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Information Technology as Enabler of Total Quality Management Performance in Manufacturing Units

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Abstract:- This research aims to study the level of Information Technology (IT) used in Total Quality Management and its impact on Total Quality Management (TQM) performance. TQM has been quite an old strategy to improve the overall effectiveness of the quality management and functioning of the organization however information technology is a new addition to operations and especially in improving different aspects of TQM in the organization. In the last decade's use of information technology has increased in manufacturing industries, and so has an investment in IT. Information technology is widely deployed along with TQM. Several studies on the relationship between Total Quality Management and information technology similarly on the effect of both on a firm's performance. Based on the literature review, we can conclude that Information technology positively impacts TQM and company results. The null hypothesis developed was that there is no significant relationship between IT and TQM performance. There is a need to study the correlation between the use of information technology and its impact on Total Quality Management. The manufacturing sector is one of the oldest and most significant beneficiaries of the Total Quality Management tools and with the newest innovation and development in the field of information technology, it has paved its way to get used in various aspects of Total Quality Management. IT-enabled Total Quality Management is assumed to be impacting the overall effectiveness of TQM and this research is aimed to validate this assumption in the manufacturing industries of Uttarakhand India.

Keywords:- *Information Technology (IT), IT and TQM, IT and TQM performance, Impact of IT on TQM.*

I. INTRODUCTION

In our daily lives, we realize that computers are an integral part of and same is information technology. Industries are not on another planet as well. Information technology is "an integrated framework that portrays information systems as being composed of management organization and technology elements" Loudon and Laudon, (1994). The first computer was invented in 1946 and by 1960 it was started largely used in various applications. Use of information technology for different applications in manufacturing and other industries. The information technology is used right from purchasing the material, vendor communication, employee search and onboarding, payroll management, decision support systems, data gathering and analysis, communications, sales and marketing, dispatch control, warehouse management, invoicing to customer and customer interfaces, Martinez-Lorente, et al, (2003). With growing innovation in technology, it has made its way to shop floors in various aspects of Total Quality management and manufacturing. Martinez-Lorente, et al, (2003) studied in detail the impact, IT-enabled TQM has on organizational performance. However, if we see at the literature available in India there has been very less work on information technology's impact on Total Quality management performance. This paper aimed to stud the same.

- *Research Scope and its Objectives*

This research paper aims to study the level of IT used in TQM in the manufacturing industries of Uttarakhand and what is the impact of IT on TQM performance. The research is limited to only the manufacturing companies of Uttarakhand which have four main clusters, 1. SIDCUL industrial area of Haridwar, 2. Sitar Ganj, 3. Kashipur, and 4. Pant Nagar. The purpose is to identify the impact of Information Technology on TQM performance in the manufacturing industries of Uttarakhand in India. As stated in the introduction section in the last decades with the boom in IT innovation and India being the leading nation in that IT has paved its way on shopfloors too. And there has been a wise use of IT in TQM with huge investment. We need to establish a correlation between the use of IT in TQM and its impact on TQM performance.

II. LITERATURE REVIEW

Use of information technology for different applications in manufacturing and other industries. The information technology is used right from purchasing the material, vendor communication, employee search and onboarding, payroll management, decision support systems, data gathering and analysis, communications, sales and marketing, dispatch control, warehouse management, invoicing to customer and customer interfaces, Martinez-Lorente, et al, (2003).

Information technology is widely deployed along with TQM. Several studies on the relationship between Total Quality Management and information technology similarly on the effect of both on a firm's performance. Suby Khanam et al, (2015), in their study on Indian ICT organizations, found that Information technology when implemented with TQM boosts the firm's performance and helps in advancing the firm's competitive advantage in the market. Martinez-Lorente, et al, (2003), revealed in their study on TQM implementation with Information technology in UK-based organizations and found that IT has a positive influence on TQM performance. Ling Li et al, (2008), in their study, concluded that ERP systems are based on TQM principles and TQM is working as a predecessor to it. He suggested going for ERP implementation after TQM implementation for a sustained period. The technology transfer performance has direct relations with TQM and the quality results of the organizations, Perez-Arostegui M. N. et al, (2013). There are multiple information technology competencies identified by Maria et al, (2015), and they were 1. flexible IT Infrastructure, 2. IT technical Knowledge, 3. IT managerial Knowledge, 4. IT integration. While their research on Spanish firms they found that Information technology competence has a significant impact on TQM and a firm's results. Daryush et al, (2015), in their study of the information technology effect on TQM in Sports federations of Iran, found that IT and TQM are significantly linked. Based on the literature review, we can conclude that Information technology positively impacts TQM and company results.

III. RESEARCH-METHODOLOGY

A well-designed instrument was used to conduct the survey for this research. The survey was done in all major four industrial scoters e.g., 1. Haridwar (including Dehradun), 2. Kashipur, 3. Sitar Ganj, and 4. Pant Nagar. Manufacturing industries falling in the small, medium, and large-scale categories were identified for the survey. The total number of requests were sent out was 339 and responses received back after two to three reminders and personal phone calls to contacts of companies received via local industrial associations, total of 110 feedbacks received after removing 6 wrongly filled responses total remained was 104 which is 30 % of the sample size and total questionnaires distributed. 32 % response is good enough and comparable looking to literature where research has been done with response rates ranging from 13 to 25 % e.g., Martinez-Lorente et all (2003) 22 %, Angel R. M. et. all (2003) 20 %, Thomas Y. Choi, Karen Eboch (1998) 20 %, Ulin Idil Sonmezturk Bolatan, Selim Zaim, et all (2016) 20 %, Maria Nieves Perez-Arostegui et all (2014) 13 %, Harjeev Kumar Khurana et all (2010) 10 %. The questionnaires were emailed to the contacts of sample companies obtained from local industry associations and feedback was also asked over phones where contact numbers were available. After receiving all the feedback data was summarized for analysis. The questionnaire was organized into four subsets, namely, firms' characteristics, IT implementation, TQM implementation, and IT-enabled TQM implementation, and the responses were asked on a five-point Likert scale ranging from zero to five where zero was asked to give if the lowest use and five was highest use. All subsets were first measured for reliability by using *Cronbach's Alpha*, and further analysis was performed by measuring Pierson's correlation between IT use in TQM and TQM performance subsets. Also, the regression correlation study was done to determine the correlation between information technology and total quality management performance. Means also measured with standard deviation for the use of IT in different aspects of TQM.

➢ *Sample profile:*

Of the total companies that participated and were surveyed, approximately 85 % are using batch production techniques. Which basically means they are making the goods in batches. 15 % of the total population said that they are using the assembly line to manufacture the products which means they are assembling various parts received at an assembly line, and about only 3 % of the total said they have a continuous manufacturing setup where goods are made without breaking the or stopping the manufacturing process. The second analysis was done based on the manufacturing category of the sample company and data was tabulated and given in the form of a bar graph in figure 2 (Fig. 2: Sample Profile, as per the manufacturing category) where it is clearly visible that diverse data ranging right from home appliances, Auto and Auto ancillary, Plastics, and paper manufacturing companies. As is evident from the data based on responses received from the survey sample companies.

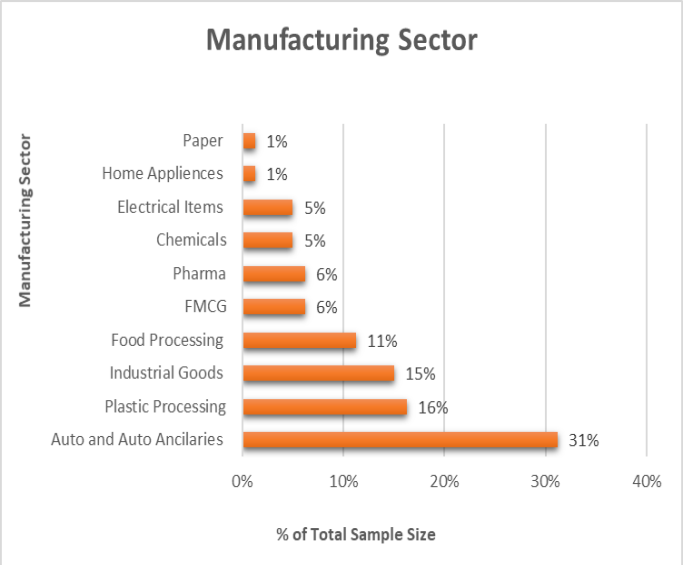

Fig 1: Sample Profile as per manufacturing category

Out of the total firms that participated in the survey, about 31 % of them said they were from the Auto and or auto ancillary manufacturing sector, the next three were Plastic processing like Injection moldings and or raw material compounding sector, Industrial Goods manufacturers about 15 % and Food processing units were around 11 %. 100 % of the companies

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said they have implemented TQM. The questionnaire subsets were tested further for reliability by using Cronbach's alpha the results show that feedback and questionnaire are highly reliable to use for data analysis. The overall Cronbach's $\alpha = 0.94$ which indicates the instrument is highly reliable. The individual constructs were also put under Cronbach alpha testing and Alpha values are summarized along with no of items related to that construct. It was observed that Cronbach's Alpha was more than 0.8 in all the subsets as shown in **Table 1,** which means the instrument is highly reliable.

Table 1: Number of items related to each construct and Cronbach's α Value linked to them

Constructs	No of Items	Cronbach's Alpha
IT for Admin	5	0.87
IT for communication	5	0.88
IT for Decision Support	3	0.91
IT for Planning	3	0.89
IT for Product Design	4	0.91
IT for Production Control	8	0.93
Top management	4	0.95
Customer relationship	5	0.97
supplier relationship	4	0.94
workforce management	8	0.99
Employee Attitude and Behavior	4	0.96
Product design Process	8	0.90
Process Flow management	6	0.94
Quality data and reporting	7	0.94

➢ *Hypothesis:*

The hypothesis was developed based on the objective to know the impact of IT implementation on TQM performance.

H0: There is No relation between the Implementation of Information Technology over Total Quality Management Performance

H1: Implementation of Information Technology and Total Quality Management performance has a significant correlation

To test the hypothesis, means were analyzed for all the constructs related to Information technology implementation (IT) namely IT for Admin, IT for Communication, IT for Decision Support, IT for Planning, IT for Product design, and IT for production Control. Similarly, the IT-enabled TQM dimensions also measured for means namely Top Management, Customer Relationship, Supplier Relationship, Workforce Management, Employee Attitude and behavior, product design process, process flow Management, and Quality data and Reporting. The correlation study was done using two-way regression analysis. Minitab - 16, version was used for statistical data analysis.

IV. DATA ANALYSIS AND RESULTS INTERPRETATIONS:

The regression analysis is summarized in table number 2 and 3. Table 2, elaborates on the results of the correlation study at an overall level whereas Table 3 presents the construct-wise data. For all the constructs of IT and TQM. The correlations are analyzed and proposed in figures from **Figure 2** to **Figure 7**. Based on data analysis and findings listed in Table 2, and Table 3, the null hypothesis 'H0' is rejected, and alternate hypothesis H1 is accepted. As we see different IT constructs are not equally and significantly correlated with all TQM dimensions instead, they have a selective impact. Pearson's correlation shows a positive relationship with all IT constructs and TQM dimensions however their significance level R-Sq. is varying and not all at an important level. Many constructs are strongly positive in correlation with R-Sq. value more than 0.5. Results are summarized below based on the findings in Table 2.

Table 2: Summary of Regression analysis of correlation among TQM constructs performance and IT Implementation.

S. No	TQM Dimensions	Regression Analysis with Over all IT Implementation		
		R-Sq.	R2-Sq. Adj.	R-Sq. (pred)
1	Top management	0.886	0.880	0.856
2	Customer Relationship	0.849	0.840	0.797
3	Supplier Relationship	0.846	0.837	0.805
4	Workforce Management	0.781	0.768	0.725
5	Employee Attitude and Behavior	0.766	0.751	0.701
6	Product Design Process	0.835	0.824	0.805
7	Process Flow Management	0.792	0.779	0.745
8	Quality Data and Reporting	0.897	0.890	0.873

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Table 3: Summary of Regression Analysis, Regression Coefficient, and significance level 'ρ' values of IT and TQM constructs

S. No	TQM Dimensions	Value type	IT Implementation					
			IT for Admin	IT for communication	IT for Decision Support	IT for Planning	IT for Product Design	IT for Production Control
1	Top Management	*Reg. Coef.*	0.606	0.294	0.052	0.269	0.216	0.287
		Sig. 'p'	0.000	0.009	0.006	0.002	0.000	0.001
2	Customer Relationship	*Reg. Coef.*	0.424	0.544	0.123	0.292	0.131	0.484
		Sig. 'p'	0.000	0.000	0.285	0.005	0.060	0.000
3	Supplier Relationship	*Reg. Coef.*	0.307	0.603	0.307	0.024	0.112	0.731
		Sig. 'p'	0.006	0.000	0.007	0.805	0.098	0.000
4	Workforce Management	*Reg. Coef.*	0.716	0.753	0.338	0.131	0.063	0.692
		Sig. 'p'	0.000	0.000	0.010	0.259	0.420	0.000
5	Employee Attitude and Behavior	*Reg. Coef.*	0.428	0.407	0.247	0.012	0.052	0.527
		Sig. 'p'	0.001	0.009	0.067	0.922	0.522	0.000
6	Product design Process	*Reg. Coef.*	0.318	0.166	0.018	0.309	0.389	0.457
		Sig. 'p'	0.007	0.228	0.882	0.004	0.009	0.000
7	Process Flow management	*Reg. Coef.*	0.768	0.519	0.390	0.110	0.074	0.555
		Sig. 'p'	0.000	0.004	0.010	0.411	0.419	0.000
8	Quality data and reporting	*Reg. Coef.*	0.217	0.051	0.163	0.275	0.078	0.564
		Sig. 'p'	0.015	0.618	0.006	0.001	0.15	0.000

➢ *IT Application with TQM Implementation:*

IT with TQM implementation is not necessarily linked to each other. It depends on the priority of the firms however from the data in Table 4, we see that both do have positively linked to each other. The implementation level when checked with a mean and standard deviation of responses from 104 respondents was observed that the application of IT and implementation of TQM was at a significantly good level. TQM has an overall mean of 4.51 with an SD from a mean is 0.33 which is quite low and shows a good level of TQM implementation among the firms similarly means of It constructs are more than 3.0 except for IT for product design where the mean is 2.73 with SD of 1.07 from mean. IT for product design is less implemented and varies greatly from industry to industry, it may have an industry-type impact over it where some firms use more while others less as shown in Table 3.

Table 4: Application of IT and TQM implementation Mean and standard deviation.

	TQM	IT for Admin	IT for communication	IT for Decision Support	IT for Planning	IT for Product Design	IT for Production Control
Mean	4.51	4.42	3.60	3.44	3.92	2.73	3.31
Standard Deviation	0.33	0.41	0.93	0.52	0.42	1.07	0.91

Companies who have implemented TQM do have significant use of information technology and both are positively correlated as we see in Table 4, the correlation level among TQM and IT application constructs is highly positively correlated with a correlation coefficient *'r'* greater than 0.6 in all the cases.

Table 4: Correlation between IT application and TQM implementation

	IT for Admin	IT for communication	IT for Decision Support	IT for Planning	IT for Product Design	IT for Production Control
TQM	0.807	0.639	0.643	0.773	0.604	0.772

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➢ *IT for Administration and TQM Performance:*

Information technology implemented to facilitate administration work like invoicing systems, stock control systems, payroll masters, and databases where we store our day-to-day working files and general data. IT for administration was tested on regression two easy correlation study thereby obtaining a regression coefficient, and significance 'p' value. As we see in Table 3 and Figure 2, IT for administration does significantly impact all TQM dimensions and has a significant positive impact on the performance of four TQM constructs namely Supplier relationships, Employee Attitude, Quality data and reporting, and Process Flow management, etc. This is very logical as we explained above the information technology for Administration was primarily associated with these TQM areas. The significance level is well below the α value of 0.05 hence we can say the relationship is positive and IT for Admin does have a positive impact on these four TQM dimensions' performances.

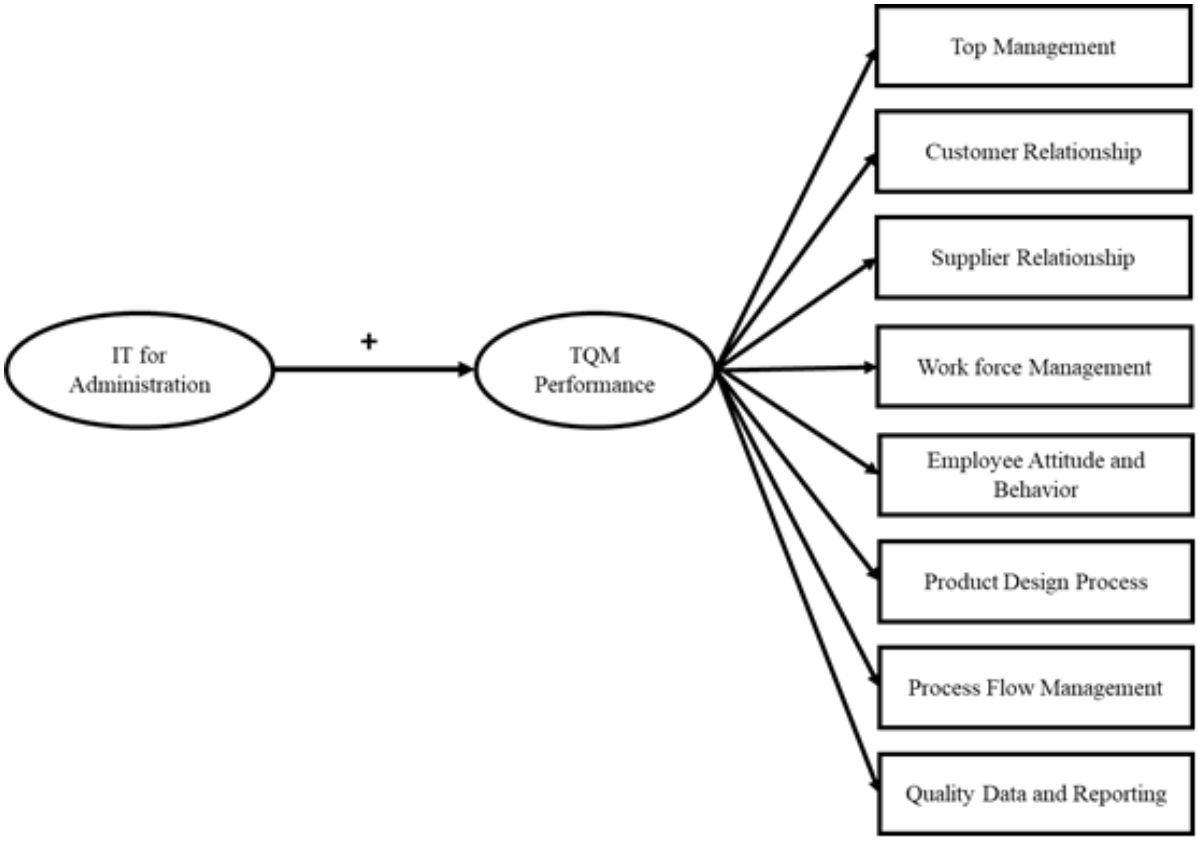

Fig 2: Impact of IT for Admin over TQM dimensions

➢ *IT for Communication and TQM Performance:*

IT for communication mainly talks about information technology used for facilitating communication like advertising on a company web, electronic data exchanges, email communications, different modes of data sharing, etc. The questions were framed to ask about such IT implementations. As we see in data analysis IT for communication has a significant impact on the performance of six TQM dimensions namely Customer relationships, Employee Attitude and Behavior, Supplier Relationships, Top Management, Workforce Management, and Quality data and reporting the significance level 'p' is well below the Alpha value of 0.05 which shows that IT for communication does have a strong positive impact over the performance of these TQM constructs.

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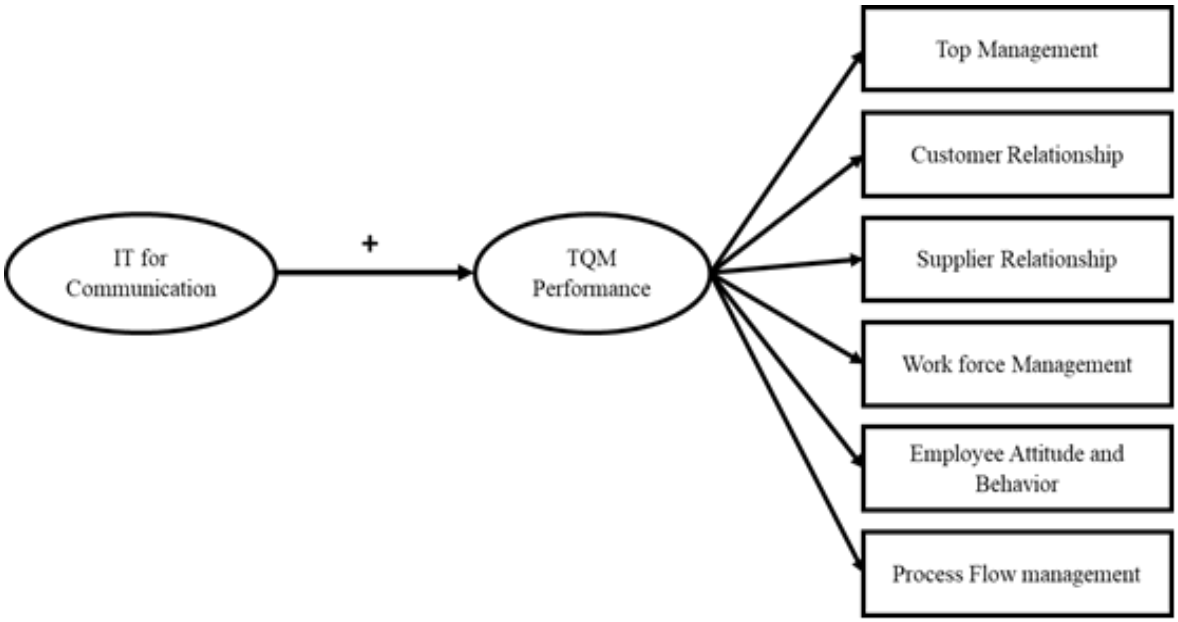

Fig 3: Impact of IT on Communication over TQM Dimensions

➢ *IT for Decision Support and TQM Performance:*

In the information technology for decision support systems like Minitab, DSS software or other data analysis tools were considered and as we see in the data analysis from regression coefficient and significance value 'p' the IT for Decision support has a positive impact over performance six TQM dimensions namely Top management, Customer relationships, Supplier Relationship, Workforce Management, Employee Attitude and Behavior and Quality data and reporting the significance level 'p' is well below the Alpha value of 0.05 which shows that IT for communication does have a strong positive impact over the performance of these TQM constructs.

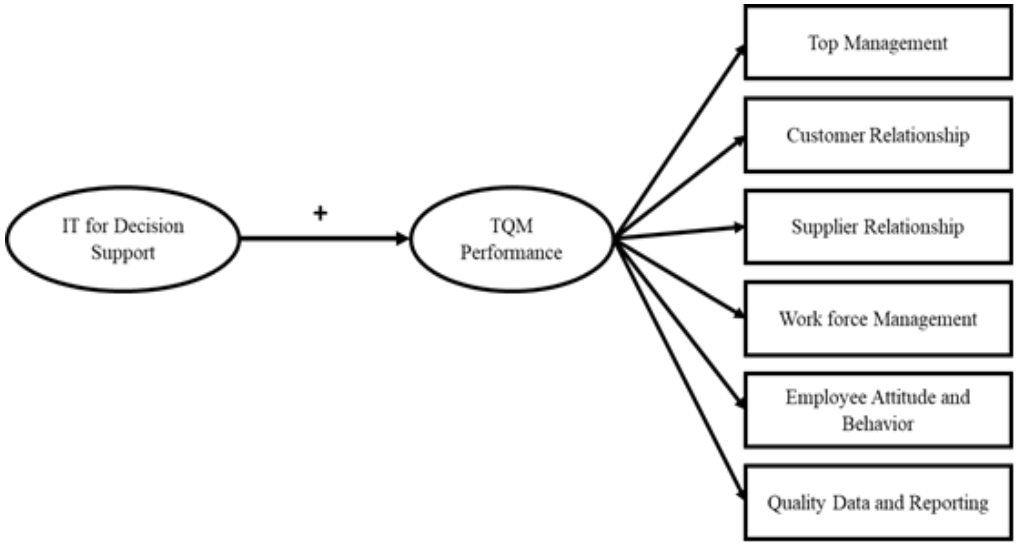

Fig 4: Impact of IT for Decision Support over TQM dimensions

➢ *IT for Planning and TQM Performance:*

IT for planning considers systems like computer-added production planning's CAPP, ERP, or enterprise resource planning and MRP systems implementations. As we see from correlation and significance analysis IT for planning has a significant positive impact over two TQM dimensions of performance namely Product design and Process flow management. The correlation values are above 0.8 in both cases with a significance value 'p' below 0.05 α level.

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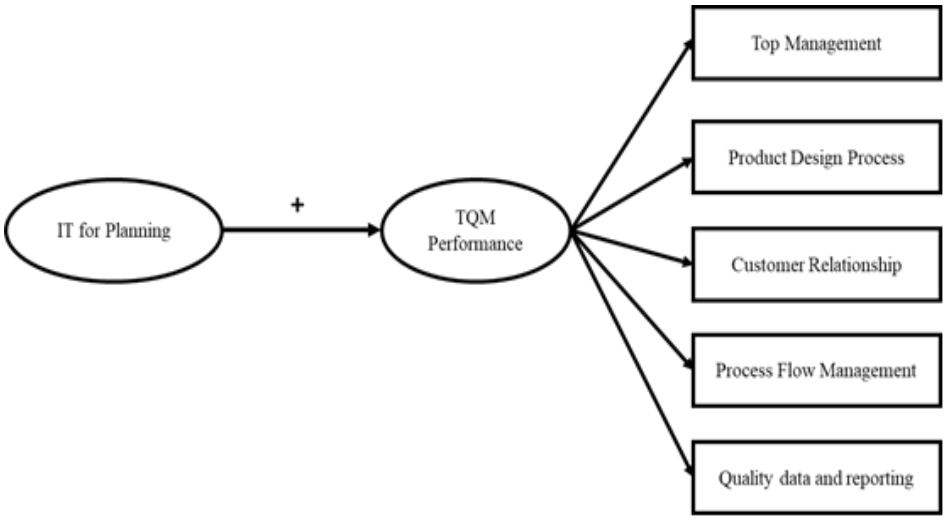

Fig 5: Impact of IT on Planning over TQM dimensions

➢ *IT for Product Design Process and TQM Performance:*

Information Technology for Product design considers systems used in designing and prototyping the products in the development phase like computer-aided design or CAD, Computer Added manufacturing CAM and computer-added Engineering CAE along with 3 D printers prototyping set-ups, etc. as we see from the data analysis regression coefficient is more than positive 0.5 and significance level 'p' is less than 0.05, indicates that IT used for planning has a very significant positive impact over the performance of four TQM dimensions namely Top Management, Customer relationships, Workforce Management and product design Process. This means the more we use IT for the design process more we improve the performance of these TQM dominions.

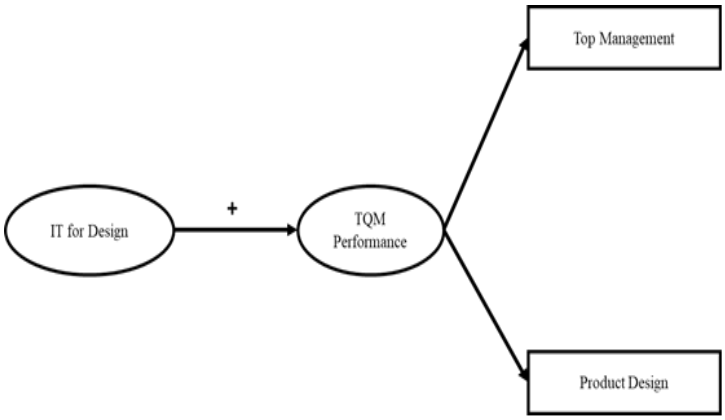

Fig 6: Impact of IT on Product Design over TQM dimensions

➢ *IT for Production Control and TQM Performance:*

Information technology implemented for controlling the production at the shop floor like CNC, Robots, electronic systems for quality checks and data collection automated warehousing systems WMS, Flexible manufacturing systems FMS, etc. Responses about implementation level were collected on eight questions. As we see from the correlation study and testing the significance level information technology has a very strong positive impact on the performance of the Process flow management dimension of TQM. Process flow management is mainly related to production control and hence it is well-linked. The regression coefficient greater than 0.5 denotes a very strong positive correlation and the significance level 'p' below 0.002 is much less than the considered confidence interval α value of 0.05.

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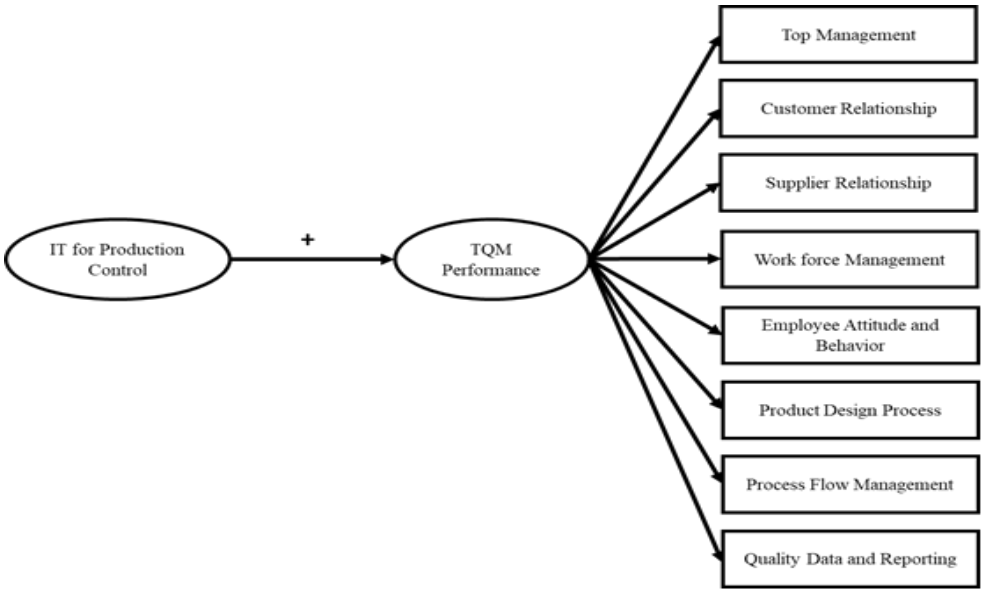

Fig 7: Impact of IT on Production Control over TQM dimensions

➢ *The overall correlation between IT and TQM performance:*

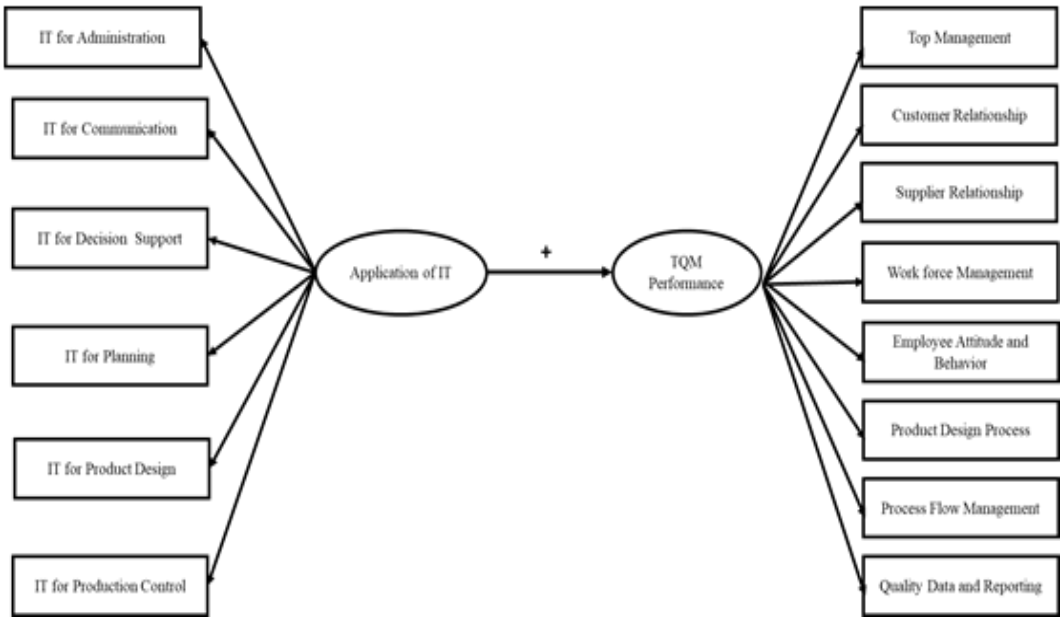

Fig 8: Correlation Between Application of Information technology, Total Quality Management, and IT-Enabled Total Quality management

If we see the overall level relationship between information technology dimensions and Total Quality management dimensions, they are positively influencing each other and as per analysis results presented in Table no 2, and Table 3, the relationship is strong and significant. In all cases as analyzed, the regression coefficient is greater than positive 0.5, and 'p' values are below 0.05 level denoting strong and positive two-way correlation among constructs of IT and TQM. Hence it can be said based on the results that the application of information technology has a very positive impact on the performance of Total Quality Management and this relationship is visible at the individual dimension level too. The overall relationship and model of IT impact over TQM are presented in Figure no 8.

V. RESEARCH CONCLUSION:

The research findings indicate that information technology implemented in different sections of the firm has a very significant level of positive impact on the performance of the Total Quality Management System of the firm. It was also found that all the information technology constructs are not

linked with all Total Quality Management rather they are linked with some specific total quality management constructs, which looks very logical too. After analysis and findings, we can say that the null hypothesis is rejected, and the alternate hypothesis is accepted hence it is proved that Information technology implementation has a very significant positive impact on the performance of Total Quality Management of the firm. The more we use Information technology in administration, communication, decision support, planning, product designing, and production control more we see the improvement in the performance of the Total Quality Management system of the firm. The below model can be derived, from the findings of this research:

- Application of IT is positively linked to implementation or better implementation of TQM and data shows that modern-age managers feel IT is vital for TQM.
- IT-enabled TQM performance is significantly positively correlated, and the application of IT does improve the performance of the Total Quality Management system in the firm.
- Information Technology used in different areas or verticals of the company is not equally co-related with all the dimensions of Total Quality management rather they have a specific correlation with each other.
- Today's business age requires advanced technological use and more advanced management systems.

The study has several limitations that give scope for future research in this area, the sample size was only limited to manufacturing industries which are normally supposed to be implementing TQM as well as Information technology at shop floors. It will be good to see non-manufacturing industries' level of IT application and its impact on Total Quality Management. Another limitation is the research is only limited to a state and 3 main industry clusters which may have their density of industry types and it may have a positive or negative impact on findings covering a wider area will be good. Another limitation can be the attitude of respondents and their knowledge base's more optimistic or pessimistic behavior may impact the response nature too.

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REFERENCES

[1]. Dewhurst, F., Lorente, A. R. M., & Dale, B. G. (1999). Total quality management and information technologies: an exploration of the issues. *International Journal of Quality & Reliability Management*.

[2]. Choi, T. Y., & Eboch, K. (1998). The TQM paradox: relations among TQM practices, plant performance, and customer satisfaction. *Journal of Operations Management*, *17*(1), 59-75.

[3]. Dewhurst, F. W., Martínez-Lorente, A. R., & Sánchez-Rodríguez, C. (2003). An initial assessment of the influence of IT on TQM: a multiple case study. *International Journal of Operations & Production Management*.

[4]. Laudon, K. C., & Laudon, J. P. (2003). *Essentials of management information*. New Jersey: Prentice-Hall. Mayasari, PDS, & Sadeli, D.(2016). The Information Technology Share In Management Information System. ICOGIA2016.

[5]. Prajogo, D. I., & Sohal, A. S. (2006). The integration of TQM and technology/R&D management in determining quality and innovation performance. *Omega*, *34*(3), 296-312.

[6]. Li, L., Markowski, C., Xu, L., & Markowski, E. (2008). TQM—A predecessor of ERP implementation. *International Journal of Production Economics*, *115*(2), 569-580.

[7]. Khanna, H. K., Laroiya, S. C., & Sharma, D. D. (2010). Quality management in Indian manufacturing organizations: some observations and results from a pilot survey. *Brazilian Journal of Operations & Production Management*, *7*(1), 141-162.

[8]. Agus, A. (2011). Enhancing production performance and customer performance through total quality management (TQM): Strategies for competitive advantage. *Procedia-Social and Behavioral Sciences*, *24*, 1650-1662.

[9]. Pérez-Aróstegui, M. N., Bustinza-Sánchez, F., & Barrales-Molina, V. (2015). Exploring the relationship between information technology competence and quality management. *BRQ Business Research Quarterly*, *18*(1), 4-17.

[10]. Marefat, D., & Faridfathi, A. (2015). Relationship between information technology and total quality management in sports federations. *Journal of Applied Environmental and Biological Sciences*, *5*(3), 52-58.

[11]. Khanam, S., Siddiqui, J., & Talib, F. (2015). Modelling the TQM enablers and IT resources in the ICT industry: an ISM-MICMAC approach. *International Journal of Information Systems and Management*, *1*(3), 195-218.

[12]. Bolatan, G. I. S., Gozlu, S., Alpkan, L., & Zaim, S. (2016). The impact of technology transfer performance on total quality management and quality performance. *Procedia-Social and Behavioral Sciences*, *235*, 746-755.

[13]. Tan, F. T. C., Tan, B., Wang, W., & Sedera, D. (2017). IT-enabled operational agility: An interdependencies perspective. *Information & Management*, *54*(3), 292-303.
[14]. Ahmed, M., & Badar, M. (2017). Investigate the improvement in organizational performance through Soft element of Total Quality Management. *International Journal of Management Sciences and Business Research*, *6*(4).
[15]. Neirotti, P., & Raguseo, E. (2017). On the contingent value of IT-based capabilities for the competitive advantage of SMEs: Mechanisms and empirical evidence. *Information & Management*, *54*(2), 139-153.
[16]. Sahoo, S., & Yadav, S. (2018). Total quality management in Indian manufacturing SMEs. *Procedia Manufacturing*, *21*, 541-548.
[17]. Digital India investments in 2017, (Sep 9, 2017) https://www.business-standard.com/article/companies/digital-india-drives-7-4-bn- investments-in-indian-internet-firms-117092900470_1.html, *Retrieved on August 10, 2018*
[18]. History of TQM, *http://asq.org/learn-about-quality/total-quality-management/overview/tqm-history.html*., *Retrieved on August 10, 2018*
[19]. MBNQA Malcolm Baldridge National Quality Award (2017-2018) model. *https://www.nist.gov/baldrige/how-baldrige-works. Retrieved on August 10, 2018*
[20]. American Society of Quality: What is Total Quality management? And History of Total quality management, https://asq.org/quality-resources/total-quality-management, *accessed on August 10, 2018*.
[21]. Potdar, P. K., & Routroy, S. (2018). Analysis of agile manufacturing enablers: a case study. *Materials Today: Proceedings*, *5*(2), 4008-4015.
[22]. Chae, H. C., Koh, C. E., & Park, K. O. (2018). Information technology capability and firm performance: Role of industry. *Information & Management*, *55*(5), 525-546.
[23]. Definition of micro, small, medium, and large-scale industries in India: h*ttp://arthapedia.in/index.php?title=Small_and_Medium_Scale_Enterprise_(SMEs), retrieved on 1st Feb 2019.*
[24]. Othman, I., Ghani, S. N. M., & Choon, S. W. (2020). The total Quality Management (TQM) journey of Malaysian building contractors. *Ain Shams Engineering Journal*, *11*(3), 697-704.
[25]. Sample calculator and formula was referred from the site, which is based on statistical calculation. *www.surveymonky.com , retrieved on 6th July 2020.*
[26]. Cronbach's alpha calculation formula picture was taken from *https://www.statisticshowto.com/cronbachs-alpha-spss/. 6th July 2020.*
[27]. The statistical concepts like Z test, persons correlation was studied from this website *https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/z-test/ 6th July 2020.*
[28]. Johri, S., & Kumar, D. (2021). Evaluation of effect of iso 9001: 2008 standard implementation on TQM parameters in manufacturing & production processes performance in small enterprises. *Materials Today: Proceedings*.
[29]. Bookbinder, J. H., & Ülkü, M. A. (2021). Freight Transport and Logistics in JIT Systems.
[30]. Nurcahyo, R., & Habiburrahman, M. (2021). Relationship between ISO 9001: 2015 and operational and business performance of manufacturing industries in a developing country (Indonesia). *Heliyon*, *7*(1), e05537.
[31]. Hassan, A. S., & Jaaron, A. A. (2021). Total quality management for enhancing organizational performance: The mediating role of green manufacturing practices. *Journal of Cleaner Production*, *308*, 127366.