Examining the Relationship of Digitalization on Business Performance: A Study from the Indian Manufacturing Sector

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Abstract— **The Indian manufacturing industry is undergoing a significant change after the global pandemic. The supply chain disruption from Covid-19 has forced many manufacturing industries to speed up the adoption of digitalization in their supply chain to address the growing need for convenience and more rapid "anytime anywhere" solutions. As a result, manufacturing industries are using advanced technology in their supply chain. Digitalization has the ability to drive the efficiency of their processes and reduce business cost. This study investigates the relationship between DIGitalization (DIG) and Business Performance (BP) in the Indian manufacturing sector. In this context, a scientific research model has been developed from the existing literature. The proposed model was tested using statistical data collected from Vice president/Associate Vice President/Divisional/Chief Managers/ Project Managers/ Senior Managers/ divisional Managers, IT managers, consultants, and project leaders of manufacturing industries. Data were analyzed through Structural Equation Modelling (SEM) using Analysis of Moment Structure (AMOS 22.0). Our empirical result indicates that there is a significant positive relationship between digitalization and business performance in the Indian manufacturing sector.**

Keywords - Digitalization; Business Performance and Structural Equation Modelling.

I. INTRODUCTION

The COVID-19 pandemic spread across the world affecting populations across countries [44]. The COVID-19 virus disrupted the Indian manufacturing sector due to the worldwide lockdown. Most manufacturing setups lack an end-to-end view of their supply chain such as end-to-end visibility, data-sharing across silos, real - time response capabilities, and flexibility in last-mile delivery. To address the above issues, the manufacturing industry can leverage digitalization with the use of Industry 4.0 technologies, to provide end-to-end supply chain management visibility. Digitalization results in increased operational efficiency and gross margin for businesses [25]. To achieve the above, the information must be shared between the manufacturing floor and business systems in real-time. Better integration of data and processes and real-time capturing of data from the machine and shop floor will enable manufacturing organizations to fine-tune their operations and produce products according to the demand of customers. In digitalization, firms implement a broad set of new technologies to optimize their business processes to improve operational efficiency and speed.

Indian manufacturing companies are on a secular growth trend due to their correlation with the growing Indian economy, which is characterized by rising demand in the domestic market and worldwide growth opportunities. According to India Brand Equity Foundation (IBEF), "By the year 2030, India has the potential to become a global manufacturing hub and it can add more than US $500 billion annually to the global economy".

The digital transformation market size in manufacturing has been valued at USD 263.93 billion and it is poised to reach USD 767.82 billion by 2026 with a CAGR of 19.48% during the forecast period 2021-2026 [32]. This digital transformation enables increased visibility, control and optimisation of production processes by integrating operations technology with information technology. The goal of value chain management is to improve bottom line of business by improving operational efficiency while preserving product quality while lowering inventory carrying costs. This builds customer confidence and Customer satisfaction. When industrial processes are digitalized, mistakes caused by lost or misread data are eliminated which is prevalent in manual operations.

Based on the above insight, current literature on digitalization does not empirically demonstrate a relationship between digitalization and business performance. Thus, we formulated our research questions to address these gaps in knowledge. Our study aims to empirically examine the relationship between digitalization and business performance in the Indian manufacturing sector. The following research question has been identified in our study.

RQ1. Does digitalization have a positive relationship with business performance in the Indian manufacturing sector?

To answer the above question, a conceptual model was developed to analyze the relationship between digitalization and business performance and the model was tested statistically through SEM (AMOS 22.0 software).

The organization of the paper is as follows. Section II provides the literature review, Section III explains the model conceptualization, Section IV describes the research methods, and Section V presents the analysis and results, followed by results discussion, conclusion, limitations, and further direction of research.

II. LITERATURE SURVEY

A. Digitalization

The 'digitalisation of manufacturing' has recently become one of the most prominent themes for major economies [3][17][33][41]. "Digitization" and "Digitalization" are two constitutive definitions that were used interchangeably in the academic literature [33][41]. At a fundamental level, digitization creates excellent sources of data, and can be defined as "moving from analogue to digital data for streamlining existing processes" [33][41]. "Digitalization is defined as adopting digital technologies to facilitate business operations" [2][13]. Digitalization is a process that takes advantage of cutting-edge digital technologies in order to enhance productivity and improve operational efficiency cutting-edge technology like Artificial Intelligence (AI), Virtual Reality (VR) and Augmented Reality (AR), Internet of Things (IoT), Cloud computing, and robotics are driving growth of manufacturing industries [51]. According to Gobble, "Digitalization is the use of digital technology, digital information, and other resources to create value in new ways" [11]. According to Gartner, "Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities" [10]. According to Westerman et al., "digital transformation is the use of technology to radically improve the performance or reach of enterprises" [50]. In a nutshell, digitization refers to information, while digitalization refers to processes. Lenka et al. explained that "Digitalization enables the processes, resources interactions and outcome between manufacturing firms and the customer to co-create value at the new frontiers of the business" [29]. According to Agarwal and Narain, the following are potential benefits of digitalization: "greater transparency", "reduced inventory levels", "clear visibility of inventory", "more decentralized warehousing", "delivery times reduction", "a better understanding of customer's requirements", "higher sales and profit margins", "improved supply chain flexibility", "better decision-making processes" and "maintaining competitive advantages" [1]. Big data analytics and cloud-based systems in the context of Industry 4.0 can significantly improve operational efficiencies [30][34][42][48]. The study has established factors to measure the perceived benefits of implementing Industry 4.0 technology [16]. Digitalization has the ability to improve flexibility, agility, and responsiveness as per customer demand in dynamic market conditions [37]. Implementing digitization in manufacturing gives an instant boost to productivity and allows quick project execution so manufacturers can meet aggressive deadlines. With digitalization, manufacturers can share real-time data across the globe also data can have accessed by anyone from anywhere [5].

B. Business performance

Business performance measures the actual performance of a business against intended goals. Regular review of the business performance saves the business against any financial or organizational problems and helps the businesses lower operational costs and improve productivity [7].Any organizational initiative, including supply chain management, should ultimately lead to enhanced organizational performance. Numerous authors have measured business performance by utilizing "financial and market indicators" such as "market share", "return on investment", "the profit margin on sales", "overall competitive position", and "the growth of market share", "sales and return on investment" [39][45][47][49][52][53].

C. Digitalization and business performance

Various studies have proved the significant relationship of technology adoption with business performance [4][12]. Digitalization increases revenue for the organization's stakeholders by widening the distribution of sales channels and increasing the productivity of industrial processes by reducing operational expenses or shortening the duration of operations. According to Horváth and Szerb, "Digital management practices with the use of IT tools tend to enhance business performance" [21]. Implementation of Big data is related to this concept, and its impact on business performance has been shown [9]. According to Hensher, leveraging digital platforms can reduce operational costs in turn its leads to business performance [18]. There is a significant positive effect of strategy or technology implementation from Industry 4.0 on business performance among SMEs [35]. It is also proven that Industry 4.0 technologies have a positive influence on service, and production and they enhance business performance [24][35][43]. Continuous innovation in technology can strengthen the relationship between people, processes, and performance [38]. According to [15], the use of digital technology has a positive relationship with business performance. According to reference [27], there is a positive relationship between blockchain technology, Supply Chain Integration (SCI) and Sustainable Supply Chain Performance (SSCP).

III. MODEL CONCEPTUALIZATION

Based on the deep understanding of research questions from the obtainable literature and experts' insights we developed a conceptual model that analyses the relationship between digitalization and business performance. As an illustration, Figure 1 shows the hypothesized model which

sheds light on the relationship between digitalization and business performance. 'Digitalization' is conceptualized as a five first order construct adapted from [19][46][54], whereas business performance of the manufacturing sectorwill be evaluated through "financial performance" and "market performance" [26][28]. Using literature support, the expected relationships between digitalization and business performance are discussed and hypothesis relating these variables are developed. Subsequently during our pilot study phase, the dimensions and items of digitalization and business performance were verified and validated using confirmatory factor analysis.

Hypothesis: There is a significant relationship between digitalization and business performance in Indian manufacturing sector.
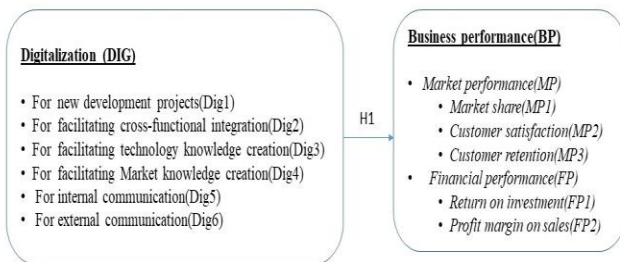

Figure 1. A Conceptual research model and hypotheses.

IV. METHOD

The research uses a quantitative approach to examine the relationship of digitalization and business performance in the Indian manufacturing context. Literature review supplemented by expert advice acts as an input to develop a questionnaire as per the objectives of the research. This gave us extensive information about the constructs namely digitalization and business performance for Indian manufacturing industry. A preliminary questionnaire was drawn up (see Appendix A), post which pre-testing was performed on 50 respondents to evaluate the clear and comprehensible wording of the questionnaire.

Data was collected from Vice Presidents (VP), Associate Vice President (AVP), Deputy Vice President (DVP) senior managers, IT managers, consultants, and project leaders and asked to fill the questionnaire survey. Data collection occurred between third week of December 2021 to Forth week of October 2022. Out of 234 usable responses, the survey revealed that around 53% of respondents were between the ages of 25-35, 36.33% were between 35-50, and the other 10.68% were above 51 years old. Furthermore, 38.03% of participants were VP/AVP/DVP/Chief Managers/Project Managers/Senior Managers/Divisional Managers, 34.19% were Technology experts and consultants, 14.96% were Technology product/marketing

Managers, and the remaining participants fell into other categories.

V. ANALYSIS AND RESULTS

A. Preliminary analysis and measurement model

A Confirmatory Factor Analysis (CFA) was used to investigate the internal construct reliability, convergent validity, and discriminant validity of measurement model. Statistical Package for the Social Sciences (SPSS 22.0) and AMOS 22.0 are used for empirical analysis. Table I shows the psychometric properties of the measurement model. The "Cronbach alpha" and "composite reliability" of all constructs were above the threshold of 0.70 which confirmed internal consistency reliability (presented in Table I).

TABLE I. RELIABILITY AND ITEMS LOADING OF THE MEASUREMENT MODEL

Construct	Items	Loading	Cronbach (α)	Composite reliability	Average variance extracted
Digitaliza-tion (DIG)	DIG1	0.879	0.921	0.938	0.719
	DIG2	0.760			
	DIG3	0.886			
	DIG4	0.876			
	DIG5	0.872			
	DIG6	0.805			
Business Perfor-mance (BP)	MP1	0.811	0.860	0.984	0.739
	MP2	0.896			
	MP3	0.915			
	FP1	0.835			
	FP2	0.837			

Hair et al. described that "Discriminant validity shows the extent to which a construct is truly distinct from other constructs" [20]. According to Fornell and Larcker, " the square root of the Average Variance Extracted (AVE) of each construct should be much larger than the correlation of the specific construct with any of the other constructs" [8]. The value of AVE for each construct should be at least 0.50. Table II demonstrates the square root of an AVE of any latent constructs is much larger than the correlation between them which confirm the discriminant validity [8]. It is evident from Table II that the questionnaire has a valid and reliable instrument for measurement of digitalization and business performance in manufacturing sector.

TABLE II : DISCRIMINANT VALIDITY OF THE MEASUREMENT MODEL

	DIG	BP
DIG	**0.874**	0.322
BP	0.322	**0.859**

Note: Diagonal in bold represents the square root of AVE whereas the off-diagonal represents correlations between constructs

To examine the "fit" of the measurement model, a number of model fit indices were obtained from the confirmatory factor analysis like Chi-square/df (Degree of freedom) = 2.953 CFI (Comparative Fit Index) = 0.959, GFI (Goodness of Fit Index) = 0.919, NFI (Normed Fit Index) = 0.939, TLI (Tucker-Lewis index) = 0.944 and Root Mean Square Error of Approximation (RMSEA) = 0.092. Gefen and Straub (2000) has proposed the acceptable fit of respective values of χ^2/df, should be less than 5, GFI, CFI, TLI and NFI should be more then 0.9 and the RMSEA value must be lower than 1. Table III clearly demonstrates that measurement model posited goodness-of-fit indices indicating a good fit with the collected data so we can proceed further for testing the structural model using SEM.

TABLE III. SUMMARY OF GOODNESS-OF-FIT INDICES FOR MEASUREMENT MODEL

Model Fit Index	Chi-square/ Degree of freedom	CFI	GFI	NFI	TLI	RMSEA
Model	2.953	0.959	0.919	0.939	0.944	0.092

B. Assessment of the structural model

According to Hair, "A structural model is a conceptual representation of the hypothesized relationships between constructs" [20]. In order to examine the proposed model and relationships, the test of the structural model was performed on SPSS 26.0 and AMOS 22 using structural equation modeling. Table IV depicts the goodness-of-fit indices for the structural model: χ^2/df, CFI, GFI, NFI, and TLI values are 2.953,0.959,0.919,0.939,0.944 The RMSEA shows a value of 0.092. Thus, we can conclude that the structural model is accepted as per goodness-of-fit indices. We can proceed to test a statistical hypothesis defined in the model.

TABLE IV. SUMMARY OF GOODNESS-OF-FIT INDICES FOR STRUCTURAL MODEL

Model Fit Index	Chi-square/ Degree of freedom	CFI	GFI	NFI	TLI	RMSEA
Model	2.953	0.959	0.919	0.939	0.944	0.092

Table V summarizes the standardized path coefficients (β), standard error and hypotheses result. The level of significance (α) is set at 0.05.

The result reveals that digitalization has a positive and significant relationship with business performance (β=0.322; $p < 0.05$), supporting the hypothesis. The result was consistent with theoretical expectations and the relationship is significant as the p-value is less than 0.05.

TABLE V : SUMMARY OF A HYPOTHESIS TEST

path	Estimates (β)	Unstandardized Regression Weight	S. E.	C. R.	P	Result support
BP<-DIG	0.322	0.233	.062	3.784	***	Yes

Notes: β = standardized beta coefficients, ***$p < .005$
S.E.= standard error
C. R. = Critical ratio
P = Estimated probability

VI. RESULT DISCUSSIONS

Digitalization is one of the biggest buzzwords across every business around the globe. Digitization is often joined by digitalisation and digital transformation in both conversations and business practices. The primary objective of this study to investigate the relationship of digitalization on business performance in Indian manufacturing sector. The conceptualized research model was build using existing literature, practical insights and consultation with the subject experts. The results of statistical testing of hypothesis reveals that digitalization has a positive relationship with business performance. Horváth and Szerb (2018) are line with the findings that management practices linked to digitalization and the use of digital tools increase business performance. Several studies have demonstrated that technology can improve business processes and boost performance [10][22][40]. IT has entered in an era of digitalisation where digital technologies can boost sustainable growth by spurring innovation and differentiation. By integrating digital technologies in current business processes, it allows authorized users to access the information more efficiently, quickly, intuitively and securely. Greater efficiencies and business benefits can boost profitability of the organization [36]. McKeown and Philip deliberated a business transformation to be "an overarching concept encompassing a range of competitive strategies which organizations adopt in order to bring about significant improvements in business performance" [31]. Our findings demonstrate that digitalization can

significantly bolster business performance in industrial firms. It can do so by boosting efficiency, lessening expenses, optimizing quality, and offering new business prospects. However, to reap the rewards of digital advancements, we need thoughtful preparation, investment in the proper tools and infrastructure, and a thorough comprehension of the potential advantages and difficulties.

VII. CONCLUSION AND LIMITATIONS

Our study takes a first step towards examining the relationship between digitalization and business performance in the Indian manufacturing sector. From the empirical results, it was evidently specified that digitalization has a positive relationship with business performance.

This study has some limitations and opportunities for future research.The findings of our research primarily focus on the Indian manufacturing sector which does not provide an adequate basis for generalization. Moreover, the said limitation potentially paves the way for further research. For improving the generalization of the study, the model can be tested in other countries. Further research can be conducted to investigate the relationship between digitalization andsupply chain performance, competitive advantage, and organizational resilience.

APPENDIX A

Questionnaire

Measures of the Digitalization(Digital)

Source: adapted from [19][46][54]

Digitalization defines the use of digitization as a lever to achieve change in processes.Please circle the appropriate number that accurately the status of digitalization

1	2	3	4	5
Very little extent	little extent	some extent	great extent	Verygreat extent

DIG/Dig1	Digitalization for new product development projects
DIG/Dig2	Digitalization for facilitating cross-functional integration
DIG/Dig	Digitalization for facilitating technology knowledge creation
DIG/Dig4	Digitalization for facilitating market knowledge creation
DIG/Dig5	Digitalization for internal communication

	(e.g., across different departments, across different levels of the organization)
DIG/Dig6	Digitalization for external communication (e.g., suppliers, customers, channel members)"

Measures of the Business Performance (BP)
Source: adapted from [26][28]

In this section, we are trying to measure the Business Performance. Please mark the best estimate that accurately reflects the status of Business performance.

1	2	3	4	5
Very little extent	little extent	some extent	great extent	Very great extent

Financial Performance (FP)

BP/FP1	Return on investment
BP/FP2	Profit margin on sales

Market Performance (MP)

BP/MP1	Market Share
BP/MP2	Customer satisfaction
BP/MP3	Customer retention

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