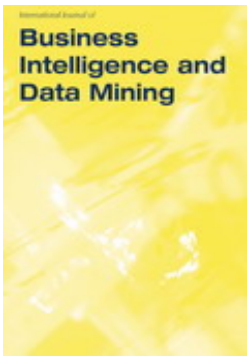

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Gaurav Abhishek Tigga*,
Ganesan Kannabiran and P. Sridevi

Department of Management Studies,
National Institute of Technology,
Tiruchirappalli, Tamil Nadu – 620015, India
Email: gauravtigga89@gmail.com
Email: kb@nitt.edu
Email: psridevi@nitt.edu
*Corresponding author

Abstract: IT integration complements the functional and operational processes, as well as helps the firm in the development of inimitable competitive advantage. The study examines the effect of ITI on supply chain integration, supplier flexibility and manufacturing flexibility; and their subsequent effects on firm performance. The extended resource-based view has been used as the theoretical perspective to develop the research model. A survey was carried out among the manufacturing industries in India. Structural equation modelling with the partial least squares algorithm was used to analyse the hypotheses proposed in the study. The results reported that ITI has a significant effect on SCI, manufacturing flexibility and SF and subsequently affects FP.

Keywords: IT integration; supply chain integration; supplier flexibility; manufacturing flexibility; firm performance.

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Biographical notes: Gaurav Abhishek Tigga is a research scholar at the Department of Management Studies, National Institute of Technology, Tiruchirappalli, Tamil Nadu, India. He received his Bachelor of Technology in Instrumentation and Control Engineering and Master of Business Administration in General Management. He is a UGC-NET Junior Research Fellowship Awardee in Management. He has research interests in information technology and operations management.

Ganesan Kannabiran is currently the Director of the IIIT Sricity and is a Senior Professor of Management at NIT, Tiruchirappalli. He has served as the Director I/C, and Dean of Research and Consultancy at NIT Tiruchirappalli. His teaching and research areas include business analysis and IT consulting, ICT for development, business analytics, IS offshoring, knowledge management and software project management. He has served as a Visiting Faculty to many leading institutions (IIM Kozhikode, Ranchi and Tiruchirappalli). He received the Emerald Indian Management Research Fund Award 2016 and has won Best Teacher in Information Technology Management, Bloomberg UTV B-School Excellence Awards.

P. Sridevi received her BE in Electronics and Instrumentation and MBA in Systems Management from the Annamalai University and awarded Doctorate in NIT Tiruchirappalli. Currently, she is working as an Associate Professor in

the Department of Management Studies, NIT, Tiruchirappalli. Her field of interest include data mining, information systems, system analysis and design and quantitative techniques. She has published book chapters on case studies and research papers in international and national journals, reviewed articles for international journals, and presented papers at international conferences. She has organised workshops in analytics at NIT Trichy and has also delivered lectures in various B-schools.

1 Introduction

The manufacturing processes and the IT associated with the firm are evolving rapidly to cater to the needs of the customer. The firm is torn between the decision to support such advancements by investing in them or address the various capital requirements associated with its processes and the supply chain (SC) (Lakshmi and Raja, 2018). The firm should also be cautious of the risks associated with the IT being implemented or integrated. The firms should focus on IT which complements the processes and operations related to the firm and its SC, rather than investing in highly advanced and priced IT (Valanarasu and Christy, 2018). Superior integration achieved through effective exchange of the right information and resources between the manufacturer and its suppliers leads to strengthening of the relationships and coordination in the SC network, thereby leading to improvements in the flexibility of the firm's operations and productivity (Huang and Lu, 2020; Manders et al., 2016). Integration of IT creates new opportunities and possibilities to efficiently link the firm with its SC partners and leverage the benefits derived from these linkages (Kitainge et al., 2019). IT aids in the dissemination, retrieval, storage and analysis of information in the firm and the SC, thereby improving the flexibility and responsiveness of the SC entities (Chen, 2019; Prakash et al., 2020; Tigga et al., 2021). IT enables the effective integration across the firm and the SC that aids in reducing the inadequacies, which develop as a result of fluctuating demand and volatile market conditions; and also resulting in flexible operations throughout the value chain (Ganbold et al., 2020; Mindur and Paweska, 2019; Samizadeh et al., 2019). As a higher-order construct, SCI was frequently investigated on its effects on the firm's and SC's effectiveness, but the cumulative impact of effectiveness and efficiency related to FP has rarely been examined (Irfan et al., 2019; Jahromi and Safaei, 2020).

The relationship between the integration of IT and SF has rarely been investigated (Cheung et al., 2018; Shekarian and Parast, 2020). Lee and Rha (2016) posit that the relationship between the integration of IT and flexibilities associated with the firm-supplier network needs to be further explored. Also, the relationship between ITI and MF has rarely been investigated empirically by prior literature. Irfan et al. (2019) asserted that flexibility is a multi-dimensional construct and that future research could focus on other dimensions of flexibility and need not be restricted to flexibilities associated with volume or mix alone. The authors motivate researchers to extend the study by incorporating higher-order SC capabilities. Ojha et al. (2019) proposed that researchers examine the relationship between SCI and the supplier and their relationship with the firm. But, the relationship between SCI and SF has rarely been empirically tested. Liu et al. (2016) and Samizadeh et al. (2019) suggested that further research could

be conducted on the impact of different IT capabilities on SCI or its dimensions to achieve better FP.

The ERBV has been extensively used to investigate the effects of the external resources and capabilities on the firm's operational capabilities and efficacy of the firm or the SC (Yuan et al., 2020). Tigga et al. (2021), from the ERBV perspective, state that integrating IT between the firm and its suppliers leads to increased collaboration and coordination, resulting in effectively responding to changes in the demand and eventually higher FP. Thus, FP is greatly affected by the supplier's resources and capabilities (Perdana et al., 2019). Therefore, this study assumed FP as a higher-order construct composed of effectiveness and efficiency. Therefore, this study uses the ERBV theory to investigate the impact of ITI on SCI, SF and MF and eventually on FP. Based on the gaps identified from previous literature, this study defines the following objectives:

1 to investigate the effects of ITI on SF and the higher-order SC capabilities, SCI and MF

2 to investigate the effects of SCI on SF and MF and their eventual impact on FP.

A research model and hypotheses were proposed based on the ERBV perspective and analysed empirically using the PLS-SEM approach. Firstly, the study investigates the relationship of ITI with SF and the multi-dimensional construct, MF. Second, the study examines the synergistic relationship between SF and MF, as well as SF and FP. Third, the study also explores the mediating effect of SCI along with SF and MF in the relationship between ITI and FP. The following sections cover the theoretical background, hypothesis development, methodology, analysis and discussion. The paper concludes with the implications for practice and directions for future research.

2 Theoretical background and hypothesis development

2.1 Extended resource-based view

The ERBV focuses on the firm' ability in the utilisation, transmission and accessing of outside resources while concentrating on the type of relationship it has with its business partners (Lewis et al., 2010). ERBV states that a firm could develop new capabilities when it coordinates and collaborates with other firms to derive financial and strategic benefits. (Lai, 2012). Jin et al. (2014) indicated that IT resources in the firm lead to the development of relation-specific capability, leading to competitive advantages. They further posit that the integration of IT across the firm and the SC requires cooperation, transparency of information and information sharing with its SC partners. Thus, ERBV is used as a perspective to explore the relationship between ITI, SCI, MF and SF and their subsequent impact on FP.

3 The effect of IT integration on supply chain capabilities

ITI has made it easier to manage information related to production, forecasting, scheduling and inventory in SCs (Qrunfleh and Tarafdar, 2014). ITI is defined as the extent to which IT is exploited for communicating relevant information, coordinating and

integrating various functions associated with the firm and its SC partners (Chen, 2019; Swafford et al., 2008). Jin et al. (2014) stated that IT resources, from the ERBV perspective, can aid in developing supplier-manufacturer relationships, leading to improvements in FP.

Mindur and Paweska (2019) have reported IT to be a vital capability associated with SCI that aids in reducing the inadequacies brought about by fluctuating demand and volatile market conditions. Prior studies state that ITI improves SCI, eventually improving performance (Ganbold et al., 2020; Mindur and Paweska 2019; Samizadeh et al., 2019). Chen (2019) have reported that ITI improves information sharing, coordination and collaboration significantly.

Prior studies posited that higher ITI levels and information exchange increase the flexibility of the firm and its suppliers (Monroe and Barrett, 2019; Swafford et al., 2008). ITI has been reported to improve FP by leveraging SC flexibility, namely SF (Swafford et al., 2008; Wieteska, 2017). Earlier studies state that ITI helps in improving the firm's ability to share, assimilate and analyse information with its suppliers; which leads to an increase in the flexibility related to the firm's operations MF and SF, eventually leading to FP (Cheung et al., 2018; Martínez et al., 2016).

Thus, we hypothesise the following:

H1a ITI is positively related to SC integration.

H1b ITI is positively related to SF.

H1c ITI is positively related to manufacturing flexibility.

4 The effect of supply chain capabilities and firm performance

According to ERBV, a firm can develop superior capabilities and performance by integrating its resources and capabilities both inside and outside its boundary (Xu et al., 2014). SCI has been identified as a crucial SC capability which aids the firm to invest and utilise the resources, effectively integrate its functions and operational activities within the firm as well as with its suppliers (Liu et al., 2016; Lee and Whang, 2004; Liu et al., 2016). Prior studies define SCI as the extent of strategic collaboration achieved by the firm with the SC partners in the effective management of intra – and inter-organisational activities, which leads to efficacy in the flow of products, information, and services, reduce costs and achieve competitive advantage (Mbugua and Namada, 2019; Ojha et al., 2019). The authors of this study define SCI as a higher-order capability consisting of four dimensions, namely, information integration (II), strategic partnership (STRGC PART), synchronised planning (SYNC PLAN), and operational coordination (OC) (Liu et al., 2016; Saeed et al., 2011). II is defined as the degree to which a firm's operational and SC related information are exchanged with SC partners (Liu et al., 2016). SYNC PLAN is defined as the degree of a firm's collaboration with its SC partners regarding planning and scheduling (Lee and Whang, 2004; Liu et al., 2016). OC refers to the degree to which a firm's SC activities are organised and automated with its SC partners (Sanders, 2007; Liu et al., 2016). STRGC PART denoted the scope of the firm's relationship with its SC partners to mutually benefit from the defined strategic goals (Lee and Whang, 2000; Liu et al., 2016).

Supply chain flexibility (SCF) refers to a firm's capacity to alter its operations effectively in the firm and throughout the SC to cater to the changes in the market through the integration of SC partners (Fayezi et al., 2017). MF and SF have been identified as critical dimensions of SCF and play an essential role in achieving FP (Shekarian and Parast, 2020; Singh et al., 2020).

Yousuf and Felföldi (2017) define SF as a firm's ability to swap among its suppliers based on the suppliers' performance or cater to the firm's requirements and manage the uncertainty in the environment by increasing their responsiveness, thereby altering the production schedules and production volumes. Jin et al. (2014) define SF as the suppliers' ability to adapt their operational activities to accommodate the firm's resource requirements to achieve the market's varying demands. The authors of this study define SF as the suppliers' ability to cater to the various needs and resource requirements if and when chosen from the collective group of suppliers associated with the firm to achieve the market demand with minimal incurred penalties.

Prior studies define MF as a firm's ability to make necessary modifications in the operational activities in order to manage variations in the market and reduce adverse conditions (Huang and Lu, 2020; Mishra et al., 2018). Numerous studies have identified various flexibility dimensions associated with MF (Dey et al., 2019; Kumar et al., 2017; Mishra, 2020) and incorporating all the dimensions in this study is difficult. Thus, this study considers the dimensions associated with MF described by Jin et al. (2014), namely production flexibility (PF), product development flexibility (PDF), and logistics flexibility (LF). They defined MF as the firm's ability to modify its production, product development and logistics activities with maximum efficacy in order to acclimatise to the varying market conditions and market demand. The authors referred to PF and PDF as capabilities associated with the firm's ability to make changes in the production and product development processes. LF of a firm was denoted as the ability of the procurement process or system to adapt to prompt changes in the delivery requests.

Güner et al. (2018) define FP as the point to which a firm measures up with its competitors and to what level. Prior studies have stated that FP is constituted of effectiveness and efficiency, which are essential in evaluating it since firms can either be effective or efficient (Liang and Frösén, 2020; Singh et al., 2020). Effectiveness denotes the delivery of products that satisfy the customer's needs, while efficiency denotes the firm's efficacy in delivering the required product (Bezuidenhout et al., 2020). The authors further proposed effectiveness to be composed of customer satisfaction, market share and acquisition of new customers, while efficiency was composed of return on investment, sales and profitability.

The effect of SCI on SF, MF and FP Jahromi and Safaei (2020) reported that higher levels of SCI in a firm lead to the development of capabilities related to quality, production, sales and delivery of goods. Superior SCI leads to the strengthening of the SC relationships by exchanging appropriate information and resources, leading to improvements in MF (Huang and Lu, 2020; Khalaf and El Mokadem, 2019; Manders et al., 2016). Prior studies posited that MF could be improved SCI and eventually led to revenue in terms of time and resources (Ojha et al., 2019; Singh et al., 2019). Jin et al. (2014) stated that firms with higher levels of integration still find it challenging to cope with the range of products to be manufactured along with fulfilling the market demand. These difficulties could not be resolved by utilising only MF; thus, the suppliers' support to the manufacturer, in terms of SF, plays a significant role in achieving the firm's

strategic goals. Shekarian and Parast (2020) also reported that SCI has a substantial effect on SF.

Superior levels of SCI lead to seamless interaction with its suppliers, thereby increasing the efficiency and effectiveness of the firm and the SC (Lai et al., 2012; Latupeirissa et al., 2020). Prior studies have identified SCI as an essential capability that positively influences FP (Jahromi and Safaei, 2020; Mbugua and Namada, 2019). Thus, we hypothesise the following:

H2a SCI is positively related to SF.

H2b SCI is positively related to manufacturing flexibility.

H2c SCI is positively related to FP.

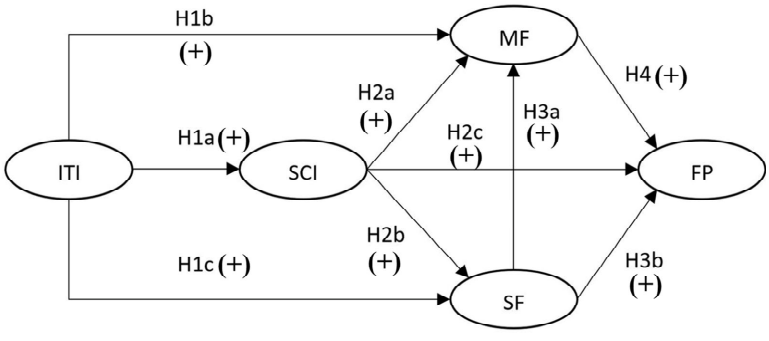
The effect of supply chain flexibilities on FP Jin et al. (2014) posit that SF has a significant influence on the manufacturing firm's logistics, product development, and production capabilities. The authors also stated that SF is a tool exploited by the firm to satisfy the customers' demands by delivering the right volume of products timely, which aids in enhancing the MF. Prior studies have reported SF to be an enabler of MF (Dey et al., 2019; Erasmus et al., 2020; Mishra et al., 2018; Mishra, 2020).

The firms have become more efficient in leveraging the SF and resources to derive maximum benefits from the relationship and subsequently improve FP (Mishra et al., 2018). Shekarian and Parast (2020) reported that SF in firms leads to FP by reducing response time and transaction costs, higher levels of quality and productivity, and faster delivery time. Yousuf and Felföldi (2017) state that SF leads to improvements in profits, and the supplier's ability to react to variations in the market demand leads to higher efficiency, lower risks and reduced costs. Thus, we hypothesise the following:

H3a SF is positively related to manufacturing flexibility.

H3b SF is positively related to FP.

Figure 1 Proposed research model



Singh et al. (2020) state that firms find it challenging to produce various products in large volumes to satisfy the market demands. Prior studies state that MF is a significant aspect for a firm to achieve a competitive advantage (Mishra, 2020; Singh et al., 2019). Chan et al. (2017) report that MF does not have a positive effect on FP. But, several studies said that MF has a direct impact on FP (Martínez et al., 2016; Wei et al., 2017). Prior studies have reported that MF has a significant impact on FP, which encompasses higher

sales, productivity, quality, distribution, profits and lower costs (Khalaf and El Mokadem, 2019; Martínez et al., 2016; Wei et al., 2017). Thus, we hypothesise the following:

H4 MF is positively related to FP.

Based on the above-defined hypotheses based on the ERBV perspective, we formulate a research model, as shown in Figure 1.

5 Methodology

This study adopted the structural equation model (SEM) using the partial least squares (PLS) algorithm as the statistical technique to analyse the proposed research model. PLS-SEM has been extensively used for analysing direct and indirect effects in complex models simultaneously (Hair et al., 2014). The study also incorporated the directions provided by Sarstedt et al. (2019) in estimating and validating higher-order constructs MF, SCI and FP in PLS-SEM.

6 Measures

The five-point Likert scale was used to weigh the measures used in the instrument ('strongly agree' – 1 to 'strongly disagree' – 5). The sources for the constructs' measures (ITI, SF, MF, SCI and FP) implemented in the questionnaire are presented in Table 1.

Table 1 Sources for construct, measures and items

Construct	*Variable*	*Source*	*No. of items*
IT Integration		Martínez et al. (2016)	4
		Swafford et al. (2008)	
		Swafford et al. (2006)	
Supplier flexibility		Huo et al. (2018)	6
		Jin et al. (2014)	
Manufacturing flexibility	Production flexibility	Jin et al. (2014)	4
		Swafford et al. (2006)	
		Zhang et al. (2003)	
	Product development flexibility	Vickery et al. (1999)	4
		Jin et al. (2014)	
	Logistics flexibility	Zhang et al. (2003)	3
		Jin et al. (2014)	
Supply chain integration	Information integration	Cai et al. (2010)	4
		Liu et al. (2016)	
	Operational coordination	Liu et al. (2016)	3
		Saeed et al. (2011)	
	Strategic partnership	Liu et al. (2016)	5
		Paulraj et al. (2008)	

Table 1 Sources for construct, measures and items (continued)

Construct	*Variable*	*Source*	*No. of items*
Supply chain integration	Synchronised planning	Lee and Whang (2000)	6
		Liu et al. (2016)	
Firm performance	Effectiveness	Lee and Rha (2016)	4
		Liang and Frösén (2020)	
		Liu et al. (2013)	
		Singh et al. (2020)	
	Efficiency	Lee and Rha (2016)	4
		Liu et al. (2016)	
		Singh et al. (2020)	

7 Sample and data collection

The survey was conducted by utilising the snowball sampling technique in India's manufacturing industries for 18 months, from November 2018 to April 2020. This technique was adopted to overcome the stringent policies employed in the industry for data collection to minimise confidential information disclosure. The target population chosen for the study were managers of core manufacturing industries. The industries for the data collection were screened based on the following criteria: net sales (> Rs1,000 crores), the number of employees (> 2,000) and had implemented IT for more than ten years. The different types of industries where data collection was conducted were based on previous literature (Huo et al., 2018; Lee and Rha, 2016; Liu et al., 2016). The industries approached for the survey were related to boilers, heavy electrical equipment (20.75%), steel and alloys (16.33%), ceramics (10.20%), fertiliser (14.29%), chemical and allied products (14.23%), automotive (9.18%), aircraft and aerospace (14.4%). The respondents were composed of senior-level and mid-level executives from several departments related to marketing, materials management, production, procurement, and information technology across industries. The departments were selected based on the suggestions acquired from industrial and academic experts and previous literature (Jin et al., 2014; Liu et al., 2013; Liu et al., 2016). The profile of the respondents was scrutinised on criteria such as designation and experience in their firm.

A pilot study was conducted to verify the instrument's validity, which consisted of 30 executives from each industry targeted for the study. The final data collection was conducted by distributing 880 questionnaires, and 496 responses were received, which indicates a 56.36% response rate. The responses received consisted of 226 complete and valid responses. Kock and Hadaya (2018) proposed 'the gamma exponential method' for minimum sample size estimation, using which a minimum sample size of 208 was obtained for a minimum β value of 0.167. Furthermore, multiple responses were collected from each firm of targeted manufacturing industries (10 respondents from various departments of each firm) to eliminate the presence of common method bias (CMB). But we carried out a full collinearity test on the samples as proposed by Kock (2015) to verify the presence of CMB. The inner variance inflated factor (VIF) values for the first-order constructs with respect to net sales, the number of employees and number of years of IT

being implemented in the firm was analysed and the VIF values were found to be below the threshold of 3.3 (as shown in Table 2) and thus confirm the absence of CMB.

Table 2 Full collinearity test, reliability and validity for the lower order constructs

	Cronbach's alpha	*CR*	*AVE*	*Full collinearity test*		
				Net sales	*No. of employees*	*Years of IT implementation*
EFFCT	0.741	0.837	0.562	1,208	2,374	1,289
EFFCY	0.735	0.835	0.559	1,212	2,366	1,387
II	0.919	0.943	0.805	1,778	1,883	2,336
ITI	0.844	0.895	0.681	1,435	1,071	1,318
LF	0.927	0.954	0.875	2,264	2,183	1,441
OC	0.904	0.940	0.840	1,361	1,532	1,548
PDF	0.843	0.897	0.693	1,737	2.89	1,245
PF	0.880	0.918	0.736	2,222	3,201	1,205
SF	0.853	0.882	0.562	1,725	1,156	1,224
STRGC_PART	0.904	0.929	0.725	1,121	2,027	1,928
SYNC_PLAN	0.873	0.905	0.618	2.06	1.97	2,313

8 Analysis and results

The study carried out PLS-SEM analysis using SmartPLS 3.0 (Ringle et al., 2015). The guidelines proposed by Sarstedt et al. (2019) were incorporated in this study to analyse the validity and reliability of:

a lower-order constructs (LOCs)

b reflective-reflective HOCs.

The hypotheses formulated during the study were examined, and the corresponding results are discussed in the following sections.

9 Measurement model

9.1 Validity and reliability of LOCs

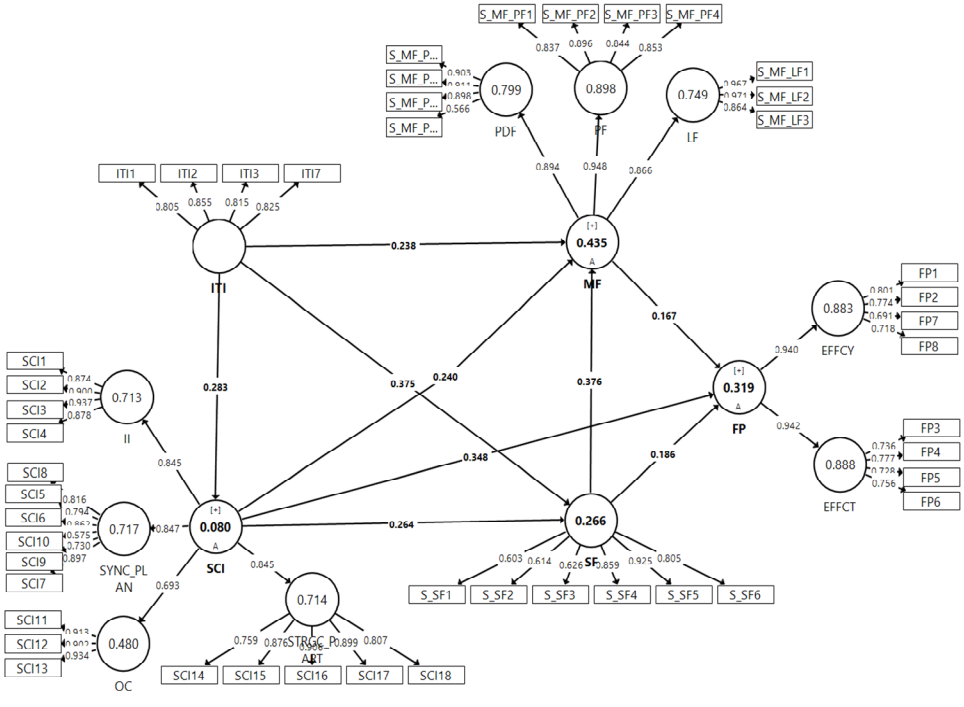
The factor loadings and the reliability (Cronbach's alpha and composite reliability) were observed to be above the threshold value of 0.7 for all the items of the LOCs taken for analysis (Sarstedt et al., 2019). Some of the LOCs' reliability was found to have values nearly equal to or more than 0.9 in some cases. The minor similarities of the items used in the instrument or the respondent's clarity in understanding the questions could be the underlying reasons behind the values' irregularities.

The validity measured using the average variance extracted (AVE) was observed to be above the threshold value of 0.5. Multicollinearity was also investigated, and the VIF was found to be lower than the threshold value of 5. The discriminant validity was found to be present among the LOCs and above 0.7 according to Fornell-Larcker criterion (Sarstedt et al., 2019). The reliability and validity values for the LOCs are given in Table 2.

10 Reliability and validity of reflective-reflective HOCs

The proposed research model with the reflective-reflective HOCs was analysed using a repeated indicator approach as specified by Sarstedt et al. (2019). The formulated measurement model is shown in Figure 2.

Figure 2 PLS-SEM measurement model



The factor loadings for all the HOCs were more than 0.7 except for OC (0.692). The reliability and validity were found to be above the threshold value of 0.7 and 0.5, respectively. The HTMT values were also found to be below the threshold value, 0.85. The reliability, validity and HTMT values for the HOCs are given in Table 3.

Table 3 Reliability and validity for the higher-order constructs

Indicator reliability – factor loadings for LOCs				*Composite reliability*		*Convergent Validity (AVE)*	
	FP	*MF*	*SCI*				
EFFCT	0.942			MF	0.930	MF	0.815
EFFCY	0.940			FP	0.939	FP	0.885
LF		0.866		SCI	0.883	SCI	0.875
PDF		0.894		*Cronbach's α*		*HTMT*	
PF		0.948		MF	0.886	MF, SCI	0.204
II			0.845	FP	0.870	MF, FP	0.219
OC			0.693	SCI	0.946	SCI, FP	0.225
STRGC_PART			0.845				
SYNC_PLAN			0.847				

11 The structural model

The parameter's standard error in the population was also determined through the bootstrap procedure used to analyse the structural model. Hair et al. (2014) stated that the coefficient for the parameters obtained through the bootstrap procedure makes a distribution that could be regarded as an approximation of the estimated coefficient's distribution in the population. The standard deviation obtained during the bootstrapping procedure could be used as a substitute for the parameter's standard error in the population. The standard deviation for the parameters were found to be in the range of 0.058 (ITI → MF) to 0.084 (SCI → FP). The standard deviation, standardised path coefficients (β) and T Statistics for the direct and in-direct paths are shown in Table 4.

Figure 3 PLS-SEM structural model

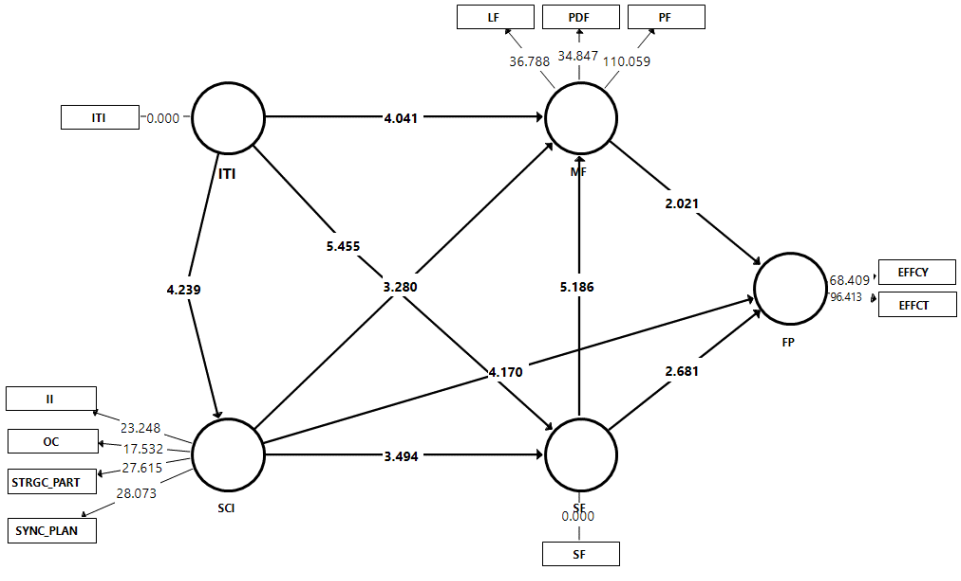


Table 4 PLS-SEM path coefficients

Hypotheses	*Direct paths*	*Standard deviation*	*Standardised path coefficients (β)*	*T statistics*	*Supported*	*Indirect paths*	*Standardised path coefficients (β)*	*T statistics*	*Mediation*	*Hypotheses*
H1a	ITI→SCI	0.067	0.284***	4,239	Yes	ITI→SCI→SF	0.074*	2,545	Partial	H1b
H1b	ITI→SF	0.069	0.375***	5,455	Yes	ITI→SCI→MF	0.066*	2,272	Partial	H1c
H1c	ITI→MF	0.058	0.234***	4,041	Yes	ITI→SCI→SF →MF	0.029*	2,245	Partial	H1c
H2a	SCI→SF	0.075	0.261***	3,494	Yes	ITI→SCI→FP	0.100**	2,959	SIE*	SIE*
H2b	SCI→MF	0.071	0.233**	3,280	Yes	ITI→SF →MF	0.145***	4,026	Partial	H1c
H2c	SCI→FP	0.084	0.352***	4,170	Yes	ITI→SF→FP	0.070*	2,359	SIE*	SIE*
H3a	SF→MF	0.074	0.385***	5,186	Yes	SCI→SF→MF	0.100**	2,783	Partial	H2b
H3b	SF→FP	0.070	0.187**	2,681	Yes	SCI→SF→FP	0.049*	2,177	Partial	H2c
H4	MF→FP	0.081	0.163*	2,021	Yes					

Note: ***→$p < 0.001$, **→$p < 0.01$, *→ $p \leq 0.05$; SIE#- specific indirect effect.

The hypotheses were tested by analysing the direct paths as shown in Figure 3, which were all found to be significant. The paths coefficients for SCI → SF (0.265), ITI → SCI (0.279), SCI → FP (0.351, ITI → SF (0.364), and SF → MF (0.398) were found to be highly significant. Similarly, the paths SF → FP (0.188), ITI → MF (0.198) and SCI → MF (0.239) were found to be moderately significant. MF → FP (0.164) was found to be the least significant among the direct paths.

The specific indirect effects were also examined in the study to identify any mediation effects exhibited by the SC capabilities. The path coefficients for the direct and indirect paths are shown in Table 4. Several partial mediation effects were observed on the ITI → MF path. The path ITI → MF was mediated strongly by SF (0.145), and weakly by SCI (0.067) and the combined effect of SCI → SF (0.029). SF was found to be an important mediator on the path IT → MF, among others. The direct path ITI → SF was found to be mediated moderately by SCI (0.074). Similarly, SF was found to moderately mediate SCI → MF (0.106) and SCI → FP (0.050). Among all the mediators identified, SF was determined to be an important mediator in the study.

Additional mediation paths were also found to exhibit specific indirect effects in relationships between ITI and FP. These relationships were not hypothesised previously in the study. The path ITI → FP was mediated moderately by SCI (0.098). Similarly, ITI → FP was mediated weakly by SF (0.068) and both SCI and SF (0.014). SCI was found to be an important mediator for the ITI → FP relationship.

12 Discussion and implications

The hypothesised relationships based on the ERBV theory, between ITI, SCI, MF and SF; and their subsequent impact on FP were statistically significant using SEM analysis. Based on the results, theoretical implications are presented in this section.

The ITI's relationship with SCI, SF and MF were found to be supported and in line with previous researchers' findings (Martínez et al., 2016; Samizadeh et al., 2019; Wieteska, 2017). ITI was found to be an enabler to SCI, which are in line with the findings reported by prior literature (Mbugua and Namada, 2019; Liu et al., 2016). The underlying reason could be that the ITI in the firm and the integrated SC improve the planning, coordination and, information sharing between the processes and operations of the manufacturing firm as well as its SC partners. Our study also reported that the relationship between ITI and SF as well as ITI and MF were significant, and these relationships were rarely explored or investigated empirically by prior researchers. Thus, this study sheds new light on the relationship between ITI and the flexibilities associated with the firm and its supplier. Also, SF was found to be strongly influenced by ITI when compared with the relationship of ITI on MF. This result also supports the ERBV perspective that IT resources can aid in developing supplier-manufacturer relationships (Jin et al., 2014). The findings of the study related to ITI and SF were found to be in line with Wieteska (2017), but previous researchers (Lee and Rha, 2016, Cheung et al., 2018; Shekarian and Parast, 2020) had indicated the relationship between the ITI and SF has rarely been investigated. The relationship between ITI and SF could be due to the improved information sharing and coordination between the firm and its SC partners brought about by the integration of IT in the Indian manufacturing firms, which further leads to the higher flexibility of the suppliers in addressing the changes in demand or product specifications to cater to the needs of the firm's customers. Therefore, we have

attempted to study ITI and SF and proved the existence of the relationship empirically. The positive relationship between ITI and MF was in line with the results reported by prior studies (Martínez et al., 2016; Swafford et al., 2008). The findings of this study imply that the integration of IT in the Indian manufacturing industries have greatly benefited the SF of the firms while also leading to improvements in the firm's MF and SC integration.

The study examined the SCI's relationship with MF and FP which were found to be supported and in line with the findings reported by previous researchers (Huang and Lu, 2020; Irfan et al., 2019; Manders et al., 2016; Mbugua and Namada, 2019; Sarkum et al., 2017; Stevens and Johnson, 2016). The result indicates that SCI helps improve the operations and processes of the firm related to manufacturing through better planning and coordination with its suppliers. The firm leverages the capabilities of its SC partners through effective SCI to manufacture products of higher quality and required volume to fulfil the customer demands thereby improving the performance of the firm. The study also empirically investigated the relationship between SCI and SF which affirms this relationship empirically and extends the body of knowledge related to SCI and flexibilities associated with the SC. The results of the study support the ERBV perspective that a firm can develop superior capabilities and performance by integrating its resources and capabilities both inside and outside its boundary (Xu et al., 2014). Among the capabilities associated with the SC, SCI was found to enable SF more than MF which suggests that SCI is a necessary factor to develop SF which is in line with Wieteska (2017). The stronger relationship of SCI with SF than MF implies that SCI greatly influences the firm-supplier relationship and less on the operations and processes of the firm. The products which are complex in design are highly modular and the Indian firms are dependent on their suppliers to manufacture and supply product components that are trivial yet critical and essential for the effective functioning of the product. The firm need not necessarily manufacture the entire product but assemble several components which make up the end-product.

The SF's relationship with MF and FP were found to be supported and in line with the findings of previous researchers (Dey et al., 2019; Kazemian and Aref, 2016; Linawati, 2017; Lu et al., 2018; Mishra et al., 2018; Yousuf and Felföldi, 2017). The relationship between the two flexibilities associated with the firm, SF and MF was found to support previous researchers' findings and affirms that SF is a critical enabler of MF (Dey et al., 2019; Lu et al., 2018; Mishra et al., 2018). The relationship between SF and MF implies that the flexibility in the manufacturing processes is greatly affected by the flexibility of the suppliers indicating further that if the suppliers are unable to supply or adhere to the product's quality or specifications as required to manufacture the product which leads to reduction in the flexibility of the manufacturer as well. Similarly, the relationship between SF and FP was also found to be supported, but the strength of the relationship was found to be moderate supporting the findings of Xu et al. (2014) which incorporated the ERBV theory that SF alone cannot lead to improvements in FP. The weakness in the relationship between SF and FP could be due to the indirect influence of the suppliers on the firm's efficacy in manufacturing products or satisfying the customers' demands.

The study also examined the relationship between MF and FP, which was supported and in line with previous researchers (Khalaf and El Mokadem, 2019; Umam and Sommanawat, 2019; Wei et al., 2017). The relationship between MF and FP was very weak in comparison to SCI and FP or SF and FP. Since MF is a HOC composed of

production flexibility, PDF and LF; there could be other dimensions which could improve the enabling power of MF on FP. The study also revealed that SCI had a stronger effect on FP when compared to SF or MF. The study also found that the relationship between SCI and FP could be improved further when mediated by SF and extends the findings of existing literature (Afshan and Motwani, 2018; Mbugua and Namada, 2019; Piprani et al., 2020).

The study also examined mediating effects imparted by the SCI, SF and MF in their relationship with ITI, SC capabilities and FP. Mediating effects were also observed in many cases (ITI → SF, ITI → MF, SCI → MF, and SCI → FP) though the mediation was partial in nature. The relationship between ITI and SF was mediated by SCI, implying that ITI improves the integration of activities and processes within the firm and with its SC partners, leading to an increase in SF as reported by Wieteska (2017). This indirect relationship between ITI and SF mediated by SCI could be due to the integration of IT in the firm which improves the information sharing, coordination and, partnership with its suppliers eventually improving the flexibility of the suppliers to adhere to any changes in the fluctuations in demand or requirements of the end customers. Similarly, ITI and MF was strongly mediated by SF which implies that SF is an important mediator that improves the effect of ITI on MF. The study also found that the combination of SCI and SF could also mediate ITI and MF, but the strength of such a relationship was weak, which implies that there might be other underlying factors that could strengthen the mediating effect of SCI and SF. From the ERBV perspective, the strength of the relationship between ITI and MF was increased by the mediator SF and this finding supports the findings reported by Jin et al. (2014). The mediating effect provided by SCI and SF on the ITI → MF relationship could be due to the dependency of Indian manufacturing firms on suppliers for the manufacturing of components associated with the product. As previously discussed, integration of IT greatly improves the information sharing, coordination and, partnership with its suppliers which indirectly affects the efficacy of the manufacturing processes of the firm. Any changes in the product volume, requirements and demand need to be addressed both by the firm and its suppliers which can be achieved through effective communication, information sharing, coordination and, partnership.

The relationship between SCI and MF was mediated by SF which implies that SF plays a significant role in improving the relationship between SCI and MF. This study affirms the findings of previous researchers (Chang et al., 2005; Huang and Lu, 2020; Jin et al., 2014; Manders et al., 2016). The relationship between SCI and FP was also found to be mediated by SF which affirm the assertions made by previous researchers. SF was identified to be an important mediator in the relationship between SCI and MF as well as SCI and FP. Suppliers in Indian manufacturing firms have a significant impact on the production processes thus, the firms need to share information and coordinate with their suppliers. The more flexible the suppliers are in adapting to fluctuating demands, the higher the flexibility of the manufacturing processes and operations of the firm thereby increasing the efficacy of the firm in manufacturing the required product to meet the demand of the customer.

Specific indirect effects were also observed where the ITI and FP were strongly mediated by SCI, moderately by SF and weakly by the combination of SCI and SF. This finding affirms and extends the assertions made by prior researchers that IT alone could not improve the firm's efficiency and performance (Daneshvar et al., 2020; Jin et al., 2014). The mediating effect of SCI and SF in the relationship between ITI and FP could

be due to the firm's ability to leverage the integrated IT to improve the coordination and information sharing with its suppliers. Similarly, the increase in the firm's ability to adapt to fluctuating demands and the changing market requirements through varying its production output and quality, leading to improvements in the firm's performance.

13 Managerial implications

The study brings out a few key implications for managers. ITI was found to significantly influence SCI, implying that a firm's activities and processes enabled by IT help in a seamless integration of the various internal functions and suppliers affiliated with the firm. ITI aids the firm in effortless communication, i.e., effective sharing of information related to alterations in product design or product volume leading to improvements in the OC eventually leading to FP. Further, the mediation results also show that SCI enabled by ITI leads to improvements in FP. The serial mediation offered by SCI and SF also helps improve ITI and FP's relationship. This statement is analogous to the concept of a smart factory where automated machines work in tandem with humans and with each other to benefit the SC through supervision of operational activities and decision making using cyber-physical systems leading to higher FP. Managers need to find the right IT infrastructure or digital systems that complement their operations and business processes in order to realise smart factories in their industry.

The integration of IT in a firm leads to higher SF due to the effective transmission and communication of information within the firm and with its SC partners. The sharing of information among its SC partners would improve the firm's ability to effectively plan and continuously improve its operations, thus enhancing SCI capability. This enables the firm to adapt to changes in the market by altering its operations to suit the customer's needs. Internet-of-things (IoT) could be beneficial for the firm as it can help the firm in automatically transferring information in a safe and secure manner. IT also helps integrate the firm's resources with that of its suppliers to achieve extended factories. However, it is not sure if Indian manufacturing companies are fully ready to share all the production and R&D related information so that the fullest potential of IT can be leveraged.

The study reported that SCI has a strong effect on FP. However, SCI mediated by SF leads to improvements in FP. This implies that the ability of the supplier to accommodate the flexibility required by the firm is the key for improvement in FP. Therefore, the firm's ability to identify the right suppliers along with the right IT options to connect its core activities greatly helps towards better the firm's performance. Also, a firm equipped with flexible suppliers and a high level of SCI would enable a firm to achieve both effectiveness and efficiency. If the firm outsources a large number of modular components of a product to its suppliers, this could lead to the development of new capabilities like resilience which aids the firm in reducing the risks associated with changes in demand and market fluctuations. The inclusion of suppliers would lead to improvements in quality, tackle changes in volumes and product designs and would improve the MF of the firm and thereby achieving higher performance.

MF is vital to the firm as it is associated with flexibilities related to production, new product development and logistics. MF was found to have a weak influence on FP. This implies that MF helps in productivity improvements, management of varying product volumes and varieties, the introduction of new products in the market, and reduction in

delivery time. SF was found to have a weak influence on FP. However, the study also found that SF mediated by MF helps improve FP. Therefore, achieving MF is a prerequisite to leverage SF. The involvement of ITI is affected by suppliers since the IT available in the firm should be compatible with the suppliers to enable seamless communication among each other, which in turn positively affects the firm's performance. Similarly, the involvement of suppliers in the planning, coordination, and partnership of the firm's processes and activities greatly affects the firm's effectiveness and efficiency. In summary, Indian manufacturing firms are rightly poised for adopting Industry 4.0 for addressing most of the SC implementations.

14 Conclusions

In this study, we attempted to examine the effects of ITI on SC integration, SF and MF and the subsequent impact on FP through the ERBV perspective. The study found ITI to have a significant effect on the SC capabilities. The study had few contributions to existing literature. The effects of ITI and SC integration on SF were analysed, and the findings of this study stressed the importance of SF. SF was also found to be an important mediator. SC integration and SF were found to be important antecedents of MF and performance of the firm. The study also found that ITI has a considerable effect on the firm's performance in the presence of SC integration and SF. Thus, the inclusion of IT and suppliers in the firms' strategy and operations through effective integration and coordination helps improve its performance and efficacy.

The study's scope was limited to MF and SF, which represented the dimensions of SC flexibility. Further research could be carried out using other SC flexibility dimensions to understand better the effect of the multi-dimensional nature of SC flexibility on FP. Similarly, SC integration as a higher-order construct was limited to information sharing, OC, STRGC PART and SYNC PLAN. Future studies could investigate the effects of other dimensions related to SC integration on FP. SC integration and SC flexibility dimensions were used in this study, but the study could be extended to include other SC capabilities. The study was conducted in Indian manufacturing industries which are currently going through a huge transformation, and adequate care needs to be taken while applying the findings in the context of other countries.

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