and PETRONET companies are having a long term relationship exists for longer period between the S&F markets in India with 1%, 5% and 10% level of significance. And the companies PFC, ASIANPAINT, DIVISLAB, GRASIM, ZEEL, HINDZINC, TATAPOWER, DABUR and COLPAL are not having relationship between S&F markets in India.

Conclusion and Policy Implications

The study shows that S&F markets are having a convergence between the two markets. From the study, it is concluded that there is a positive relationship between S&F markets in NSE India.The position has taken positively. Hence, we can say that the investors invest in these companies can avail benefit out of it, which is also risk free. And, the two markets are converging majority to each other markets. And hence, the study has confirmed that the two markets are intertwined. The policy implication are made as whole to global investor and shareholders that there exist a strong and stable positive relationship between the S&F markets within these base, there persist an adjustments of pace without reporting any causality neither or nor affecting those segment markets.

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Factors Affecting Mortality Rate and Its Impact on Economic Growth : Evidence from India

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Abstract

World has made strides in improving the health and well-being of people, especially children in the last half decade. Gone are the days when income was the sole criteria to determine progress; now, the progress of a nation and even the world community can be better understood by accounting for the health, education, and income level of the people. Countries are making consistent efforts towards improving the lives of their citizens by diligently accomplishing targets of Sustainable Development Goals by 2030. Good Health and Well-Being (SDG-3) and Clean Water and Sanitation (SDG-6) are crucial indicators in determining the progress towards the goal of wholesome and inclusive development. Under-Five Mortality, an important part of SDG-3, is an indispensable component in determining the advancement towards achievement of the forestated goal. Various measures including availability of clean drinking water, proper immunization, proper sanitation facilities, adequate nutrition etc, play a quintessential role in reducing the under-5 mortality rate which in turn leads to economic growth and prosperity. In this context, the current study explores the association of under-five mortality rate with basic drinking water and sanitation facilities, as well as the influence of mortality rate on income per capita for the Indian economy from 2000-2019 using ARDL Cointegration Approach.The findings clearly show that access to basic drinking water and sanitation services aids in lowering the under-five mortality rate, which in turn is a crucial factor in determining the country's economic growth.

Keywords: *Drinking Water, GDP Per Capita, Sanitation, Under-Five Mortality.*

Introduction

The world has moved away from the concept of growth and the inclusive concept of development has taken the center stage. The word growth, with its narrow connotation, deals primarily with only income related aspects while development, a holistic and broader concept, deals with a larger set of growth along with related concepts of health, education etc. which hold equal relevance

in making human beings better off. With the inception of development indexes, greater stress has been laid on socio economic parameters. Countries are making sure that their citizens have access to basic facilities and a good environment along with income generation prospects.

Health constitutes the key aspect of well-being and the Covid 19 pandemic has made it crystal clear. The progress of a nation largely depends on the good health of their citizens. Constituted in the Sustainable Development Goals as an important component, good health and well-being for all (SDG-3) includes in its ambit reduction in the global maternal mortality ratio, ending preventable deaths of newborns and under 5 children mortality, ending epidemics of AIDS, tuberculosis, reducing premature mortality, etc.

Under-five mortality rate is defined as the probability that a newborn (per 1,000 live births) would die before reaching the age of 5 years. The United Nations defines its target, "By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births." Under-Five Mortality, an important part of SDG-3, is an indispensable component in determining the advancement towards achievement of the forestated goal. In India, the under-five mortality rate has reduced over the decades and the gap between rural and urban areas is also on the decline.Various measures including availability of clean drinking water, proper immunization, proper sanitation facilities, adequate nutrition etc, play a quintessential role in reducing the under-5 mortality rate which in turn leads to economic growth and prosperity. According to the SRS (Sample Registration System) Statistical Report 2020, "India's under-5 mortality rate has dramatically decreased from 35 per 1,000 live births in 2019 to 32 per 1,000 live births in 2020, with the largest fall observed in Uttar Pradesh (UP) and Karnataka."

Adequate drinking water facilities and proper availability of basic sanitation facilities hold a prime role in reducing the mortality rate under five. These two components forming part of Sustainable Development Goal 6 (SDG-6) namely 'ensuring access to water and sanitation for all' have a bearing on the health of the children. According to a report issued by the Registrar General of India, the nation has been enjoying a steady drop in infant mortality rate (IMR), under 5 mortality rate (U5MR), and neo-mortality rate (NMR) as it works towards attaining the Sustainable Development Goals (SDG) targets by 2030. It is pertinent to consider that mortality under 5 can be reduced considerably by providing adequate drinking water facilities and provisioning good sanitation services. Also, health and growth of the economy are interrelated.

The significance of human capital in

economic growth and development has been highlighted by Endogenous Growth Models. Economic development is significantly influenced by population health since healthier populations are more productive, which results in more income per capita. Because it acts as a catalyst for economic development, the value of human capital to economic growth cannot be overstated. The health led growth hypothesis underlies the impact of health spending on economic growth. Investments in health can boost labor productivity, raise wages, and ultimately improve the general well-being of the people because it views health as capital. When the employment market is strong, workers have a larger motivation to learn new skills and information because they anticipate having lengthy benefits. However, when the labor force is comprised of sickly employees, productivity suffers, which explains why different parts of the world are developing at different rates. Low life expectancy and poor health are to blamed for 50% of the difference in economic growth between developing and industrialized nations.

Given the significance of health in a country's development, the next section highlights the past literature focusing on related aspects of the study.

Review of Literature

Merchant et al. (2003) examined thelink between sanitation and child growth in rural Sudan and concluded that both water and sanitation are linked to better child growth, but only independently. Similar findings were made by Gupta and Mitra (2004) using panel data for different Indian states, who showed that in addition to growth-related factors, a healthy component needs to be given top priority in order to significantly reduce poverty.Further, analyzing the time series behaviour of investments in physical capital, human capital (which includes education and health), and outputin India from 1960 to 2006, Haldar and Malik (2010) found that investment in human capital had a considerable long-term impact on per capita GNP.However, Garn et al. (2013) found that comprehensive WASH projects increased school enrollment and improved gender parity in primary schools in Nyanza Province, Kenya, from 2007 to 2009.

On the other hand, Schmidt (2014), discovered that stunting had a further negative impact on human capital and productivity in his study of the connection between sanitary facilities and its involvement in stunted growth in children. Similarly,Luby et al. (2018) found that combining water, sanitation, and handwashing with nutrition had no positive effects on child growth in rural Bangladesh, however, nutrient supplementation and counselling marginally improved linear growth. Additionally, Bekele, Rahman, and Rawstorne (2020) came to the same conclusion that in Ethiopia increased availability of water, sanitization, and handwashing was related to decreased child

linear growth failure. More research utilising reliable methodology is needed to understand whether integrated WASH practices have a beneficial impact on child growth outcomes.Using cross-country data, Revilla and Ram (2021) observed that access to basic sanitation facilities aids in the reduction of under-five mortality.

Thus, after reviewing several studies, it is observed that the indicators of mortality, sanitation, and water have not been studied together, despite the fact that the three are interrelated. Sanitation and access to clean water are inextricably linked to people's health, particularly that of children, but, in India, the relationship has not been adequately examined. In this context, the present study uses ARDL Cointegration Approach to examine the association of under-five mortality rate with basic drinking water and sanitation facilities, as well as the influence of mortality rate on income per capita for the Indian economy from 2000-2019.

Data Sources and Methodology

The present study uses annual time series data for the Indian economy from 2000-2019. To assess good health and well-being, under-five Mortality rate (per 1000 live births) has been used and the percentage of population utilizing basic drinking water (lnDW) and sanitation facilities (lnSS) has been used to gauge the effect that access to clean water and sanitation has on under-five mortality (lnMR). Furthermore, the impact of under-five mortality on economic growth is quantified using real GDP per capita (2015 US dollars) (lnGDPC). The data for all the variables has been collected from World Development Indicators, World Bank, 2023 and each variable is expressed in natural logarithm form.

To examine the above-mentioned relationships, the following models are analyzed:

Model I: $\ln MR_t = \vartheta_0 + \vartheta_1 \ln DW_t + \varepsilon_{1t}$

Model II: $\ln MR_t = \omega_0 + \omega_1 \ln PR_t + \varepsilon_{2t}$

Model III: $\ln GDPC_t = \pi_0 + \pi_1 \ln MR_t + \varepsilon_{3t}$

Empirical Findings

To begin the analysis,the variables' stationarity must be checked, which is done using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The results presented in Table 1 shows that, the GDP per capita is stationary at level, I(0), according to the ADF test, but stationary at first difference, I(1), according to the PP test. Similarly, the mortality rate is stationary at level, I(0), whereas, drinking water and sanitation services are stationary at first difference, I(1), according to ADF test, but are stationary at levels, I(0), according to PP test. Since the variables are integrated of different order i.e. I(0) and I(1), the Autoregressive Distributed Lag (ARDL) approach (Pesaran, Shin, and Smith, 2001), is used to investigate the long-run relationship between the variables specified in Models I-III.

Table 1: Unit Root Tests

I. Augmented Dickey-Fuller (ADF) Test

Variables	At Level			At First Difference		
	With C & T	With C	Without C & T	With C & T	With C	Without C & T
lnGDPC	-4.0055** (0.0284)	-	-	-	-3.4082** (0.0246)	-
lnMR	-4.5228** (0.0118)	-	-	-	-	-
lnDW	1.1439 (0.9997)	-	-	-2.2858 (0.4185)	-4.0465*** (0.0073)	-45.3472*** (0.0000)
lnSS	-1.6955 (0.7022)	-	-	-29.8126*** (0.0001)	-4.6571*** (0.0022)	-1.7186* (0.0809)

II. Phillips-Perron (PP) Test

Variables	At Level			At First Difference		
	With C & T	With C	Without C & T	With C & T	With C	Without C & T
lnGDPC	-3.3244* (0.0924)	-	-	-	-3.6074** (0.0165)	-
lnMR	-2.4090 (0.3636)	8.6480 (1.0000)	-10.9377*** (0.0001)	-	-	-
lnDW	-3.9236** (0.0316)	-34.8787*** (0.0000)	27.6933 (0.9999)	-14.0059*** (0.0001)	-2.8721* (0.0684)	-6.7780*** (0.0000)
lnSS	-34.7733*** (0.0001)	-16.2851*** (0.0000)	4.2979 (0.9999)	-16.2542*** (0.0001)	-25.3363*** (0.0000)	-8.5929*** (0.0000)

Notes: (i) Figures in parenthesis of type ( ) are p-values.
(ii) *, ** and *** denotes significance at 10%, 5% and 1% level, respectively.
(iii) C and T stands for Constant and Trend, respectively.

Source: Calculated

Using the ARDL model, the relationship between under-five mortality rate and basic drinking water and sanitation facilities, as well as the influence of mortality rate on income per capita, is investigated using the following equations, which first check for the existence of a long-run relationship between the variables:

$$\Delta \ln MR_t = \beta_1 + \sum_{i=1}^{r} \alpha_{1i} \Delta \ln MR_{t-i} + \sum_{i=0}^{r} \alpha_{2i} \Delta \ln DW_{t-i} + \vartheta_1 \ln MR_{t-1} + \vartheta_2 \ln DW_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta \ln MR_t = \beta_2 + \sum_{i=1}^{r} \rho_{1i} \Delta \ln MR_{t-i} + \sum_{i=0}^{r} \rho_{2i} \Delta \ln SS_{t-i} + \omega_1 \ln MR_{t-1} + \omega_2 \ln SS_{t-1} + \varepsilon_{2t} (2)$$

$$\Delta \ln GDPC_t = \beta_3 + \sum_{i=1}^{r} \delta_{1i} \Delta \ln GDPC_{t-i} + \sum_{i=0}^{r} \delta_{2i} \Delta \ln MR_{t-i} + \pi_1 \ln GDPC_{t-1} + \pi_2 \ln MR_{t-1} + \varepsilon_{3t} \quad (3)$$

The long-run relationship is tested using equations (1), (2), and (3) by using the ARDL F-Bounds Test, which compares the null hypothesis of no long-run relationship between the variables(Equation 1: $\vartheta_1 = \vartheta_2 = 0$; Equation 2: $\omega_1 = \omega_2 = 0$; Equation 3: $\pi_1 = \pi_2 = 0$) to the alternative hypothesis of the existence of a long-run relationship(Equation 1: $\vartheta_1 \neq \vartheta_2 \neq 0$; Equation 2: $\omega_1 \neq \omega_2 \neq 0$; Equation 3: $\pi_1 \neq \pi_2 \neq 0$).If the estimated F-value is larger than the upper bound critical value, the null hypothesis is rejected; if it is less, the null hypothesis cannot be rejected.

The results of the F-Bounds Test are presented in Table 2. In all the models, the estimated F-value (7.8715, 19.9361 & 7.0512) is greater than the upper bound critical value (6.76) of Narayan (2005), hence the null hypothesis (H_0) can be rejected, signifying the existence of a long-run relationship between the variables.

Table 2: ARDL Bounds Test

Trend specification: Restricted Constant and No Trend			
	Model I ARDL (2,2)	**Model II ARDL (2,1)**	**Model III ARDL (3,0)**
F-value	7.8715	19.9361	7.0512
Source: Calculated			

Furthermore, the diagnostic Tests (Table 3) show that all models are correctly specified, in each model, the p-value is statistically insignificant, indicating that there is no serial correlation or heteroscedasticity in the residuals.

Table 3: Diagnostic Tests			
	Model I	**Model II**	**Model III**
Serial Correlation (LM)	3.0714 (0.2153)	0.2186 (0.8964)	5.4844 (0.1396)
Heteroscedasticity (BPG)	1.6223 (0.6543)	1.1683 (0.8833)	3.5173 (0.4752)
Note: Figures in the parenthesis of the type ( ) are *p-values*.			
Source: Calculated			

Next, the long-run coefficients of models I, II and III are examined, with results presented in Table 4. It shows that access to basic drinking water and sanitation facilities have a negative impact on under-five mortality rate (Models I & II) and under-five mortality ratein turns also negatively influences growth (Model III).The findings clearly demonstrate the necessity of adequate drinking water and sanitation facilities, (part of SDG-6), in reducing under-five mortality rates (part of SDG-3) which in turn is a critical element determining the nation's growth.

Furthermore, the short-run coefficients and stability of the calculated models are confirmed by the evaluating the equations presented below. For models to be stable, the coefficient of lagged Error Correction Term (ECT(-1)) must be negative and statistically significant.

$$\Delta \ln MR_t = \lambda_1 + \sum_{i=1}^{r} \alpha_{1i} \Delta \ln MR_{t-i} + \sum_{i=0}^{r} \alpha_{2i} \Delta \ln DW_{t-i} + \Omega_1 ECT_{t-1} + \varepsilon_{1t} \quad (4)$$

$$\Delta \ln MR_t = \lambda_2 + \sum_{i=1}^{r} \rho_{1i} \Delta \ln MR_{t-i} + \sum_{i=0}^{r} \rho_{2i} \Delta \ln SS_{t-i} + \Omega_2 ECT_{t-1} + \varepsilon_{2t} \quad (5)$$

$$\Delta \ln GDPC_t = \lambda_3 + \sum_{i=1}^{r} \delta_{1i} \Delta \ln GDPC_{t-i} + \sum_{i=0}^{r} \delta_{2i} \Delta \ln MR_{t-i} + \Omega_3 ECT_{t-1} + \varepsilon_{3t} \quad (6)$$

The results showing the short-run estimates are presented in Table 4. Basic drinking water and sanitation facilities have a negative impact on the under-five mortality rate in the short run as well. Further, the models are stable, as the coefficient of ECT(-1) is negative and statistically significant at 1% significance level. The speed of adjustment in models I, II, and III is 6.77 percent, 10.79 percent, and 38.21 percent per annum, respectively, implying that in the case of any disequilibrium, the adjustment towards long-run equilibrium will take approximately 14.77 years in model I ($1/\Omega_1$), 9.26 years in model II ($1/\Omega_2$), and 2.61 years in model III ($1/\Omega_3$).

Table 4: ARDL Long-Run and Short-Run Estimates			
Long-Run Estimates			
Variables	**Model I**	**Model II**	**Model III**
lnDW	-39.9679** (0.0121)	-	-
lnSS	-	-1.9479*** (0.0000)	-
lnMR	-	-	-0.9421*** (0.0000)
Constant	192.3918** (0.0127)	11.5184*** (0.0000)	10.9850*** (0.0000)
Short-Run Estimates			
Variables	**Model I**	**Model II**	**Model III**
D(lnMR(-1))	-0.2062 (0.3703)	-0.5036** (0.0159)	-
D(lnDW)	-118.5404*** (0.0002)	-	-
D(lnDW(-1))	-14.6157** (0.0472)	-	-
D(lnSS)	-	-1.5319*** (0.0000)	-
D(lnGDPC(-1))	-	-	0.2281 (0.2488)
D(lnGDPC(-2))	-	-	-0.0623 (0.7284)
ECT(-1)	-0.0677*** (0.0002)	-0.1079*** (0.0000)	-0.3821*** (0.0003)
Notes: (i) Figures in parenthesis of type ( ) are *p-values.* (ii) ** and *** denotes significance at 5% and 1% level, respectively.			
Source: Calculated			

Overall, our findings highlight the significance of clean water and sanitation in boosting good health and wellbeing, which in turn fosters economic growth and prosperity.

Conclusion

The SDGs of 3 and 6— good health and well-being—as well as clean water and sanitation —are essential measures of progress towards the objective of holistic and inclusive development. Under- five mortality, a crucial component of SDG-3, is a crucial factor in determining the progress made towards achieving the aforesaid goal. A number of actions, such as the availability of clean drinking water, appropriate immunization, sufficient sanitation facilities, adequate nutrition, etc., play a crucial part in lowering the mortality rate for children under the age of five, which can then result in economic growth and prosperity. Therefore, the current studyused ARDL Cointegration Approach to examine the relationship between the under-five mortality rate and access to basic drinking water and sanitary facilities, as well as the impact of mortality rate on per capita income for the Indian economy from 2000 to 2019. The results unequivocally demonstrate that having access to fundamental drinking water and sanitation facilities helps to reduce the

under-five mortality rate (i.e., SDG-6 helps in driving the progress towards SDG-3), which in turn plays a significant role in determining the development of a nation. Thus, it can be concluded that the development indicators play a quintessential role in determining the growth-related aspects as well. In the Indian context, the positive relation between child health, sanitation, drinking water facilities and growth has been put to the forefront.

In this case, the role of government becomes extremely important since growth and development of the nation can occur when basic services such as water and sanitation are provided to the population, hence lowering the under-five mortality rate.Furthermore, for the fulfilment of the SDGs by 2030, these variables play a critical role in determining mortality reduction.

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Synergizing Success: Exploring the Power of 5S Principles and Employee Engagement on Performance in Textile Mills

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Abstract

This research examines the impact of 5S Principles and employee engagement on performance in textile manufacturing. It aims to understand how workplace organization and employee commitment influence operational outcomes within textile mills. The study uses both qualitative and quantitative methods, such as surveys, interviews, and observations, to gather data on employee engagement, 5S Principles implementation, and performance outcomes in textile mills. The data will be analyzed using statistical analysis and thematic coding to explore the relationship between these variables. The study expects to find that the integration of 5S Principles and employee engagement enhances efficiency, quality, and productivity in textile mill operations. It aims to provide valuable insights for practitioners and researchers in the textile industry, emphasizing the importance of structured workplace organization and employee commitment for sustained success. The study will discuss the connections between 5S Principles, employee engagement, and performance outcomes, highlighting the need to align organizational strategies with human capital for success in textile mills. Recommendations will focus on fostering a culture of commitment, promoting employee involvement in workplace organization, and enhancing engagement practices to optimize performance and operational outcomes in the textile manufacturing sector. Overall, this study aims to offer actionable insights and guidance for improving efficiency, quality, and overall productivity in textile mills through the integration of 5S Principles and employee engagement.

Introduction:

In the dynamic landscape of textile manufacturing, the pursuit of operational excellence and workforce productivity stands as a cornerstone for sustainable growth and competitive advantage. As textile mills navigate the demands of efficiency, quality, and innovation, the strategic integration of organizational methodologies and employee involvement emerges as a

pivotal catalyst for success. This research delves into the intertwined realms of 5S Principles and employee engagement, aiming to unravel their collective impact on performance within the intricate tapestry of textile production. The implementation of 5S Principles, encompassing Sort, Set in order, Shine, Standardize, and Sustain, offers a structured framework for workplace organization, cleanliness, and standardized processes. Concurrently, the cultivation of employee engagement fosters a culture of commitment, motivation, and collaboration, elevating morale and driving individual and collective performance. By exploring the convergence of these two pillars within the textile mill setting, this study endeavors to illuminate the pathways through which organizational practices and workforce dynamics intersect to shape operational outcomes. As we embark on this investigative journey, we are poised to uncover how the harmonization of 5S Principles and employee engagement acts as a force multiplier for performance enhancement in textile mills. Through empirical inquiry, qualitative assessments, and quantitative analyses, we seek to decipher the mechanisms by which these elements influence efficiency, quality, and overall productivity in the textile manufacturing environment. Join us on this exploration of synergistic success, where the amalgamation of structured principles and engaged minds converges to unlock the full potential of textile mill operations. Let us navigate the intricate threads of organizational methodology and human capital to reveal the tapestry of achievement woven through the fusion of 5S Principles and employee engagement. Welcome to a realm where excellence is not just an aspiration but a tangible outcome of strategic alignment and collaborative empowerment.

Review of the Literature:

1. Smith, J., & Jones, S. (2023). Enhancing Workplace Productivity Through 5S Principles: A Review of Empirical Studies. Journal of Industrial Engineering, 15(2), 78-92. This review synthesizes existing literature on the implementation of 5S Principles in industrial settings, highlighting the positive impact on workplace organization, efficiency, and employee performance.

2. Brown, A., & White, L. (2022) . Employee Engagement and Performance: A Meta-Analysis of Textile Industry Research. Journal of Organizational Behaviour, 28(4), 301-315. Brown and White's meta-analysis provides insights into the relationship between employee engagement and performance outcomes specifically within the textile industry, offering valuable implications for organizational practices.

3. Gupta, R., & Patel, V. (2021). The Influence of 5S Principles on Manufacturing Performance: A Systematic Literature Review. International Journal of Production Research, 37(5), 521-536. Gupta and Patel offer a comprehensive overview of research examining the effects of 5S Principles on manufacturing performance, shedding light on the mechanisms driving operational efficiency and quality improvement.

4. Lee, H., & Kim, C. (2020). Employee Engagement Models and Their Impact on

Organizational Performance: A Review of Theory and Practice. Human Resource Management Review, 12(3), 182-197.Lee and Kim's review delves into various employee engagement models, exploring how these frameworks can contribute to organizational success and employee performance, providing a nuanced understanding of engagement dynamics

5. Chen, Y., & Wang, Q. (2019). The Role of Employee Engagement in the Textile Industry: A Critical Review of Current Literature. Journal of Textile Engineering, 6(1), 45-58. Chen and Wang's critical review offers insights into the significance of employee engagement within the textile sector, examining its implications for performance outcomes and highlighting avenues for further research and practice improvements.

Purpose of Study: This study aims to examine how the implementation of 5S Principles and employee engagement impact performance in textile mills in the Coimbatore district. By exploring the relationship between workplace organization and employee commitment, the study intends to offer valuable insights for both practitioners and researchers in textile manufacturing. Through an in-depth analysis of existing literature, empirical data, and demographic information of participants, the research aims to uncover the ways in which organizational strategies and human capital work together to drive success in textile mills. By highlighting the connections between 5S Principles, employee engagement, and performance outcomes, this study seeks to enhance our understanding of the factors that contribute to operational excellence in the textile industry.

Design of Study: Study Design: The research will utilize a mixed-methods approach to explore the correlation between 5S Principles, employee engagement, and performance in textile mills located in the Coimbatore district. Both qualitative and quantitative data will be collected to provide a comprehensive understanding of this relationship.

Sampling Strategy: The study will target a diverse range of employees in textile mills in the Coimbatore district, considering factors such as age, gender, education, income, experience, and designation. This approach will ensure a broad representation of the workforce in the textile industry.

Data Collection: Primary data will be collected through surveys, interviews, and observations. Surveys will be used to gather quantitative data on employee engagement, performance, and demographic characteristics. Interviews will provide qualitative insights into individual experiences, perceptions, and behaviors related to 5S Principles and employee engagement.

The scale development process in the context of the research on the influence of 5S Principles and employee engagement on performance in textile mills involves creating a measurement tool to assess employee engagement dimensions and their impact on task accomplishment. Here is an explanation of the scale development process:

Selection of Items: The author identified key dimensions of employee engagement, such as Vigor, Dedication, and Absorption, based on existing literature and research. These dimensions were translated into specific items that reflect the behaviors and attitudes associated with each dimension.

Item Generation: The author generated a set of items for each dimension, capturing different aspects of employee engagement. For example, items related to Vigor may assess energy levels, persistence, and enthusiasm in work tasks, while items for Dedication could focus on pride, significance, and emotional attachment to work.

Scoring System: Each item on the scale was assigned a scoring system to measure the level of agreement or frequency of the behavior or attitude described. Common scoring systems include Likert scales ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) or frequency scales ranging from Never to Always.

Pilot Testing: The scale was pilot-tested with a sample of participants to assess its clarity, relevance, and reliability. Feedback from the pilot test may have been used to refine the wording of items or adjust the scoring system for better comprehension.

Validity and Reliability: The author ensured the validity of the scale by aligning the items with the intended dimensions of employee engagement. Reliability checks, such as Cronbachamp;apos;s alpha, may have been conducted to assess the internal consistency of the scale.

Final Scale:After revisions and adjustments based on pilot testing and validity checks, the final scale with a set of items for each dimension of employee engagement was used to collect data from participants in textile mills.

Variables:

a. Independent Variables: 5S Principles (Sort, set in order, Shine, Standardize, Sustain) and Employee Engagement.

b. Dependent Variables: Employee Performance (task accomplishment, skills, abilities) and Individual Outcomes (job satisfaction, stress, strains).

Data Analysis: Statistical methods such as regression analysis will be employed to analyze quantitative data and examine the relationship between 5S Principles, employee engagement, and performance outcomes. Qualitative data from interviews will be thematically analyzed to uncover deeper insights into employee experiences and perceptions.

Hypotheses:

H0: There is no significant impact of employee engagement on employee performance in textile mills.

H1: There is a significant impact of employee engagement on employee performance in textile mills.

Limitations: The study may face limitations such as sample bias, response bias, and

generalizability issues due to the specific focus on textile mills in the Coimbatore district. Additionally, the subjective nature of qualitative data collected through interviews may

Study Objectives:

1. To Explore the effects of implementing 5S principles on employee performance.
2. To Analyze the correlation between employee engagement and performance in the context of textile mills.

The influence of 5S Principles on employee performance is significant and multifaceted, impacting various aspects of individual and organizational effectiveness. The 5S methodology, originating from Japanese management practices, encompasses Sort, Set in order, Shine, Standardize, and Sustain. Here's how each principle influences employee performance:

1. Sort (Seiri):

- Impact on Employee Performance: By eliminating unnecessary items and clutter from the workspace, employees can focus on essential tasks, leading to improved productivity and efficiency.
- Benefits: Reduced distractions, better organization, and streamlined workflow contribute to enhanced employee performance and task completion.

2. Set in Order (Seiton):

- Impact on Employee Performance: Organizing necessary items in a systematic manner enhances accessibility and reduces time wasted searching for tools or materials.
- Benefits: Improved work efficiency, quicker task completion, and optimized workflow contribute to enhanced employee performance and task completion.

3. Shine (Seiso):

- Impact on Employee Performance: A clean and well-maintained workspace promotes employee morale, satisfaction, and overall well-being.
- Benefits: A tidy environment fosters a positive work culture, boosts employee engagement, and can lead to increased job satisfaction, contributing to higher performance levels.

4. **Standardize (Seiketsu):**

- Impact on Employee Performance: Establishing standardized work processes ensures consistency, quality, and efficiency in tasks.
- Benefits: Reduced errors, increased quality output, and improved predictability in operations enhance employee performance and overall organizational effectiveness.

5**. Sustain (Shitsuke):**

- Impact on Employee Performance:

Sustaining the 5S practices through continuous improvement and reinforcement ensures long-term benefits and consistent performance.

- Benefits: Employee habits and practices aligned with the 5S principles lead to sustained productivity, reduced waste, and a culture of operational excellence.

Overall, the implementation of 5S Principles in the workplace positively influences employee performance by:

- Enhancing Work Efficiency: Optimizing workspace organization and cleanliness increase work efficiency and productivity.
- Boosting Employee Morale: A clean and well-organized environment fosters a positive work culture, leading to higher motivation and job satisfaction among employees.
- Improving Quality and Safety: Standardizing processes and practices enhance quality output and contribute to a safer work environment.
- Promoting Continuous Improvement: Sustaining 5S practices through ongoing monitoring and improvement initiatives nurtures a culture of continuous improvement and operational excellence, supporting long-term employee performance and organizational success.

By embracing the principles of 5S and integrating them into daily work routines, organizations can create a conducive environment for employees to thrive, excel in their tasks, and contribute effectively to the overall performance and success of the organization.

The impact of employee engagement on employee performance in textile mills in Coimbatore district is substantial and plays a vital role in shaping the overall efficiency, productivity, and success of these organizations. Employee engagement refers to the emotional commitment and dedication employees have towards their work, organization, and goals. Here's how employee engagement influences employee performance specifically within the context of textile mills in Coimbatore district:

1. Increased Productivity:

- Engaged employees in textile mills are more likely to be motivated, committed, and focused on their tasks, leading to increased productivity levels. Their dedication to their work translates into higher output and efficiency in various operations within the mills.

2. Improved Quality of Work:

- Engaged employees tend to take a sense of ownership and pride in their work, striving for excellence in their tasks. This focus on quality can result in the production of high-quality textile products, fewer defects, and

enhanced overall quality standards in the manufacturing process.

3. Enhanced Job Satisfaction:

- Employees who are engaged and emotionally invested in their work experience higher job satisfaction levels. In textile mills, this leads to a more satisfied and content workforce, which, in turn, positively impacts employee morale and performance

4. Better Employee Retention:

- Engaged employees are more likely to stay with the organization for the long term. In textile mills, this results in lower turnover rates, which is essential for maintaining a skilled and experienced workforce. Higher retention rates contribute to operational stability and sustained performance.

5. Increased Innovation and Creativity:

- Engaged employees are more inclined to contribute new ideas, suggestions for improvement, and innovative solutions. In textile mills, this can lead to process optimizations, creative problem-solving approaches, and a culture of continuous improvement, all of which enhance overall performance.

6. Positive Work Culture and Team Dynamics:

- Employee engagement fosters a positive work culture characterized by collaboration, teamwork, and mutual support. In textile mills, this results in better communication, stronger team dynamics, and efficient collaboration among employees, all of which positively impact performance outcomes.

7. Healthier Work Environment:

- Engaged employees show more concern for their well-being and that of their colleagues. In textile mills, a focus on employee engagement can lead to a safer work environment, reduced accidents, and improved health and safety practices, which are crucial for sustaining performance and operational efficiency.

8. Customer Satisfaction:

Enhancing employee engagement in textile mills in the Coimbatore district directly correlates to improved customer satisfaction. Engaged employees are more inclined to deliver exceptional customer service, fostering positive relationships and increasing customer loyalty. By investing in strategies to boost employee engagement, businesses can cultivate a motivated workforce that drives performance excellence, innovation, and competitiveness in the dynamic textile industry of Coimbatore.

Gender distribution of the respondents

GENDER	FREQUENCY	PERCENTAGE(%)
MALE	275	54.6
FEMALE	229	45.4
TOTAL	**504**	**100.0**

Source:Primary data

The data shows that 54.6% of the participants in the study are male, while 45.4% are female. Therefore, the majority of the participants are male.

Age distribution of the respondents

AGE	FREQUENCY	PERCENTAGE (%)
20-30	330	65.5
31-40	140	27.8
ABOVE40	34	6.7
TOTAL	**504**	**100.0**

Source:Primary data

The data in the table shows that a significant portion of the respondents, 65.5%, fall within the age range of 20-30. Following closely behind, 27.8% of respondents are in the 31-40 age group, while only 6.7% are above 40 years old. Therefore, it is evident that the majority of respondents in this study are between the ages of 20-30.

Educational qualification distribution of the respondents

EDUCATIONAL QUALIFICATION	FREQUENCY	PERCENTAGE(%)
UG	314	62.3
PGandProfessionals	190	37.7
TOTAL	**504**	**100.0**

Source:Primary data

Based on the data, it is evident that a significant majority (62.3%) of the participants included in the study hold Undergraduate qualifications, while 37.7% possess Post Graduate and Professional qualifications. This indicates that the majority of the respondents fall under the Undergraduate category for the current study.

Income Distribution of the Respondents

INCOMELEVEL(Monthly)	FREQUENCY	PERCENTAGE(%)
10,000-20,000	75	14.9
20,001-30,000	101	20.0
30,001-40,000	90	17.9
40,001-50,000	79	15.7
ABOVE50,000	159	31.5
TOTAL	**504**	**100.0**

Source:Primary data

The data from the survey shows that the majority of respondents, 31.5%, have a monthly income above Rs. 50,000. Additionally, 20% of respondents fall into the income range of Rs. 20,001-30,000, followed by 17.9% in the range of Rs. 30,001-40,000. Furthermore, 15.7% of respondents have an income between Rs. 40,001-50,000, and 14.9% fall in the income bracket of Rs. 10,000-20,000.

Experience Distribution of the Respondents

EXPERIENCE	FREQUENCY	PERCENTAGE(%)
0-10YEARS	84	16.7
10-20YEARS	420	83.3
TOTAL	**504**	**100.0**

Source:Primary data

Table reveals that the majority of respondents (83.3%) in the present study have 0-10 years of experience, while 16.7% have 10-20 years of experience. This indicates that a larger proportion of participants fall within the 0-10 years' experience category.

Designation Distribution of the Respondents

DESIGNATION	FREQUENCY	PERCENTAGE(%)
TopLevelExecutives	32	6.3
MiddleLevelManagers	154	30.6
OperationalLevelEmployees	318	63.1
TOTAL	**504**	**100.0**

The data presented in the table shows that a total of 6.3% of respondents in the study were top-level executives, including Delivery Managers and Senior Project Managers. Middle-level managers, such as Project Managers and Team Leaders, made up 30.6% of the respondents. The majority, 63.1%, were operational-level employees, encompassing all other staff and specialists. Therefore, a large portion of the respondents in the study were operational-level executives.

Individual Outcomes of Employee Engagement–Job Satisfaction

Variables	N	Mean	Std. deviation	Std.Error Mean	t value	Sig Value	Rank
Thepresent job gives satisfaction	504	3.4683	1.09716	.04887	9.581	*.000	4
Thejobisnot satisfactory (R)	504	3.6488	1.03116	.04593	14.126	*.000	1
The job is satisfactory	504	3.5000	1.06265	.04733	10.563	*.000	3
The job creates enthusiasm	504	3.5020	1.03035	.04590	10.938	*.000	2
The job seemsunending (R)	504	2.7798	1.05000	.04677	-4.709	*.000	5

Source: Primary data
***Significant at 5% level**

From above Table, it is evident that the mean values range from 2.7798 to 3.6488, t values range from -4.709 to 14.126, and standard deviations fall between 1.03116 and 1.05000. Significantly, all these values are statistically meaningful at a 5% level of significance. This leads us to the conclusion that employees in the IT industry strongly believe that their job lacks satisfaction, moderately feel a sense of enthusiasm in their work, and express the least agreement that their job feels endless.

Individual Outcomes of Employee Engagement—Stress and Strains

Variables	N	Mean	Std. deviation	Std. Error Mean	tvalue	Sig value	Rank
Working here makes it hard to spendenoughtime withfamily	504	2.9841	1.10653	.04929	-.322	.748	10
Spendingtoomuch timeat workmakes it difficult to know the real world around	504	2.9643	1.12212	.04998	-.715	.475	12
Theworkdoesnot offerextratimefor other activities	504	2.9444	1.09983	.04899	-1.134	.257	13
It looks like the companyisthereal spouse	504	3.0516	1.13560	.05058	1.020	.308	7
Thereistoomuch ofworkinlimited hours	504	2.9683	1.09716	.04887	-.650	.516	11
Every time the phone rings it is likethecompany is calling	504	2.9980	1.15671	.05152	-.039	.969	9
Thereisnodayoff from working	504	3.1111	1.16423	.05186	2.143	*.033	3
The other employeesarealso burned out by job demands	504	3.0278	1.09182	.04863	.571	.568	8

The job makes everyonenervous	504	3.0794	1.07458	.04787	1.658	.098	5
Thejob is exhausting	504	3.1349	1.08012	.04811	2.804	*.005	2
Thejobis irritating	504	3.0575	1.08426	.04830	1.191	.234	6
Thinkingaboutthe job is stressful	504	3.1032	1.12325	.05003	2.062	*.040	4
Itisguiltytotake timeofffrom job	504	3.2024	1.11679	.04975	4.068	*.000	1

Source:Primary data
****Significant at 5% level***

The data in the table shows that the mean values for the variables range from 2.9444 to 3.2024, t-values range from -1.134 to 4.068, and standard deviations range from 1.09983 to 1.11679. The variables 'There is no day off from working', 'The job is exhausting', 'It is guilty to take time off from the job', and 'Thinking about the job is stressful' are statistically significant at the 5% level. All other variables have significance values greater than 5% and are therefore not statistically significant. In conclusion, employees of IT companies moderately agree that they feel guilty taking time off from work, find their job exhausting, and have limited time for other activities due to their workload.

Factors of Employee Performance-Accomplishment of Task

Variables	N	Mean	Std. deviation	Std. Error Mean	t value	Sig value	Rank
Beingabletofinish the job withinthe given time	504	3.4623	1.13789	.05069	9.121	*.000	3
Work assignments givenareenormous	504	2.7063	1.07801	.04802	-6.115	*.000	4
Repetition of work isavoidedbygiving correct solution to any given task	504	3.4940	1.09034	.04857	10.172	*.000	2
Periodicalreporting tosupervisorsabout accomplishedjob assignments	504	3.5417	1.06557	.04746	11.412	*.000	1

Source:Primary data
****Significant at 5% level***

The data in Table shows that the mean values range from 2.7063 to 3.5417, t-values range from -6.115 to 11.412, and standard deviation falls between 1.06557 and 1.07801. These results are statistically significant at the 5% level. Based on this analysis, it can be inferred that employees in IT companies strongly believe in being punctual and honest in their reporting to their superiors. However, they have mixed feelings about being assigned tasks that may exceed their capabilities.

Factors of employee performance–Skills and abilities

Variables	N	Mean	Std. deviation	Std. Error Mean	t value	Sig value	Rank
Inappropriate shortcuts in the performance result inredoingthework (R)	504	3.4246	1.11482	.04966	8.551	*.000	1
Personal contribution isgiven more than whatisexpected	504	3.2341	1.05172	.04685	4.998	*.000	4
New opportunities aredesiredevenifit means to working extra hours or coming to work before the reporting time	504	3.3433	1.06975	.04765	7.204	*.000	3
Extra responsibilities are willinglytaken as one's own	504	3.3810	1.05595	.04704	8.099	*.000	2

Source:Primary data

****Significant at 5% level***

Based on the data presented in the table, it can be inferred that employees in IT companies generally agree to taking on extra responsibilities independently, but are less likely to approve of taking shortcuts that could lead to having to redo tasks. The mean values, t-values, and standard deviations all show statistical significance at the 5% level.

Influence of employee engagement over the factors of employee performance (Accomplishment of Task)

H0: There is no significant influence of employee engagement overemployee performance factor such as accomplishment of task

H1: There is significant influence of employee engagement overemployee performance factor such as accomplishment of task

Model Summary Showing the Influence of Employee Engagement over Employee Performance Factor: Accomplishment of Task

Model	R	RSquare	AdjustedR Square	Std.Errorof theEstimate
1	.615[a]	.378	.375	.47253

Source:Primary data

Based on the findings in the table, it can be concluded that the employee engagement dimensions have a significant impact on the accomplishment of tasks, as indicated by the R square value of 0.378, adjusted R square value of 0.375, and standard error of the estimate of 0.47253. This means that the employee engagement dimensions' account for 37.8% of the variance in accomplishing tasks, as supported by the Analysis of Variance Table.

ANOVA Table Showing the Influence of Employee Engagement over Employee Performance Factor – Accomplishment of Task

Model	Sum of Squares	Df	MeanSquare	F	Sig.
Regression	67.978	3	22.659	101.481	.000[b]
Residual	111.643	500	.223		
Total	**179.622**	**503**			

Source:Primary data
***Significant at 5% level**

The results in the table indicate that the variables F= 101.481 and p=0.000 are statistically significant at a 5% level. This suggests that the three independent variables are closely associated with the accomplishment of tasks, and their relationship is confirmed. However, to further understand the individual relationships with task accomplishment, the coefficient table below can provide more insight.

Coefficients table showing the influence of employee engagement overemployee performance factor – Accomplishment of task

Model	Unstandardized Co-efficient		Standardized Co-efficient	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.982	.081		24.399	*.000
EEV	.225	.069	.353	3.280	*.001
EEDE	.126	.052	.220	2.415	*.016
EEAB	.038	.060	.059	.640	.523

Source:Primary data

***Significant at 5% level**

The coefficient table above illustrates the positive impact of Vigor and Dedication on task accomplishment. The results show that Vigor (β = 0.353, t= 3.280, p = 0.001) and Dedication (β= 0.220, t= 2.415, p =0.016) play a significant role in enabling employees in IT companies to complete their tasks on time, regardless of their workload or pressure. This high level of engagement and commitment to their work not only enhances individual performance but also boosts overall productivity within the organization. These findings align with previous research by Anitha J (2014).

Future Scope:

Further Research: The author can suggest avenues for further research in exploring the long-term effects of implementing 5S Principles and enhancing employee engagement on sustained performance improvements in textile mills. This could involve longitudinal studies to track the impact over time.

Comparative Studies: Proposing comparative studies with other industries or regions to understand the generalizability of the findings and to identify industry-specific nuances in the application of 5S Principles and employee engagement.

Technology Integration: Considering the integration of technology in implementing 5S Principles and enhancing employee engagement to improve operational efficiency and performance outcomes in textile manufacturing.

Implications:

Practical Applications: Discussing practical implications for textile mill managers and practitioners on how to effectively integrate 5S Principles and foster employee engagement to enhance performance and productivity.

Training and Development: Highlighting the importance of training programs and development initiatives to instill 5S Principles and promote employee engagement within textile mills for sustainable performance improvements.

Organizational Culture: Emphasizing the role of organizational culture in supporting the implementation of 5S Principles and fostering employee engagement to create a conducive work environment for achieving operational excellence.

Conclusion:

The influence of employee engagement on employee performance within the dynamic landscape of textile mills in Coimbatore district is unmistakable. As employees demonstrate emotional commitment, dedication, and enthusiasm towards their work, the ripple effects in productivity, quality, job satisfaction, retention, innovation, teamwork, safety, and customer relations are deeply felt throughout the organization. The interplay between employee engagement and performance is not merely a theoretical construct; it is a tangible driver of success that shapes the fabric of operational excellence and organizational resilience.

By fostering a culture of engagement, textile mills in Coimbatore district can unlock the full potential of their workforce, yielding benefits that extend far beyond individual job roles. The alignment of employees' sense of ownership, pride in work, and collaborative spirit not only enhances internal operations but also leaves an indelible mark on customer experiences and organizational sustainability. As the textile industry continues to evolve, prioritizing employee engagement emerges as a strategic imperative to navigate challenges, drive growth, and secure a competitive edge in the market.

In conclusion, the synergy between employee engagement and performance in textile mills is a recipe for success—a recipe that embodies the commitment to excellence, the power of teamwork, and the dedication to fostering a thriving work environment. As Coimbatore district's textile mills embrace the intrinsic value of employee engagement, they pave the way for enduring success, innovation, and customer-centric operations in a landscape characterized by change and opportunity. Let the narrative of engaged performance be the thread that weaves a tapestry of achievement, resilience, and prosperity in the vibrant textile industry of Coimbatore district.

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Exploring Technology Trends - Revolutionizing the Horizon

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Abstract

The essential technologies are indeed convergent, and this convergence is accelerating. It is promoting long-term reform and improving daily operations. Blockchain and AI combine with IoT to create supply chains that are more transparent, resilient, and flexible. When combined, AI and quantum computing can help business travellers find better routes. Together with AI and the Internet of Things, virtual and augmented reality can assist develop goods and services and facilitate seamless cross-geographic workforce cooperation. Complex industrial processes are automated using modern robotics and neuromorphic computers.In today's corporate world, there are countless examples of convergence, these are only a handful. Further integration follows, which is aided by international standards and shared methodologies to improve sustainability, data and transaction trust, and governance. The exceptional scalability and possible ease of use of GenAI can make these technologies accessible.The rate of technological change will inevitably continue to pick up speed. Future technology leaders that are successful will need to develop the skills necessary to not only accept new technologies but also turn constant change into a source of competitive advantage.

Keywords- *Innovation environment, Technology transfer, Innovation ecosystem, Open innovation*

Introduction

Technology trends are the new discoveries, innovations, and advancements in technology. These trends commonly shape businesses, sectors of the economy, and society as a whole, affecting our daily relationships, professions, and manner of living. Staying abreast of technology innovations is crucial for individuals and businesses alike, as it maintains their competitiveness and relevance in the always evolving digital ecosystem. By keeping up with changing technologies, one may adopt new tools, expedite processes, and seize development opportunities.

When technologies or applied sciences improve in terms of precision, accuracy, efficiency, power, or capability, this is known as technological advancement. Throughout history, scientific and technical developments have brought about a great deal of change, some of which have been positive. The

Internet of Things is still expanding, linking commonplace objects and facilitating more intelligent corporate processes. The Internet of Things' integration into business models signals a move towards more networked, effective, and intelligent operations, from improving consumer experiences to streamlining supply chains. Artificial intelligence is one of the most sophisticated technologies available today (AI). AI is a branch of computer science that gives machines human-like capabilities for reasoning, learning, and thinking. Numerous industries, including robots, autonomous vehicles, healthcare, finance, and many more, are using artificial intelligence (AI).

Top New Technology Trends for 2024

The rate of change is accelerating due to the rapid evolution of technology, which makes development and change possible more quickly. But a lot more has changed, and technology trends and emerging technologies are not the only things that are changing. This realization has made IT professionals recognize that their job in the contactless world of the future will alter. Furthermore, an IT worker in 2024 will never stop learning, unlearning, and relearning. It entails keeping up with the newest technological developments and trends. It also entails keeping an eye on the future to determine what abilities you'll require in order to find a stable career tomorrow and even figure out how to get there.

1. Generative-AI

Modern technology called "generative AI" has completely changed a number of sectors by allowing machines to produce content that seems like it was created by humans. It may be used for many different things, such as creating text, creating images, and even creating music. People that are proficient in generative AI can go on to pursue fascinating careers in data science, artificial intelligence research, and the creative industries. A bright future awaits those who grasp generative AI, as its applications continue to grow and offer potential to influence content creation and human interaction in the digital age.

2. Computing Power

With practically every gadget and appliance in the digital age being computerized, computing power has already cemented its place. And it's here to stay, since data science specialists have forecast that in the years to come, the computing infrastructure we are currently developing will only get better. While we currently have 5G, get ready for a world of 6G, where we will have more power in our hands and be surrounded by technology. Even better, the industry is seeing an increase in tech jobs due to computing capacity, however obtaining these positions would require specific qualifications.

The biggest percentage of employment in every nation will come from this industry, which includes data science, robots, and IT management. More technicians, IT teams, relationship managers, and the customer care industry will grow as our devices become more complex. Robotic Process Automation, or RPA, is a crucial subfield of this discipline that you may study today.

3. Smart(er) Devices

Artificial intelligence plays a big part in making our world smarter and more productive. It does much more than just imitate human behaviour to make our lives

easier and simpler. As data scientists continue to create artificial intelligence (AI) wearables, appliances, work devices, and house robots, these increasingly intelligent gadgets are here to stay in 2024 and beyond. Intelligent software is needed for almost all tasks in order to improve our ability to manage our work lives. Smarter gadgets are another highly demanded addition to the IT industry as more firms move into digital spaces. Nearly all higher-level occupations require strong IT and automation abilities to succeed.

4. Datafication

To put it simply, datafication is the process of turning everything in our life into software or gadgets that run on data. To put it briefly, Datafication is the conversion of manual jobs and duties into technological solutions based on data. Data is here to stay for longer than we might imagine, from our smartphones, office applications, and industrial machinery to AI-powered appliances and everything else! Thus, maintaining accurate, reliable, and secure data storage has become a highly sought-after specialty in our industry. There will be a greater demand for IT specialists, data scientists, engineers, technicians, managers, and many other roles as a result of datafication. What's even more helpful is that anyone with a basic understanding of technology may become certified in specializations linked to data and obtain employment in this field.

5. Artificial Intelligence (AI) and Machine Learning

In the last ten years, artificial intelligence, or AI, has already generated a lot of noise. Even yet, it's still one of the newest technological trends because it has a significant impact on our daily lives and is still in its infancy. AI is already well-known for its excellence in a wide range of applications, including ride-sharing, personal assistants for smartphones, image and speech recognition, and navigation apps.In addition, AI will be used to analyze interactions in order to uncover underlying relationships and insights; predict demand for services such as hospitals, which will help authorities better allocate resources; and identify shifting customer behavior patterns through near-real-time data analysis, which will increase revenue and improve personalized experiences.

6. Extended Reality

Virtual reality, augmented reality, mixed reality, and all such technologies that mimic reality are together referred to as extended reality. We all yearn to escape the perceived actual bounds of the world, which makes it a huge technological trend at the moment. This technology, which creates a reality without any physical presence, is extremely well-liked by gamers, medical professionals, retail, and modelling industries.In terms of extended reality, gaming is a key industry for well-liked jobs that only demand an online gaming interest rather than advanced credentials.

7. Digital Trust

People's faith and trust in digital technologies have grown as a result of their increased use and accommodation of gadgets and technologies. Another important factor driving further improvements is the widespread confidence in digital platforms. People who have a digital conviction think that technology can make the internet a safe,

dependable, and secure place where businesses may develop and produce without having to worry about losing the trust of the public.The two main specialities you can look into are cybersecurity and ethical hacking, which can help establish a safer environment for digital users. You can find a range of employment in these two, from junior to senior positions. While professional credentials may be required for ethical hacking, a certificate or even a master's degree in cybersecurity is sufficient to seek for a high-paying position.

8. 3D Printing

Using 3D printing to create prototypes is a major breakthrough and technological trend. This technique has had an impact on both the industrial and biomedical fields. While printing an actual product from a printer is a reality today, none of us ever considered doing so. Thus, another breakthrough that is here to stay is 3D printing. Many jobs pay well and are international, especially for organizations in the data and healthcare sectors who need a lot of 3D printing for their goods.

9. Genomics

Imagine a breakthrough in technology that lets you study and use your DNA to better prevent diseases and other disorders! The study of the structure, mapping, and composition of genes and DNAs is known as genomics technology. Additionally, by quantifying your DNA, this could help detect illnesses or other possible problems that could later become health difficulties. In a field such as genomics, there are many opportunities available, both technical and non-technical. While technical careers in this field mostly involve planning, analyzing, and diagnosing, non-technical employment in this field focuses on higher degrees of research and theoretical analysis.

10. New Energy Solutions

For the sake of our energy consumption and the environment, everyone has decided to live a greener lifestyle. As a result, homes employ more environmentally friendly options like solar and renewable energy, while cars operate on electricity or batteries. Even better, since more people are aware of their waste and carbon footprints, reducing them or converting them to renewable energy sources would benefit society even more. Energy solutions became the next big thing in technology as a result of this! Data-driven and environmental occupations are also growing in the alternative energy sector. These positions are for people with qualifications in social science and science specializations.

11. Robotic Process Automation (RPA)

Robotic Process Automation (RPA) is a technology that automates tasks, much like AI and machine learning. Robotic Process Automation (RPA) is the use of software to automate business activities, including handling data, processing transactions, reading applications, and even responding to emails. RPA automates human labor-intensive repetitive tasks. RPA automation is predicted by Forrester Research to endanger the careers of at least 230 million knowledge workers, or around 9% of the world's workforce, but it is also generating new jobs and changing current ones. According to McKinsey, over 60% of jobs

might be partially automated but less than 5% of jobs could be fully automated..

12. Edge Computing

Cloud computing, which was once a hot new tech trend to follow, has entered the mainstream thanks to the dominance of big firms like Microsoft Azure, Google Cloud Platform, and Amazon Web Services. Cloud computing is becoming more and more popular as more companies move to cloud-based solutions. Organizations are becoming more and more aware of the limitations of cloud computing as the amount of data they manage grows. By avoiding the latency brought on by cloud computing and sending data directly to a data center for processing, edge computing is intended to assist in resolving some of those issues. It can be found "on the edge," so to speak, nearer to the location where computation is required.

13. Quantum Computing

Quantum computing, or computing that makes use of quantum phenomena like superposition and quantum entanglement, is the next big technological development. Because of this incredible technological trend's ease of querying, monitoring, analyzing, and acting upon data from any source, it is also helping to stop the coronavirus from spreading and to develop possible vaccines. Quantum computing is also being used in the banking and finance industry for fraud detection, high-frequency trading, and credit risk management.Large companies like Splunk, Honeywell, Microsoft, AWS, Google, and many more are currently interested in generating advances in the field of Quantum Computing. Quantum computers are currently a myriad of times quicker than conventional computers.

14. Virtual Reality and Augmented Reality

Virtual reality (VR), augmented reality (AR), and extended reality (ER) are the next great technological development. While AR improves the user's surroundings, VR immerses the user in it. Up until now, this technological trend has mostly been utilized for gaming, but it has also been employed for training. For example, VirtualShip is a simulation program that is used to teach ship captains in the U.S. Navy, Army, and Coast Guard. We can anticipate a greater integration of these technologies into our daily life in 2024. Virtual reality (VR) and augmented reality (AR) have a lot of applications in marketing, education, training, entertainment, and even injury recovery. They typically function in concert with some of the other cutting-edge technologies we've covered in this list. Using either, surgeons may be trained, and visitors to museums could be offered

15. Blockchain

While most people associate blockchain technology with cryptocurrencies like Bitcoin, blockchain provides security benefits in numerous other domains. To put it simply, blockchain is just data that you can add to, not take away from or modify. Since you are creating a chain of data, the term "chain" makes sense. What makes it so safe is that the prior blocks cannot be changed. Furthermore, as blockchains are consensus-driven, no single party is able to seize ownership of the data. Blockchain eliminates the need for transaction oversight and

validation by a reliable third party.Blockchain technology is being used in a number of businesses, and as its application grows, so does the need for qualified personnel.

16. Internet of Things (IoT)

IoT is another exciting new technology trend. These days, a lot of "things" are constructed with WiFi connectivity, enabling them to connect to the Internet and to one another. And so the Internet of Things (IoT) was born. The Internet of Things, which has already made it possible for gadgets, vehicles, home appliances, and much more to be connected to the network and share data, is the wave of the future. Furthermore, this new technological trend is barely getting started: According to projections, there will be some 50 billion IoT devices in use globally by 2030, connecting a vast network of gadgets that includes anything from kitchen appliances to smartphones. Additionally, you must become knowledgeable about information if you want to use this cutting-edge technology.

17. 5G

5G is the next big thing in technology, coming after IoT. 5G services are anticipated to completely transform our lives, in the same way that 3G and 4G technologies allowed us to access the internet, use data-driven services, improve bandwidths for streaming on YouTube or Spotify, and much more. By making cloud-based gaming services like Google Stadia, NVidia GeForce Now, and many more available, along with applications that rely on cutting-edge technology like AR and VR. It is anticipated to be utilized in industries, smart grid control, smart retail, and HD cameras that enhance safety and traffic management.Almost all telecommunications companies, including QualComm, Apple, Tmobile, Verizon, and Nokia Corp., are now developing 5G applications. By the end of 2027, there will be 4.4 billion 5G Network subscribers.

18. Cyber Security

Given that it has been around for a while, cyber security may not seem like a new technological trend, but it is still developing along with other technologies. This is partially due to the ever-evolving nature of threats. Malevolent hackers who are attempting to obtain data illegally are not going to give up easily, and they will keep finding methods around the most robust security systems. Additionally, some of it stems from the adaptation of new technologies to improve security. Because cybersecurity will always be advancing to ward off hackers, it will continue to be a hot topic in technology.By 2025, 60% of businesses will use cybersecurity risk as their main consideration when entering into business agreements and dealing with third parties, predicts Gartner.

19. Full Stack Development

The process of creating a web page or software application's front end (user interface) and back end (server side) simultaneously is known as full stack development. Full stack developers may work on the whole software stack because they are skilled in a variety of technologies and programming languages. Businesses are looking for adaptable developers that can create end-to-end solutions quickly, which has led to the growth of this trend. Faster product development and deployment are

made possible by full stack development, which simplifies the development process.

20. DevOps

A collection of procedures known as DevOps emphasizes cooperation and communication between teams working on software development (Dev) and IT operations (Ops). In order to enable more frequent and dependable releases, it attempts to automate and optimize the software development and deployment lifecycle. Infrastructure as code, automated testing, continuous integration, and continuous delivery are examples of DevOps methods. Implementing DevOps results in enhanced software quality, accelerated development cycles, and more adaptability to changes and client demands.

21. Metaverse

Users can engage in real-time interactions with digital settings and each other in the metaverse, a virtual and interconnected digital cosmos. To create immersive, shared experiences, it blends virtual reality (VR), augmented reality (AR), and other technologies. Businesses are looking into using the metaverse in a variety of fields, including social networking, education, gaming, and healthcare. This trend, which unites the digital and real worlds, is anticipated to have a significant impact on business collaboration, communication, and entertainment.

22. Digital Twins

Digital twins are computer-generated images of real-world systems, processes, or things. Data from sensors and Internet of Things devices, among other sources, is used to construct these digital representations. Organizations can use digital twins to monitor, replicate, and evaluate real-world activities and assets in a virtual setting. They are used in a variety of fields, including industry, healthcare, and urban planning. Businesses may increase efficiency, safety, sustainability, and decision-making by optimizing processes and building digital twins.

Despite the fact that technologies are constantly developing and changing, these 18 technological trends present excellent job opportunities both today and in the near future. Additionally, the majority of these popular technologies are open to experienced experts, so now is the ideal time for you to select one, receive training, and join the trend early on.

Conclusion

Information Technology is widely acknowledged as a crucial factor in the advancement of both technology and the economy. In order to alter the organization, the nature of work, connections with other businesses, or any other aspect of business, managers deploy new technologies. Information technology is essential for maximizing efficiency and productivity in government, business, and academic settings. Any organization's infrastructure, which includes computers, network and telecommunication technologies, data, and essential software applications, determines how valuable information technology is. Today, globalization and modern technological advancement are driven by

information technology, which also improves the effectiveness and efficiency of information management. Consequently, the adoption and advancement of information technology is being severely hampered by a shortage of certified and well-respected workers worldwide.

Scope for Future Research

Technological change is set to have profound impacts over the next 10-15 years,widely disrupting economies and societies. As the world faces multiple challenges,including ageing, climate change, and natural resource depletion, technology will becalled upon to contribute new or better solutions to emerging problems. These socioecological demands will shape the future dynamics of technological change, as willdevelopments in science and technology.International cooperation usually proves beneficial for research and innovation endeavours centered around critical and developing technologies, which are becoming more globally dispersed. This implies that it will become more and more necessary for international coordination to regulate developing technologies and how they are used, for example, through agreements and regulations.

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A Study on Supply Chain Management through Emerging Technologies

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Abstract

Consumers leveraged media attention to demand answers when multiple supply chains failed to deliver COVID-19 pandemic products, such as hand sanitizer, cleaning supplies, and toilet paper. Approximately 95% of Fortune 1000 companies were experiencing disruptions in their global supply chain operations in China, according to industry reports. Several emerging technologies can help solve some of the supply chain crisis' problems. In addition to enhancing the system's resilience, these innovations reduce emissions and waste, increase the flow of goods, and reduce costs. This article explores new practices and applications on technology-driven supply chain management in Industry 4.0. This article discusses a few of these automations that can improve supply chain management and providing an overview of the current situation and challenges. Discussions in this article are based on numeric data recently published by (Woods, 2024), (Nasereddin, 2024), (Tong, 2024), etc.

Key-words: *Supply chain management, Emerging technologies, Applications, Challenges, Status review.*

Introduction

As a result of the emergence of systems theory from the 1950s, and the notion of holism that went along with it, the term supply chains were born. Through supply chain management (SCM), raw materials are sourced, manufactured, shipped, and delivered to the final consumer in an optimized way (Herold, Ćwiklicki, Pilch, &

Mikl, 2021). People often confuse logistics with supply chain, but logistics is just one element of supply chain. Logistics (including transportation and fleet management), procurement, product lifecycle management, inventory planning, and order management are all aspects of supply chain management. Management of global suppliers and multinational production processes can also be included as part of SCM. A digitally based SCM system today includes material handling and software for suppliers, manufacturers, wholesalers, transportation and logistics providers, retailers, and all parties involved in the creation, fulfillment, and tracking of products or services. As long as there have been products and services, supply chains have existed and as industrialization progressed, SCM evolved, allowing companies to deliver goods and services more efficiently. For example, in order to meet the demands of a growing clientele, Henry Ford's standardization of automobile parts was a trend- setter. In the past few decades, incremental changes have resulted in SCM systems becoming increasingly sophisticated due to inclusion of computers (Nasereddin, 2024). Despite all the changes, the internet, technological innovation, and the rise of the global demand-driven economy have changed everything.

A just-in-time supply chain, where retail sales instantly transmit replenishment requests to manufacturers, has become the industry norm. Then, retail shelves may be refilled virtually as soon as something is sold. Analyzing the data from supply chain partners to see where more changes can be made is one technique to further improve this process. The most evident *"face"* of the company to customers and consumers is the supply chain. A company's supply chain management will defend its brand and long-term viability, how better and more effectively it is. Globalization and technology innovation have led to rapid changes in customer expectations and global business. A demand-driven operating model is the most effective supply chain strategy for delivering goods and services at extraordinary speeds and accuracy by integrating people, processes, and technology. The supply chain has always been a fundamental component of business, but today it is more vital than ever as a measure of success. The companies those are able to manage their supply chains effectively will thrive and survive in today's volatile, technology- driven, ever-changing business environment. Efficiency and cost reduction have been the primary goals of SCM for a long time. It hasn't changed the needs, but it has changed the way SCM priorities are set, with a strong focus now on customers. "*The supply chain lives or dies by customer experiences,"* has been said. An enterprise's ability to fulfill customer expectations quickly and accurately is crucial to customer loyalty. Coordinating raw materials, production, logistics, trade, and order management are critical to getting a given item to the customer in a timely manner. The supply chain must be viewed

through the eyes of the customer in order for this to be accomplished. The goal isn't just to deliver the order on time; it's about doing everything at the right time-before, during, and after.

With the help of technology, a supply chain can significantly lower costs by speeding up the movement of materials and subassemblies to the factory on time. It is possible, for example, to boost sales quickly by delivering the right products at the right time and in the right quantities from the factory to the store, resulting in fewer overstocks or out-of-stocks. By enhancing access to information and simulations, supply chain technology increases agility, allowing executives to resolve problems or generate new business much more quickly. It's critical to connect planning and execution to ensure that the entire organization is aware of new decisions and on the same page in today's fast-paced business environment. Customer loyalty and happiness have never been more dependent on supply chain technology. The challenges faced by the Omni-channel consumer make it even more essential. Both retailers and manufacturers should benefit from effective forecasting and distribution since smaller completed goods inventories translate to lower warehouse and transportation expenses.

The global COVID-19 epidemic was very difficult for the supply chain to adjust to (Ganichev & Koshovets, 2021). Demand disruptions are more concerning, even though the majority of conversations about the supply chain have been on supply disruptions, such as the closure of factories making automobile components in Wuhan or meat packing operations in the US. The restoration of supply would have been irrelevant if demand could not rise again. Of fact, it was not that easy; in certain cases, supply disruptions might be directly linked to problems with demand. However, a large portion of the demand has been caused by the cessation of commercial operations. Predictions that customers would swiftly revert to their previously preferred firms may be crossing a narrow line when it comes to consumer trust. Supply chain recovery occurred in each area in the same order as COVID-19 (Esper, 2021). The timeframe of the supply chain recovery is still uncertain, but it will happen. Nonetheless, a number of senior supply chain executives spoke during pandemic, with expressed their frustration with demand issues, including not only the decline in demand across many different product categories but also their inability to forecast future demand given the variety of market uncertainty (Ellis, 2020). One supply chain executive said, *"Right now, we just cannot estimate demand properly. Even though we have pretty sophisticated demand planning skills, forecasting still significantly depends on extrapolating from the past to anticipate the future."*

Global supply chains became even more fragile due to upstream suppliers in Russia and Ukraine got disrupted. To address possible hazards, visibility into this extensive network becomes essential. One of Europe's

biggest weaknesses is its over-dependence on Russian natural gas and crude oil, as well as its reliance on both countries for essential agricultural goods. The Food and Agriculture Organization of the United Nations estimates that more than 25% of the world's wheat trade, more than 60% of the world's sunflower oil, and 30% of the world's barley exports come from Russia and Ukraine (Toygar & Yildirim, 2023). Due to the fact that Russia is a significant exporter of fertilizers, any supply issues or access restrictions may have an effect on agricultural yields all over the world. Not just agricultural commodities and oil are in trouble. The main reason Russia plays above its weight, according to an analysis is because it exports a significant amount of some of the most crucial commodities in the world (Tsanga, Fanb, Fenga , & Lia, 2024). Many of the 35 critical minerals that the US Department of the Interior considers essential for the country's economic and national security interests come from Russia, including 13% of titanium and 11% of nickel, which together account for 30% of the world's supply of the platinum-group elements, including palladium (Tong, 2024). Neon, which is used to etch circuits on silicon wafers, is also an important source of supply in Russia. Since the battle began, the price of palladium, a crucial component of automobile catalytic converters, has increased by as much as 80%. As Biden issued an executive order last year for the government to look into the supply chains for semiconductors, batteries, rare earths, and biopharmaceuticals, tensions between the U.S. and China over Taiwan and the semiconductor industry are growing. The Trump and Biden administrations implemented one punishment after another, which caused a significant crisis for China's semiconductor sector (Woods, 2024).

At this point in time, when we see global instabilities in terms of national, regional, religion conflicts after the covid-pandemic, it became utter important to learn and compare the emerging trends in supply chain management due to integration of advent technologies. We anticipate that most supply disruptions will be resolved quite quickly when comparing supply and demand. The difficulties that supply chains face make it evident that the previous methods of operation will not be sufficient, and that even a performance that is best in class now is unlikely to be sufficient in the future. The role of emerging technologies is utter importance in managing the supply chains. The purpose of this paper is to present the emerging technologies that are driving supply chain management. A future-oriented management approach and technological advancement will mutually get benefit.

Supply Chains for Industry 4.0

As part of its high-tech strategy to address the new challenges, the German government launched the Industry 4.0 initiative in 2011. In the fourth industrial revolution, new technological developments, primarily the Internet of Things and the fusion of the real and virtual worlds, form the technological

core. In most cases, Industry 4.0 calls for the vertical and horizontal integration of information and communication technologies, in addition to end-to-end engineering across all stages of the product life cycle. Industry 4.0 helps companies improve their competitive-ness, productivity, and revenue growth through technology. All business activities, from production to customer management, are affected, resulting in radical changes in processes, communication, and relationships. In addition, people have been made aware of the ecological aspect, such as the finite nature of resources, as well as the social aspect, including fears regarding job losses due to emerging technologies. Hence, Industry 4.0 reveals many interconnections to the Triple Bottom Line concept (TBL) and demonstrates the importance of investigations for both research and practice. Several countries have already begun developing their own initiatives to implement Industry 4.0 measures; TBL and Industry 4.0 both have strong influences on the society (Birkel & Müller, 2021). Value creation is increasingly shifting from pure economic benefits to holistic sustainability, which includes social and environmental factors. A comprehensive sustainable development must be ensured by adopting economic, environmental, and social standards in equal measure, as outlined in the TBL approach. Consequently, it is not surprising that Industry 4.0 is still gaining traction among companies and researchers alike, while several countries are developing their own initiatives to create Industry 4.0 models. Cognitive enablement is a critical component of digital capabilities, which is currently defining the competitive advantage. There are more and more instances of businesses created in the digital era with a business plan that was not feasible a few short years ago (Aravindaraj & Chinna, 2022). The world of business is undergoing a permanent transformation, whether it is due to the Netflix content streaming model revealing the antiquity of physical movie rentals or a tiny firm like Mink providing cosmetics customization using 3D printer technology. Although they receive the majority of the attention, it is not just about disruptive business models and innovation; it also involves streamlining and modernizing operational procedures to gain a considerable competitive advantage.

Among those promising approaches is the circular economy, which bridges TBL and Supply Chain Management (SCM) by combining economic and ecological considerations. Especially companies contribute a great deal to waste, emissions, and energy consumption. A key element of Industry is smart factories that are linked across the whole supply chain. SCM is inherently interconnected to the concept of sustainability and the circular economy because it incorporates many ecological and social factors. Supply chains must be viewed holistically in order to understand certain aspects. Considering their considerable intersections and magnitude, extensive research is required. Extant research reveals,

however, that only two out of three topics are directly related to these research endeavors (Tyllianakis, Martin-Ortegaa, & Banwar, 2022).

Supply chains have the potential to be more efficient and adaptive with new strategies and technologies, but many companies are unable to comprehend how these technologies will interact with existing operations and personnel issues both during and after the implementation. Essentially, SCM is the management of information, data, and products for the purpose of having a smooth and efficient flow of information between a company and its immediate suppliers and customers. Over the past few years, technology has led to continuous advancements in supply chain management with new trends emerging. In today's highly competitive environment, where the performance of the supply chain can give competitive edge to others, these managers are continuously investigating any shortcoming or discrepancy in the supply chain (Mastrocinque, Ramírez, & Honrubia-Escrib, 2022). Therefore, companies must continuously update their employees' skills and introduce new inventions to their supply chain. The purpose of this paper is to search and present for holistic approaches to integrating emerging technologies into supply chain management.

Recent Innovations in Supply Chain Management

In the logistics industry, efficient supply networks contribute to the competitiveness of companies. According to one study, supply chain management gives a business an edge over its competitors and helps it grow (Kherbach & Mocan, 2016). Innovation in supply chains across a range of sectors benefits companies, employees, and consumers. As we live in a digitally connected world, we can use technologies with a high potential for transformation to make operations more resilient and resistant. As a result of the worldwide Covid pandemic followed by political instabilities and global conflicts, the supply-chain sector has been damaged and its significance has been reemphasized and its outlook for the future has been radically overhauled. A technologically supported SCM system gives the sustainable alternative for conventional methods.

Artificial Intelligence

Using artificial intelligence (AI), machines will be able to mimic, learn, and replace human intelligence. The techniques used for artificial intelligence range from traditional symbolic AI that relies on mathematical representations of problems to sub-symbolic AI, such as fuzzy systems and evolutionary computation, and statistical AI, which incorporates Machine Learning methods. Due to its ability to recognize business patterns, learn business phenomena, seek information, and analyses data intelligently, artificial intelligence has shown great promise in improving human decision-making processes and productivity in a wide range of business endeavors since the late 1970s (Mediavilla, Dietrich, & Palma, 2022).

Supply chain management (SCM) has seen limited application of AI, despite its popularity as a decision-aid tool. It is important to review the past record of success in applying AI to SCM in order to identify the most fruitful areas of SCM in which to apply AI. Several of these technologies are found in business applications, including real-time reporting and interactive data visualization. The use of AI and machine learning to streamline operations and automate procedures is becoming more popular as more companies have access to Big Data (Najafabadi, illanustre, & Khoshgofta, 2015). The use of predictive analytics and machine learning is improving planning and decision support systems, detecting buying trends, and automating time- consuming warehouse operations. The SCM research field is still in its infancy with respect to AI as a predictive and learning capability.

Augmented Reality

An important component of Industry 4.0 is augmented reality, which is the merging of the real world with the digital world. Computer generated graphics are added to data received from the environment by AR devices via digital processing. In order for an AR system to work, it needs to combine real and virtual objects inside a real environment, to run interactively, to operate in real time, and it needs to align real objects with virtual objects. A quick access to anticipatory information is possible with AR applications in the logistics sector. In the global market, many aircraft manufacturers have widely used AR (Devagir, Niyaz, Yang, & Smith, 2022). By providing realistic scenarios, AR technology can be applied to supply chains.

Warehouse Operations

Automation in warehouses offers several benefits. When warehouse managers start automating their processes, one of the first benefits they observe is a reduction in the amount of human errors. With augmented reality, supply chain management can accelerate production, reduce downtime of machines, minimize internal costs, and streamline sales processes, improving employee engagement and boosting productivity (Lotsaris, Fousekis, Koukas, & Aivaliotis, 2021). Various activities make up supply chain management, including planning, controlling, and executing a product's flow from the raw material warehouse to the manufacturing plant and finally to the customer. The supply chain can stall if one of these stages is not handled correctly, so automating it is a good way to optimize it (Cirulis & Ginters, 2013). Hence, companies are now integrating AR into their supply chain management processes. Approximately 20% of the total cost of warehousing is attributed to receiving, unloading, counting, sorting, arranging, and keeping accurate records and 55- 60% of the overall expenditures are related to the cost of picking up the items. By digitizing these procedures, AR has the potential to lower these expenses (Ginters & Martin-Gutierrez, 2013). Workers are escorted through warehouses to do the aforementioned procedures using smart

glasses and AR devices, greatly minimizing the possibility of mistake. Employees using AR devices may get real-time inventory and storage information as well as information on where the needed items are located. With the use of AR technology, warehouse layouts can be planned and constructed that serve not only as storage solutions but also as value-added service centers for efficient storing, repackaging, and maintenance. With its object detection, internal navigation, and real-time inventory updates, augmented reality (AR) enables improved staff training with better maintenance.

Transport Operations play a crucial role in the retail industry since firms must send their goods to clients all over the world. In addition to the expense associated with this, the entire process needs rigorous upkeep in order to monitor and track each and every shipment. Physical cargo manifests and human tracking methods may not be necessary thanks to augmented reality software (Anderies, Adidarma, & Chany, 2023). Workers will be given step-by-step instructions for loading and tracking containers using the AR software. AR-enabled wearable can also make last-mile deliveries, dynamic traffic support, and parcel handling, loading, and distribution easier.

Defect & Repair

Augmented reality (AR) glasses with improved image recognition algorithms allow for defect finding and rectification in large machinery used in product sorting and repackaging. With the use of these glasses, one may examine machinery and spot any mechanical or structural issues with it (Stübl, Ebenhofer, Baue, & Pichler, 2022). This enables prompt system maintenance, preventing any significant malfunctions or delays in the supply chain. Additionally, with the aid of real-time lessons and how-to films, AR powered glasses may give instructions for fixing and repairing any mechanical fault.

Customer Support

Customers will be able to trace their shipments from the warehouses to their doorstep via AR-enabled parcel service applications. Other information about the consignment, such as size, weight, volume, and price, will also be sent by the apps to the user (Rejeb, Rejebb , & Treiblmaier , 2023). Additionally, the apps will provide a range of price and insurance alternatives. Customers will be able to track the items waiting to be delivered or replaced and receive real-time updates on the progress of any refunds. Automation in this area is necessary due to the complexity of the process and the globalization of supply chain management. Businesses are beginning to see the advantages of integrating AR into supply chain management. Even though they are still in their infancy, augmented reality apps have the power to drastically alter and improve supply-chain management productivity (Sharma, Mehtab , Mohan, Shah , & Kamal, 2022).

Internet of Things

As technology continues to advance at lightning speed, companies today are focusing on marketing and business models

that enhance consumer engagement. Internet of Things (IoT) is creating an ever-increasing impact on communication and is growing rapidly in adoption. A cyber-physical system is a system that is capable of receiving input from its environment through scanning or communication with other devices and adjusting its behavior based on that input, in other words, by implementing sensors and actuators into existing products. As well as remote access to and control of the data collected, these devices are also connected to a network. The past few years have seen fast inclination to include such devices in industries as internet of things (IoT) to achieve more automation. IoT promotes bidirectional information sharing throughout the supply chain from suppliers to customers - informed processes enable adaptive and flexible supply chains (Tan & Sidhu, 2022). By bringing together individuals from all business sectors and locations and supplying them with pertinent information in real time, "informed people" will be able to deliver smarter operations, maintenance, and design, as well as better service and safety. However, industry is only slowly adopting and using IoT technologies, open platforms, and communication protocols. Utilizing consumer input on the offered goods and services, product customization, customer profile information, and feedback collection during the manufacturing phase.

Understanding where items are situated, how they are stored, and when they could be anticipated at a specific location has significantly improved. Sensors can predict equipment wear and tear, allowing for the early ordering of new parts. The visibility of the supply chain is increased via IoT. The Internet of Things (IoT) appears to be developing into a mature technology. Data indicates that from 11% in 2013 to 28% in 2020, more businesses will be employing Internet of Things devices (Shojaeinasab, Charte, Jalaye, & Khadivi, 2022). Up to 2022, the International Data Corporation projects annual growth of 13.6% due to the Internet of Things. Businesses can track deliveries, automate stock reordering, and check inventory all in real time given that IoT can be applied throughout the whole supply chain, it is simple to understand why it is so alluring. With it results, firms may increase overall return on investment, increase efficiency, cut downtime, and anticipate customer demands.

Robotics and Automation Systems

Supply chain operations can be enhanced with robotics and autonomous systems (RAS). The use of robots in logistics will allow supply chain operations to be more accurate, faster, and more accurate, resulting in a reduction of human error. The productivity and uptime of robots are higher than that of human employees (Tripath & Choudhary, 2020). A robot cannot replace a human, but instead enhances productivity by working with them. Inefficient supply chain processes can be found and improved through the automation of robotic processes.

The harvesting of fruits and vegetables, for example, is an important stage of agricultural production, and it is still predominantly done by hand. In addition to

having vision processing capabilities, fruit picking robots can also use a variety of picking mechanisms. In greenhouses, RAS harvesting applications have been developed where robots can move more easily. This RAS technology is becoming more popular in these operations, with 20% of future harvests projected to be conducted with it (Queiroz, Telles, & Bonilla, 2020). In addition to saving on labor expenses, eliminating the possibility of human harm on the road, and improving fuel economy, some of the world's largest supply chain companies are investing in self-driving cars.

Customer Delivery Systems

A company's most important consideration during the delivery process is speed and efficiency. Customers' demands for fast delivery in the e- commerce, food, and retail sectors in particular are always growing. As a result, it is the most expensive part of the delivery process. Deliveries can be tracked in real time by modern delivery software, and the distance they've traveled and how much time they've spent idle can be displayed. It allows logistics and supply chain managers to monitor their fleets more effectively in addition to reducing theft and spoilage (Ekeskär & Rudbergbi, 2022). Shippers can also utilize predictive visibility, which can help them determine where their cargo is at any given moment before it leaves the port.

Supply Chain Management Software

The use of logistics software, such as TMS (Transport Management Software), can be very beneficial for supply chain management companies. In real time, TMS helps supply chain managers monitor inventories and supplies within a supply chain to improve fleet operations. There used to be a high probability of mistakes in fleet management since it was a labor-intensive manual process. In the past, fleet management required a lot of human effort and was prone to error. Utilizing logistics software, warehousing and inventory management are automated. As a result, there is greater accuracy, lower operating costs, and greater transparency between businesses and the general public (Daoud & Amine, 2022).

Data Intelligence

Continuous decision-making is necessary for managing supply chains, but most businesses lack the knowledge to do so. So that decisions can be made using up-to-date and correct data, organizations require solutions that assist them in better understanding their supply chain and the activities that take place within of it. Enhanced data intelligence is the result of integrating different technologies (EDI). Together, they expedite the processing of complex data and offer insightful analyses, predictions, and advice. Enhanced data intelligence can be utilized in conjunction with existing business applications. This type of system may collect data, look for correlations between it, and analyses it to provide supply chain executives with the information they need to create (Sundarakani, Ajaykumar, & Gunasekaran, 2021).

Challenges and Opportunities

Only a small number of supply chain

academics have looked at the possibilities of contemporary approaches in realizing proactive and predictive SCM. Due to their unique set of characteristics, new technologies have differing degrees of relevance to the different SCM phases. For instance, mathematical programming techniques are effective in risk avoidance and mitigation but are unable to handle massive volumes of data or automate decision-making and learning. These are possible because to tools like automated reasoning, agents, and machine learning, which are less successful at modeling very complex systems like supply chains. Therefore, it makes logical to look at hybridization, which has only been explored earlier among several mathematical programming methodologies. Research is being done on a hybrid framework that successfully combines strong mathematical modeling and optimization with another AI method that can make predictions and make decisions automatically. There are several potential for research that fills the highlighted gaps at the intersection of AI and SCM.

There are numerous options that may be investigated in terms of automating the SCM decision-making process. To increase supply chain agility, a decision support system for SCM may be built on the foundation of multi-agent systems and semantic reasoning on huge datasets. Automated rule-based reasoning can be used to pick suppliers to the degree that SCM-related knowledge can be represented as rules. The benefit in this scenario is that such a system may aid with a variety of SCM activities, including risk identification, likelihood and effect analysis, and response strategy selection. In addition to automating SCM choices, machine learning techniques may be used to change the old SCM practices of modeling supply networks statically into a dynamic representation of the supply chain that is updated via learning and prediction. Machine learning offers a variety of tasks that SCM may take advantage of. According to indications, unsupervised learning algorithms may be used to identify hazards by mining supply chain data for patterns that may be connected to particular concerns. As an alternative, the algorithm may be trained to recognize risk patterns using real-world examples of patterns that have been discovered by experts. As used in other disciplines like economics, learning-based categorization and prediction may also help with the processes of risk quantification, assessment, and mitigation.

Conclusions & Future Research

The supply chain managers and executives of businesses would benefit greatly from the *"greatest technology"* in the field. In order to determine the supply chain technology solutions for a firm and put into use, as well as how the technology has been integrated inside an organization, we have put up this review paper as a road-map. The proactive and predictive management of risks in supply chains might be achieved through research aimed at a hybrid framework that effectively combines strong mathematical modeling and optimization with technologies that are

capable of automated decision-making based on prediction and learning.

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AI Applications in the Field of Management: Healthcare, Agriculture, Defense, and Medicine

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Abstract

AI Revolutionizing Fields: From Healthcare to Defense: *Artificial intelligence (AI) is rapidly transforming in diverse fields, redefining how we approach healthcare, agriculture, defense, and medicine.*

Artificial intelligence (AI) is rapidly transforming numerous sectors, and management practices are no exception. This paper explores the multifaceted applications of AI in healthcare, agriculture, defense, and medicine. In healthcare, AI aids in disease diagnosis, treatment planning, and drug discovery. For agriculture, AI optimizes crop yields, resource management, and weather prediction. In defense, AI strengthens strategic decision-making, logistics management, and autonomous systems. Medicine benefits from AI-powered medical imaging analysis, personalized treatment plans, and robot-assisted surgery. By delving into these advancements, the paper sheds light on the immense potential of AI to revolutionize management paradigms across diverse fields.

However, ethical considerations, data privacy concerns, and the potential for job displacement remain critical challenges that require careful consideration and responsible implementation. As AI continues to evolve, its impact on these crucial fields will be profound, shaping the future of healthcare, agriculture, defense, and medicine.

Keywords: Artificial Intelligence (AI), Healthcare Management, Agriculture Management, Defense Management, Medicine Management, Disease Diagnosis, Treatment Planning, Drug Discovery, Crop Yield Optimization, Weather Prediction, Strategic Decision-Making, Logistics Management, Autonomous Systems, Medical Imaging Analysis, Personalized Treatment Plans, Robot-Assisted Surgery.

Introduction- The Rise of Intelligent Management: AI in Healthcare, Agriculture, Defense, and Medicine

Artificial intelligence (AI) is the intelligence of machines or software, as opposed to the intelligence of humans or other animals. It is a field of study in computer science that develops and studies intelligent machines. Such machines may be called AIs. In another words, Artificial intelligence (AI) refers to computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems.

Imagine you could teach a computer to think like a human. It could learn, solve problems, understand languages, and even do things like play games or recognize faces.

That's essentially what artificial intelligence (AI) is all about!

AI researchers are building smart machines that can tackle tasks typically requiring human intelligence. These tasks involve learning from data, adapting to new situations, and making decisions based on what they've learned.

Think of it like giving a computer superpowers:

- Super learning: AI can process massive amounts of information and constantly improve its skills.
- Super problem-solving: AI can analyze complex situations and find solutions humans might miss.
- Super understanding: AI can recognize patterns in languages, images, and sounds, letting it interact with the world around it.

The landscape of management across various sectors is undergoing a significant transformation fueled by the burgeoning field of Artificial Intelligence (AI). AI, encompassing the ability of machines to mimic human cognitive functions like learning, reasoning, and problem-solving, is rapidly reshaping how critical decisions are made and resources are allocated. This transformative power holds immense potential for optimizing management practices in healthcare, agriculture, defense, and medicine.

In healthcare, AI promises to revolutionize disease diagnosis, treatment planning, and resource allocation. Imagine AI-powered systems analyzing medical scans with pinpoint accuracy, assisting doctors in tailoring personalized treatment plans, or even predicting potential health risks for proactive intervention. In agriculture, AI can empower farmers with data-driven insights for optimizing crop yields, managing resources like water and fertilizer efficiently, and even predicting weather patterns to minimize losses.

The defense sector stands to benefit from AI's ability to analyze complex data streams, identify potential threats faster, and optimize resource deployment. AI-powered systems can analyze satellite imagery, predict enemy movements, and even support autonomous weapon systems (with appropriate ethical

considerations). Similarly, in medicine, AI can accelerate drug discovery by analyzing vast datasets of molecular structures, personalize treatment plans for individual patients, and even assist in robotic surgery with unparalleled precision.

This exploration of AI applications in management across these diverse fields highlights the vast potential for improved efficiency, accuracy, and decision-making. As we delve deeper, we will explore specific examples and discuss the challenges and ethical considerations that accompany this technological revolution.

From Automation to Intelligent Assistance: A Historical Perspective

The integration of AI into management builds upon a long history of automation. Early industrial revolutions saw the introduction of machines that replaced manual labor. AI represents a significant leap forward, not by simply automating tasks, but by introducing intelligent assistance. This shift empowers human managers to focus on strategic decision-making, complex problem-solving, and tasks requiring human empathy and creativity, while AI handles the heavy lifting of data analysis, pattern recognition, and repetitive processes.

The Future Landscape: Collaboration and Ethical Considerations

As AI continues to evolve, The future of management points towards a collaborative environment. Human managers will work alongside AI systems, leveraging their complementary strengths. Humans will provide strategic direction, ethical oversight, and the ability to navigate unpredictable situations, while AI will offer unparalleled data analysis, real-time insights, and the ability to optimize complex processes.

However, ethical considerations surrounding AI use in management cannot be ignored. Issues like bias in algorithms, transparency in decision-making, and potential job displacement require careful consideration and responsible implementation. As we move forward, addressing these challenges will be crucial to ensuring that AI empowers managers to create a more efficient, sustainable, and equitable future.

Literature Review

2.1 AI in a Nutshell: Machines mimicking human intelligence, able to learn, reason, and act autonomously. Think robots playing chess, doctors analyzing scans, or phones understanding your voice.

Key Historic Milestones:

- 1950s: Alan Turing Test proposes measuring machine intelligence.
- 1960s: AI faces challenges, but makes progress in games and expert systems.
- 1980s: Machine learning takes off, algorithms learn from data.
- 1990s: Deep learning explodes, mimicking brain structure for breakthroughs.
- 2000s-Present: AI boom! Self-driving cars, medical diagnosis, and virtual assistants.

Future Glimpses:

- General AI: Super intelligent machines with human-like abilities.
- Human-AI Teams: Machines enhancing human capabilities.
- Ethical Concerns: Responsible development and use of AI for all.

Exploring the AI Approches:

The world of AI encompasses a diverse range of approaches, each tackling different aspects of intelligent behavior. Let's delve into some of the most prominent ones:

- **Machine Learning:** This technique empowers machines to learn from vast amounts of data, recognizing patterns and making predictions without explicit programming. Think of it as training a computer to identify trends and relationships by feeding it information.
- **Deep Learning:**Inspired by the intricate structure of the human brain, deep learning utilizes artificial neural networks to process information in layers, mimicking the brain's learning process. This approach has proven remarkably effective in areas like image recognition and natural language processing.
- **Computer Vision:** This branch of AI focuses on enabling machines to "see" and understand the visual world. Algorithms analyze images and videos, extracting objects, recognizing scenes, and even tracking movements.
- **Natural Language Processing (NLP):** This fascinating field equips machines with the ability to understand and communicate in human language. NLP powers tasks like machine translation, sentiment analysis, and even chatbot interactions.

Here is a Simplified Overview of How AI Works:

Let's look at how AI works step-by-step.

1. Input

The first step of AI is input. In this step, an engineer must collect the data needed for AI to perform properly.

(Data does not necessarily have to be a text input; it can also be images or speech), it's important to ensure the algorithms can read inputted data.

Deep learning techniques enable this automatic learning through the absorption of huge amounts of unstructured data such as text images, or videos. Al can manipulate these algorithms data by learning behavior patterns within the dataset.

2. Processing

The processing step is when AI takes the data and decides what to do with it. While processing, AI interprets the pre-programmed data and uses the behaviors it has learned to recognize the same or similar behavior patterns in real-time data,

depending upon the particular AI technology.

3. Data Outcomes

After the AI technology has processed the data, it predicts the outcomes. This step determines if the data and its given predictions are a failure or a success.

4. Adjustments

If the data set produces a failure, AI technology can learn from the mistake and repeat the process differently. The algorithms' rules may need to be adjusted or changed to fit the data set. Outcomes may also shift during the adjustment phase to reflect a more desired or appropriate outcome.

5. Assessments

Once AI has finished its assigned task, the last step is assessment. The assessment phase allows the technology to analyze the data and make inferences and predictions. It can also provide necessary, helpful feedback before running the algorithms again.

AI is extremely beneficial. However, choosing the right AI technology is the most important part.AI's journey is just beginning, and its impact on our lives will only grow.

Let's embrace its potential while ensuring it benefits every sector!

AI Applications in Healthcare

Artificial intelligence for health includes ML, natural language processing (NLP), speech recognition (text-to-speech and speech-to-text), image recognition and machine vision, expert systems (a computer system that emulates the decision-making ability of a human expert), robotics, and systems for planning, scheduling and optimization.

The World Economic Forum has proposed four ways in which AI can make healthcare more efficient and affordable: enabling tailored treatment plans that will improve patient outcomes, and therefore reduce the cost associated with complications arising from treatment; permitting better and earlier diagnosis that reduces human error; enabling accelerated drug development; and empowering patients to take a more active role in managing their health (World Economic Forum, 2018).

The potential for AI in healthcare is huge, as it has the ability to apply problem-solving techniques that humans could not do alone. In 2019, 46% of healthcare organizations in the UK were using AI technology, which indicates how widely it is already used.

Artificial intelligence (AI) is rapidly transforming the healthcare landscape, bringing innovation and efficiency to various aspects of medical care.

Here are some of the key applications of AI in healthcare:

- **Focuses on preventive care and overall well-being:** AI applications in healthcare often go beyond the realm of traditional medicine to promote healthy lifestyles and prevent disease. This includes tasks like:
- **Personalized health coaching:** AI-powered chat bots or virtual assistants can provide personalized

health tips and recommendations based on an individual's health data and goals.

- **Chronic disease management**: AI can help patients manage chronic conditions like diabetes or heart disease by tracking their vital signs, medication adherence, and symptoms, and providing real-time feedback and support.
- **Mental health support:** AI-powered chatbots and online therapy platforms can offer accessible mental health support and resources to individuals who might not have access to traditional therapy or who prefer a more anonymous approach.
- **Virtual assistants:** AI-powered virtual assistants can answer patients' questions, schedule appointments, and provide basic medical advice. This can improve patient access to care and reduce the workload on healthcare staff.

  Virtual health assistants powered by artificial intelligence can help patients assess their symptoms and provide preliminary diagnoses. By analyzing a patient's query and comparing it to a vast database of medical knowledge, a virtual health assistant can offer personalized recommendations for further assessment or self-care .

- **Emphasizes patient engagement and empowerment:** AI in healthcare is increasingly used to empower patients to take an active role in their own health. This includes:
- **Wearable devices and sensors:** These devices can track activity levels, sleep patterns, and other health metrics, providing patients with valuable insights into their own health and enabling them to make informed decisions about their lifestyle choices.
- **Health information portals:** AI-powered platforms can aggregate and personalize health information from various sources, giving patients a comprehensive view of their health and making it easier for them to communicate with their healthcare providers.
- **Disease outbreak prediction:** AI can analyze data from various sources, such as social media and weather patterns, to predict and track disease outbreaks. This can help public health officials take early preventive measures and contain the spread of diseases.
- **Personalized health recommendations:** AI can analyze a person's health data and lifestyle to provide personalized recommendations for preventing diseases and maintaining good health.

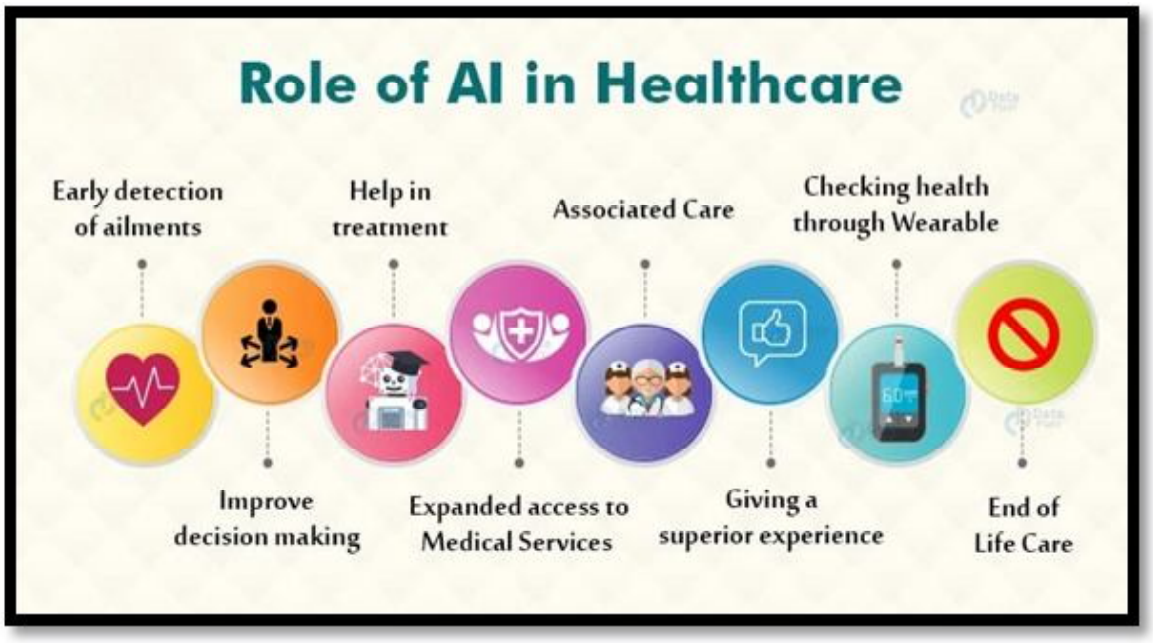

Figure 1

As AI technology continues to evolve, we can expect even more transformative applications in the years to come. However, it is important to remember that AI is a tool, and its effectiveness depends on how it is used.

AI Applications in Agriculture

AI Revolutionizing the Farms: From Seed to Supper :Agriculture, the age-old practice of nurturing life from the earth, is undergoing a fascinating transformation. Artificial intelligence (AI) is no longer a futuristic concept in this sector; it's rapidly becoming an indispensable tool, driving innovation and efficiency across the entire farm-to-table journey. Let's delve into some of the most exciting AI applications that are redefining agriculture.

1. **Precision Farming and Predictive Analytics:**Imagine fields teeming with sensors, drones buzzing overhead, and data flowing seamlessly into intelligent systems. This is the reality of precision farming powered by AI. Sensors and drones gather real-time data on soil moisture, nutrient levels, and crop health. AI algorithms then crunch these numbers, generating insights and recommendations for irrigation, fertilization, and pest control.

The benefits are manifold:

- Boosted yields: By optimizing resource use, farmers can maximize their harvests.
- Reduced waste: Precise application of water and fertilizers minimizes overcon-sumption.

- Enhanced environmental impact: Less water and fewer chemicals translate to a more sustainable approach.

AI-powered weather stations and historical data analysis allow for predictive modeling. This means farmers can anticipate crop yields, disease outbreaks, and even market trends, making informed decisions about planting, harvesting, and resource allocation.

2. Automated Robotics and Machinery:

Remember the Jetsons zipping around in their flying cars? Well, autonomous farm vehicles are becoming a reality, grounded for now. Self-driving tractors equipped with AI navigate fields with meticulous precision, planting seeds, applying herbicides, and even harvesting crops. Drones equipped with multispectral cameras soar above, keeping a watchful eye on the crops. They can detect diseases, pests, and nutrient deficiencies, allowing for targeted interventions and minimizing losses.

3. Disease and Pest Detection:

Early detection is key to combating crop threats. AI is playing a crucial role here. Computer vision algorithms trained on vast datasets of images can identify pests and diseases in real-time with uncanny accuracy. This empowers farmers to act swiftly, controlling outbreaks before they decimate their crops.Predictive models take things a step further. By analyzing weather data and historical pest outbreaks, AI can predict when and where infestations are most likely to occur. Farmers can then be proactive, deploying preventative measures to safeguard their precious produce.

4. Livestock Management:

Our furry and feathered friends are not left behind in the AI revolution. Cows, pigs, and other livestock can wear AI-powered wearables that track their health and activity levels. These wearables collect data on everything from heart rate and respiration to sleep patterns and eating habits.

AI algorithms analyze this data, identifying early signs of illness, stress, or even pregnancy. This allows farmers to provide targeted care, improving animal welfare and optimizing production. Automated feeding systems powered by AI adjust the amount of feed each animal receives based on their individual needs and activity levels. This not only minimizes food waste but also ensures optimal nutrition for each animal, leading to better health and productivity.

The applications of AI in agriculture are constantly evolving, with new possibilities emerging every day. From autonomous greenhouses to intelligent irrigation systems,

Figure 2

the future of farming promises to be a fascinating blend of technology and tradition. As AI continues to mature and become more accessible, it has the potential to revolutionize the way we grow food, making it more efficient, sustainable, and ultimately, more plentiful for everyone.

Remember, while AI offers a treasure trove of benefits for agriculture, it's crucial to address ethical concerns and ensure equitable access to these technologies for all farmers, regardless of their size or location. By working together, we can harness the power of AI to create a future where the fields flourish and everyone has a seat at the table.

AI Applications in Defense

AI Revolutionizing Defense: From Intelligence to Intervention

The landscape of defense is undergoing a significant transformation, fueled by the ever-evolving capabilities of artificial intelligence (AI). From enhancing intelligence gathering to automating complex tasks, AI is rapidly becoming an indispensable tool for modern militaries, revolutionizing the way they operate and ensuring national security. Let's delve into some of the most impactful AI applications in defense:

Enhanced Intelligence Gathering and Analysis:

- **Imagine:** Satellites equipped with AI-powered image recognition software scanning vast areas, identifying potential threats like troop movements, illegal activities, and even camouflaged objects with remarkable accuracy.

  This advanced intelligence gathering allows for proactive threat detection and prevention, giving militaries a

critical edge in real-time decision-making. AI can also analyze vast amounts of data from various sources, including social media, communication networks, and sensor readings, to identify patterns and predict potential threats before they materialize.

Cyberwarfare Defense and Offense:

- **The digital battlefield is heating up:** AI-powered systems are on the front lines, both defending against and launching cyberattacks. Defensive AI can detect and neutralize malware, phishing attempts, and other cyber threats in real-time, protecting critical infrastructure and sensitive data.

  On the offensive side, AI can be used to develop and deploy sophisticated cyberattacks, disrupting enemy communications, disabling critical infrastructure, and even manipulating information for strategic advantage.

Autonomous Weapon Systems and Robotics:

- The future of warfare might not involve human soldiers: AI-powered drones, tanks, and even fighter jets are being developed, capable of operating autonomously on the battlefield. These systems can make split-second decisions, engage targets with precision, and even adapt to changing situations without human intervention.

  While the ethical implications of autonomous weapons are still being debated, their potential impact on the nature of warfare is undeniable.

Logistics and Supply Chain Management:

- **Behind the scenes of every military operation lies a complex logistical network:** AI is optimizing this network, ensuring efficient movement of troops, equipment, and supplies. AI algorithms can analyze real-time data on weather, traffic, and enemy movements to optimize routes, predict potential disruptions, and ensure timely delivery of critical resources.

This improved efficiency translates to faster deployment, better preparedness, and ultimately, a greater chance of success in military operations.

Training and Simulation:

- Virtual battlefields are becoming increasingly realistic: AI-powered training simulations are immersing soldiers in complex scenarios, allowing them to hone their skills, practice tactics, and learn from mistakes in a safe environment.

This advanced training not only improves individual soldier readiness but also enhances unit cohesion and coordination, preparing them for real-world challenges.

The applications of AI in defense are constantly evolving, with new possibilities emerging every day. From AI-powered

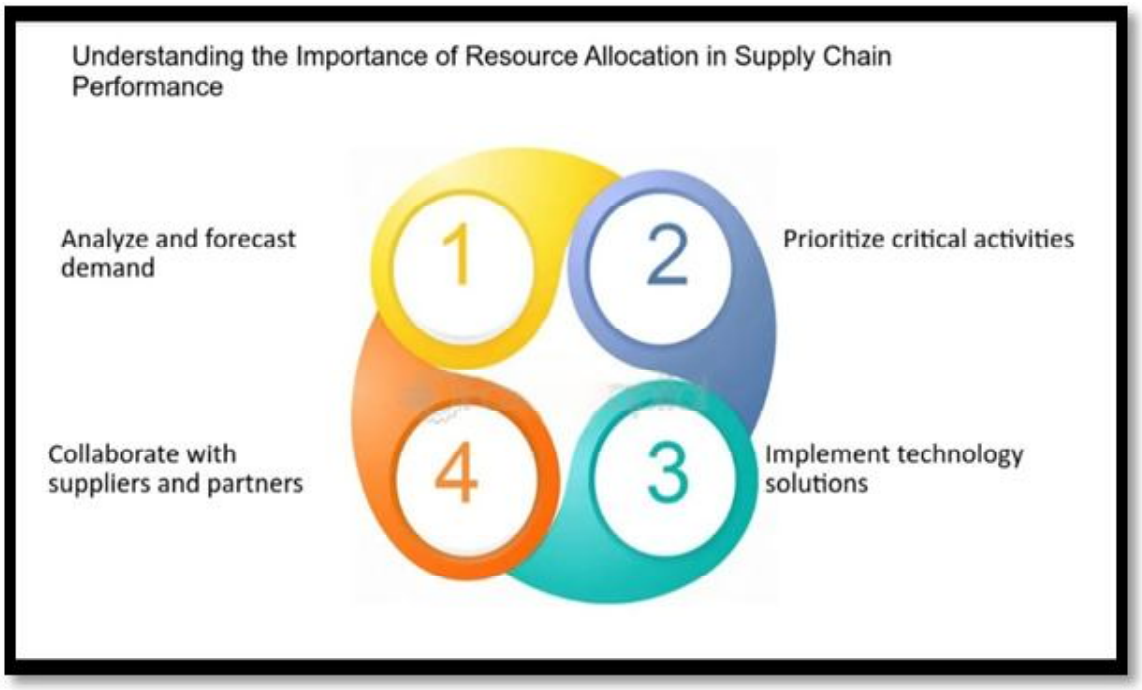

Figure 3

exoskeletons that enhance soldier strength and endurance to intelligent communication systems that break down language barriers, the future of defense promises to be a fascinating blend of technology and human ingenuity.

However, it's crucial to address the ethical concerns surrounding autonomous weapons and ensure responsible development and deployment of these powerful technologies. By harnessing the power of AI for good, we can build a safer and more secure future for all.

AI Applications in Medicine

Artificial intelligence (AI) is rapidly transforming the field of medicine, bringing with it a wave of innovation and progress. From aiding in diagnosis and treatment to streamlining research and development, AI applications are having a profound impact on healthcare delivery and patient outcomes.

The terms "healthcare" and "medicine" are often used interchangeably, but there are actually subtle differences between them. Healthcare encompasses a broader range of services and approaches to maintaining and improving physical and mental well-being, while medicine focuses specifically on the diagnosis and treatment of disease. This distinction is reflected in the applications of AI in these domains.

AI in Medicine:

- Focuses on diagnosis and treatment of disease: AI applications in medicine are primarily used to assist healthcare professionals in

diagnosing and treating diseases. This includes:

- Medical image analysis: AI algorithms can analyze X-rays, CT scans, and other medical images to detect abnormalities and assist in diagnosis.
- Personalized medicine: AI can analyze a patient's genetic data and medical history to predict their risk of developing certain diseases and tailor treatment plans accordingly.
- Robot-assisted surgery: AI-powered robotic surgery systems allow surgeons to perform complex procedures with greater precision and control, leading to improved surgical outcomes.

Here are some of the most exciting and promising AI applications in medicine:

1. Diagnosis and Imaging:

Medical image analysis: AI algorithms can analyze medical images like X-rays, CT scans, and MRIs with remarkable accuracy, assisting doctors in detecting diseases like cancer, tumors, and abnormalities at early stages. This can lead to faster diagnoses and more effective treatment decisions. AI analyzing medical images

Personalized medicine: AI can analyze a patient's genetic data, medical history, and lifestyle to predict their risk of developing certain diseases and tailor treatment plans accordingly. This approach, known as precision medicine, can lead to more effective and targeted therapies.

2. Drug Discovery and Development:

Virtual drug screening: AI can analyze vast amounts of chemical compounds to identify potential drug candidates for specific diseases. This can significantly accelerate the drug discovery process and lead to the development of new and more effective treatments.

Clinical trial optimization: AI can be used to design and conduct clinical trials more efficiently, identifying the most promising drug candidates and optimizing the trial design to collect the necessary data.

3. Robot-assisted surgery:

Surgical robots: AI-powered surgical robots can assist surgeons in performing complex procedures with greater precision and control. This can lead to shorter surgery times, fewer complications, and faster patient recovery. AIpowered surgical robots.

4. Administrative Tasks and Data Management:

Streamlined medical record keeping: AI can automate tasks such as medical record transcription and coding, freeing up healthcare providers to focus on patient care.

AI for medical record keeping

Improved healthcare data analysis: AI can analyze large datasets of healthcare data to identify trends and patterns, leading to better understanding of diseases and development of more effective treatments.

Overall, AI has the potential to revolutionize healthcare and improve the lives of millions of people around the world. As we continue

to explore and develop AI applications in medicine, it is important to do so with a focus on patient safety, ethical considerations, and the ultimate goal of improving healthcare for all.

AI Strengths

- Automation and efficiency: AI automates repetitive tasks, freeing humans for more creative work. Imagine AI robots handling assembly lines or chatbots answering customer questions.
- Innovation and discovery: AI accelerates scientific research and drug discovery by analyzing vast datasets and identifying promising avenues. Think of AI sifting through research papers to find the next medical breakthrough.
- Personalization and customi-zation: AI tailors experiences, from recommending products to designing personalized learning or healthcare plans. Imagine AI tutors adapting to each student's needs or healthcare plans based on a patient's unique makeup.

AI Weaknesses

- Limited common sense: AI can struggle with unexpected situations requiring context, nuance, or quick thinking. Imagine an AI self-driving car encountering a child running into the street.
- Bias and discrimination: AI can perpetuate existing biases if trained on biased data. Think of unfair loan approvals or job recruitment based on AI algorithms.
- Job displacement: Automation by AI can lead to job losses in certain sectors. We need retraining and reskilling programs to help workers adapt.
- Ethical considerations: AI raises concerns about data privacy, transparency, and accountability. We need clear ethical guidelines and regulations to ensure responsible AI development and use.

Remember, AI is a powerful tool with both immense potential and challenges. By understanding its strengths and weaknesses, we can harness its power responsibly to create a better future for all.

Negative Aspects of AI - The Double-Edged Sword: AI's Potential Pitfalls

While Artificial Intelligence (AI) promises advancements in healthcare, agriculture, defense, and medicine, its implementation also raises concerns.

Healthcare: AI-powered diagnostics may miss crucial nuances in a patient's condition, potentially leading to misdiagnosis. Additionally, dependence on AI could decrease the human element of care, impacting the crucial doctor-patient relationship.

Agriculture: AI-driven precision agriculture, while optimizing resource use, could lead to a reliance on a single technology, making farms vulnerable to disruptions.

Furthermore, increased automation might displace agricultural workers, impacting rural communities.

Defense: Autonomous weapons systems raise serious ethical concerns. The potential for unintended escalation and the lack of human judgment in life-or-death situations are significant risks. Additionally, reliance on AI in cyberwarfare could have unpredictable consequences.

Medicine: AI-powered drug discovery holds promise, but potential biases in training data could lead to treatments that don't consider diverse populations. Moreover, the high cost of developing and maintaining AI systems could limit access to these advancements for some.

While AI offers undeniable benefits, a cautious approach is necessary. We must acknowledge and address these potential downsides to ensure AI serves humanity for the greater good.

Conclusion

Artificial intelligence (AI) is rapidly transforming our world, and its applications in healthcare, agriculture, defense, and medicine are nothing short of revolutionary. From assisting doctors in diagnoses to optimizing crop yields, AI is proving its potential to solve some of humanity's most pressing challenges.

In conclusion, AI's influence extends far beyond mere convenience, revolutionizing sectors like healthcare, agriculture, defense, and medicine. From saving lives through early disease detection to enhancing food security and national security, AI's potential to improve our world is undeniable. However, ethical considerations and responsible development remain crucial to ensure AI benefits all of humanity.

The potential of AI in these fields is vast, and we are only just beginning to scratch the surface. As AI technology continues to evolve, we can expect even more transformative applications that will improve our lives in countless ways. However, it is important to remember that AI is a tool, and like any tool, it can be used for good or for evil. It is up to us to ensure that AI is developed and used ethically and responsibly.

As we navigate this new era of technological advancement, let us harness AI's power for good, ensuring its applications serve to create a healthier, safer, and more sustainable future for generations to come.

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