The Information Technology Capability and Financial Performance of Global Auto Firms in Thailand: The Role of the Supply Chain as a System of Internal and External Collaboration

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***Abstract*-The researcher specifies the relation between the latent and observed variables and inter-correlation is allowed between all the factors. This research is based on proposing and evaluating the model based on the association between internal and external collaboration, IT capability, and performance of a firm. The study results in important implications, which are important from managerial and theoretical perspectives. The study contributes in a significant way through testing empirically the theoretical assumptions in the previous literature based on the influence of IT on firm performance and collaboration. The study has used the SEM-PLS as a statistical technique to answer the research questions. In this research, it has been considered that there are two constructs of collaboration. Separate constructs have been developed for internal and external collaboration. Moreover, stages are involved in collaboration including simple sharing of information to a truly developed collaboration. A key finding of this study is the influence of internal collaboration on the performance of firm. This finding has been suggested by several research studies, but it does not confirm the crucial role served by internal collaboration. The study, which is among the pioneering studies on the issue will provide policy guidelines to relevant ministry and also helps the researchers in understanding the issues in the Thai auto industry.**

Keywords: *Supply Chain, Collaboration, Financial performance, Information technology, Global, Thailand*

1. Background

The face of the industry has changed with the advancements in the informational technology over the last decade. From a theoretical perspective, functions such as logistics and SCM (SCM) have been influenced. Organizations receive benefits in terms of performance through SCM which is based on mutual collaboration among the partners in the supply chain [1, 2]. Considering the recent collaborative association between Michelin and Sear that has reduced the inventories for both companies by 25% [3]. In a similar way, the collaborative relation between General Motors with its suppliers has reduced cycle times in the development of vehicle by to eighteen months (previously it was four years). Large of the amount of information sharing with the supply chain members such as logistics, operations, and strategic planning results in this type of collaboration. Firms receive greater benefits through sharing of information such as improvement in production planning, visibility, distribution, and inventory management.

The existence of an effective and efficient Information technology (IT) system supports this type of collaboration. The required information is processed and transmitted through the use of IT, which is important for the process of decision-making. Moreover, it is considered as the backbone of the structure of supply chain business [4, 5]. IT is considered an important enabler for SCM activities because of all the above reasons. The auto industry of Thailand is dominated by global players. Unlike the neighboring country Malaysia, which is developing the local industry through the establishment of local brands, the Thai industry is hosting the global auto players. It is evident from figure 1 that 98.6 percent of the auto production is from the global firms.

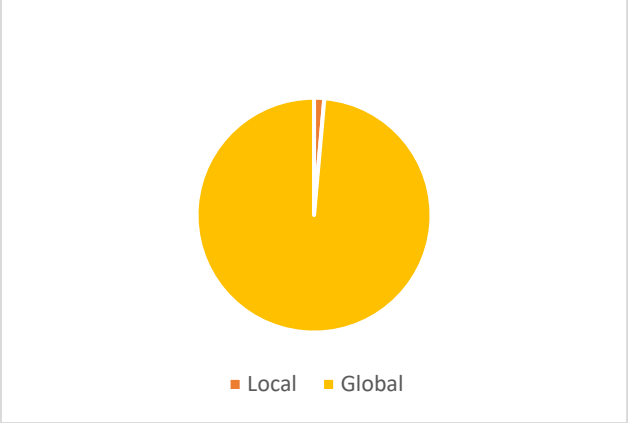

Figure 1. Auto production from global and local manufacturers in Thailand
Source: Thai Automotive industry association

The extent of external and internal information sharing in the organization has been improved by the advancements in IT capabilities. The performance of a

firm is positively related to IT capability(ITC) [6, 7]. It has revealed that firms can achieve competitive advantage through the use of IT in information sharing with partner firms [8]. In a similar way, a positive influence is created by collaboration of all the chain members on the e performance of firms. The relation between firm collaboration, ITC, and performance of a firm has not been revealed properly. There is a need for huge investments in IT and efforts are required. Moreover, more empirically based research is required to understand role of IT in organizational performance because of the prolific nature of information sharing [7]. This research is based on adding to the existing knowledge through testing the relation between the level of collaboration (external and internal) in an organization, ITC, and performance of a firm. Literature studies have been used for constructs and model development.

2. Literature Review and Hypothesis development

The previous research studies have analyzed the influence of IT on a firm. However, the context of this study is different as it involves analyzing the configuration of specific IT applications with the organizational competitive priorities and comparing benefits of some IT applications [8]. The nature of IT research within SCM is strategic. It has been suggested by studies that there can be significant differences in SCM practices and strategies because of the use of IT capabilities. The study conducted by Panayides [2] identified that the most common factor linked with the latest supply chain practice is IT. The typology of Panayides [2] was used to link strategy specifications and firm practice.

The extended enterprise model has documented the significance of IT in SCM. This model was developed by Panayides [2], modifications were made by Edwards, et al. [9]. The key attributes of a firm have been identified by this model, which move towards high-class logistics. An important component of the model is the integrated IT system. In this framework, the firms carrying out operations across the boundaries are considered high-level firms. They conduct activities across the boundaries in a seamless manner because of ITC, which manages effective flow of information in real time.

The idea of IT as an enabling factor for SCM has been supported by research but its role in supply chain strategy has not been linked with greater use of IT. A wide range of activities is involved in SCM practices, which include internal and external practices, aimed at value creation for the end-customers [10, 11]. Value can be created for end customers through greater coordination between the associated firms. It results in low costs for the firm by elimination of unnecessary operations as well as underutilization of resources [12]. However, there is need for collaboration between the internal and external organizational activities [12].

Cross-functional planning is required in internal organizational collaboration along with sharing of databases and coordination. Sharing of information is required by internal cross-functional activities and external organizational collaboration across the supply chain participants [13]. The coordination of logistics and operations between organizations increases with high level of collaboration in the internal and external organization. The organizational performance improves with greater coordination [2]. IT was regarded by the CEOs as the most crucial strategic tool in a London School of Economics survey (Compass Group l998). It was claimed that technology is not the only source of achieving competitive advantage, but it leads to efficient sharing of information. The idea that IT supports SCM activities is supported by the research and its role in supply chain strategy has been discussed. However, the studies did not state the association between collaboration, ITC, and performance of firm.

2.1 Research Hypotheses

A conceptual model has been proposed in the study, which represent the relation between collaboration (external and internal), ITC, and performance of firm. ITC has been defined as the technological ability for acquiring, processing, and sharing of information in an effective manner for decision-making [4]. It has been depicted by the research model that internal and external collaboration (EC) of an organization (which are two different collaboration constructs) is influenced by IT capabilities.

The construct of internal collaboration (IC) is referred as a mutually share process in which collaboration is shown between more than one departments, who have mutual understanding, share resources, common vision, and work for collective objectives [13]. On the other hand, EC is regarded similar to IC, but the focus is on the collaboration among firms not departments. Previous research studies have assumed about the association of internal and EC with IT, but it has not been tested directly. The relation between IT and several other constructs of collaboration has been studied such as relationship commitment [5]. It was found by Lun, et al. [5] that there is a positive and strong association between IT investments and relationship commitment among the partners in supply chain. Some researchers have investigated that coordination costs decrease and coordination increase through use of IT [4, 14]. The development of first two hypotheses is supported by these research studies, which assume that internal (IC) and EC (EC) is positively influenced by IT.

H1: ITC has significant impact on the IC of Thai global auto firms

H2: ITC has significant impact on the EC of Thai global auto firms.

Mixed results have been revealed through literature review regarding the influence of IT on financial performance of a firm [1, 2]. It was found that there are inconsistencies in different studies, which lead to variations in measures and methods for analysis. However, most of the recently conducted research studies found that IT has a direct influence on financial performance of the firm [2, 7]. Considering these research studies, it can be expected that ITC is positively related with performance of a firm in a significant way. It can be referred as achievement of set goals [7]. In this way, the third research hypothesis is formulated as below:

H3: IC has significant impact on the external EC of Thai global auto firms

It has been posited by the proposed model that ICs are influenced by ECs that influence the performance of a firm. In the developed model, the association between IC and EC is in line with the recent conducted researches. It has been argued that the communication in the supplier firm limits the association and collaboration with the buyers. In this way, internal communication plays the role of mediator in the association of buyer and supplier collaboration. It was found by Bienstock, et al. [12], that IC is directly influenced by EC. In the similar way, a recent study found that supply chain collaboration is influenced through IT, which is based on the preposition that collaboration between and within the firms is subsumed equally under the supply chain integration construct. The researchers claim that different internal functions are integral for supply chain. The following research hypothesis has been formulated for testing this relation.

H4: External supply chain collaboration has significant impact on the financial performance of Thai global auto firms.

H5: IC mediates the relationship between EC and financial performance of Thai global auto firms.

The performance of an organization improves with high level of association and coordination [2]. An empirical supported was provided by Seyhan, et al. [13] for the relation of customer service performance and internal integration. Significant differences have been found by this study in customer service performance having higher integration. Moreover, it was revealed that the performance of firm is influenced through IC [12]. Considering this, the following research hypothesis has been formulated.

H6: Internal supply chain collaboration has significant impact on the financial performance of Thai global auto firms.

H7: IC mediates the relationship between ITC and financial performance of Thai global auto firms.

3. Methodology and Measurement

The study has adopted the survey-based method for answering the research questions raised. The response rate of the study is 69 percent and scale are soaped form the previous studies.

The definition of IT has been considered for the formulation of scale items for this factor. There can be different interpretations for different groups of constituencies. IT has been defined as the technology adopt for sourcing information, processing and sharing it for decision-making [4]. The ITC of firm was evaluated using four scale items such as ITC with respect to key customers, industry standards, level of information, and with respective to competitors as well as key suppliers. The comparison of the scale items can be made as the ones used or adopted by Lun, et al. [5]. However, the respondents were asked by the scale items about the leading ability of the company [5]. In this research, it was asked to the respondents that how the comparison is made by the company relative to competition and industry standards in the use of IT.

This factor was measured using three scale items including use of an integrate database for sharing information, cross-functional coordination in strategic planning and sharing of information regarding operations between the departments. The support for sharing information and existence of collaboration was measured through these variables. The focus of first variable was on strategic collaboration. The literature has documented the significance of aligning functional strategies and making firms' part of the overall strategy [15, 16]. Active participation of functional strategies is required by a true strategy formulation to ensure the alignment of functional strategies with overall business strategy [16]. In previous research studies, the scale items used for measuring IC are compared with the scale items used in this study [12].

The implementation of SCM has a necessary component of direct involvement of SCM in strategic planning. SCM greatly drives the IC that is based on the internal functions' integration within the firm including product development/design, procurement, manufacturing, distribution, marketing, etc. [17]. Elimination of this variable was a surprising thing.

The level of EC with supplier is an important element of SCM [18, 19]. The competitive performance is improved through with collaboration of internal cross-functional activities related to the supplier functions and members in the channel [17]. Based on the collaboration process and information type shared, there exist differences in collaboration. This study includes four variables for determining EC. These variables include sharing of operations, sharing of cross-functional processes, and involvement in collaborative networks with different suppliers, cost information sharing, and information planning. Moreover, these scale items can be compared with the scale items used for determine EC by previous researchers [12].

The previous research studies have measured the performance of firm can be measured in different ways [2,

20]. There are four basic competitive priorities i.e. quality, flexibility, dependability, and cost are included in these measures. An added dimension is innovation. It has been suggested by some researchers that quality manufacturers in the world work of different performance objectives rather than the key focus on one objective.

This research study has used a composite construct including multiple measures considering the approach for various performance objectives adopted in previous research studies [21]. The measures include quality, introduction time of new product, delivery, and cost. All these scale items have been used in previous research studies [21].

4. Analysis

The study performed the empirical data analysis. For this purpose, a second-generation statistical technique, i.e. PLS-SEM was adopted, which includes the measurement and the structural model. The initial step of estimating PLS-SEM is the determination of the measurement model. The most common issues encountered by researchers are non-normality of data and small sample size. Due to the occurrence of these same issues in present study, the partial least square structural equation modelling was adopted, as it seems to be an appropriate technique for statistical procedures. However, the CB-SEM was not considered to be appropriate in this regard. Therefore, based on Hair, et al. [22] suggestion, the present study determined a sample size of 121 to be sufficient for PLS-SEM estimation. Nonetheless, both approaches CB-SEM and PLS-SEM share a commonality i.e. these approaches involve two steps [22-24]. The PLS-SEM path model estimation involves measurement or outer model estimation, followed by the determination of structural models' path relations [24].

The estimation of measurement model involves measurement of the statistical components, to ensure if the item loading is adequately loaded and is appropriate to undergo statistical testing. Measurement model also shows if the survey items adequately measures their respective constructs. Thus, the study examined the measurement model through assessment of the construct validity, internal consistency, discriminant and convergent validity by Smart PLS, in order to perform statistical procedures.

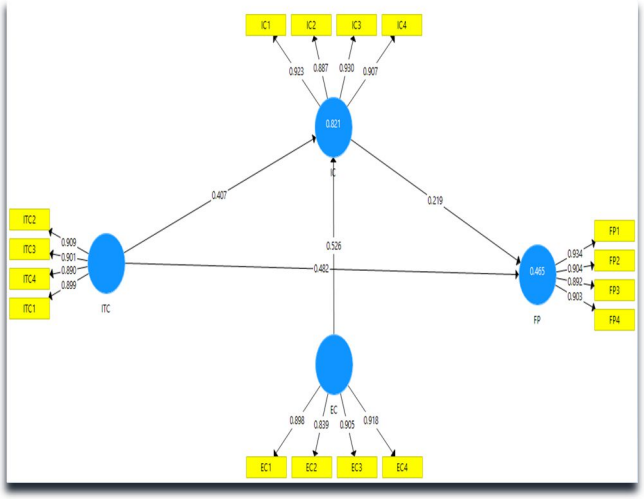

Figure 2. Outer model

Furthermore, a precondition to validity is the achievement of internal consistency or reliability. The reliability considers the degree of measures to yield compatible outcomes and involve no measurement errors [25]. The internal consistency and validity also confirm the inner model association of variables [26]. It is considered important as unreliable measures can cause defective influence, resulting in the weakening association among the measures. Thus, in order to handle measurement errors, Hosany, et al. [25] has put forward a multi-item scale approach, which enables the researcher to omit unreliable items for improving the reliability. However, since all items were measured multiple times, therefore this study found no measurement errors.

Internal consistency refers to a procedure for testing reliability of items [25, 27] with respect to homogeneity of items. According to Clossey, et al. [28], it determines the extent of items to measure the same construct. For determining internal consistency, composite reliability (CR) is a most common measure [27] and is interpreted just as the measure of Cronbach alpha (CA). For present study, the result of Cronbach alpha measure is shown in Table 5.13, indicating that all items of the model are reliable since, the reliability values are found to be consistent with the minimum acceptable level i.e. 0.70 [25, 27]. This indicates that each model construct has higher internal consistency. On the other hand, the minimum satisfactory range of reliability is 0.70-0.90 [29]. However, in view of Hair, et al. [27], if the value for reliability test lies above 0.90 or 0.95, then it reflects that majority of indicators tend to estimate similar phenomena, and is considered to be undesirable. Generally, the convergent and discriminant validity are considered as the sub-categories of construct validity and are capable of adequately measuring the construct validity. The item loadings and cross-loadings are examined for confirming the particular item validity and for establishing convergent validity. The convergent validity is the extent to which two same construct measures which must be theoretically related are in fact related [24]. An item is considered to be

a good indicator for measuring a construct if it exhibits high loadings for its own construct, on the other hand, if the item has higher loadings for other model constructs, then it is indicative of an item's potential issue.

Table 1. Reliability

	Cronbach's Alpha	rho_A	CR	(AVE)
EC	0.913	0.914	0.939	0.793
FP	0.929	0.930	0.950	0.825
IC	0.933	0.934	0.952	0.832
ITC	0.922	0.922	0.945	0.810

The acceptable range for outer model loadings is greater than 0.50, whereas, below 0.50 outer-model loading calls for the exclusion of items with lowest loadings [22]. Thus, to enhance the data quality, items with lowest loadings are excluded one by one from the model. The outer-model loadings are shown in Table 2 The table shows high indicator loadings for their respective constructs with a range of 0.749-0.950, thereby confirming the validity of constructs involved in the measurement model.

Table 2. Outer loadings

	EC	FP	IC	ITC
EC1	0.898			
EC2	0.839			
EC3	0.905			
EC4	0.918			
FP1		0.934		
FP2		0.904		
FP3		0.892		
FP4		0.903		
IC1			0.923	
IC2			0.887	
IC3			0.930	
IC4			0.907	
ITC2				0.909
ITC3				0.901
ITC4				0.890
ITC1				0.899

An average variance extracted (AVE) measure was employed following the suggestion of Tzempelikos and Gounaris [30] which require to exhibit AVE=0.50 or above to achieve convergent validity. Besides, the AVE, factor loadings, and composite reliability were suggested by Hair, et al. [22] having threshold levels of 0.50, 0.70 and 0.70 respectively. Henseler, et al. [24] stated that AVE=0.50 represents that on average, the latent variable explained the 50 percent of variation in the manifested variable. Similar to convergent validity, the discriminant validity observes the dissimilarity of measures of the constructs. It can be established through two different measures, i.e. 1) Tzempelikos and Gounaris [30] criterion, and 2) Cross-loadings method. However, the Tzempelikos and Gounaris [30] criterion is the standard discriminant validity testing approach [26]. Thus, the current study performed the discriminant validity assessment to establish external consistency of the underlying model. Although, the study achieves discriminant validity when each construct's square root value turns out to be higher than the maximum correlation among the constructs. Alternatively, researchers also use cross-loading method, since it is a radical approach and incorporates more constructs.

Table 3. Discriminant Validity

	EC	FP	IC	ITC
EC	**0.891**			
FP	0.788	**0.908**		
IC	0.886	0.739	**0.912**	
ITC	0.884	0.773	0.872	**0.900**

Subsequently, the study attempted to examine the structural model which aims to assess the variables' correlation and regression assumptions. The estimation of structural model involves five steps, namely, collinearity assessment, observing the significance of model relationships and their relevance; followed by the computation of the coefficient of determination and effect size; determining the relevance, and lastly analysing q^2 effect sizes. Other than that, the mediation effects were also assessed by the study. The detailed discussion of structural model examination is presented in the subsequent sections. Starting with the initial step of structural model assessment. The collinearity problem was addressed, which is the condition of having high correlation between some of the indicators. The table 4 indicates the absence of multicollinearity in the data, since all the variables are within the threshold level, i.e. tolerance level> 0.20, and VIF<5. Thus, the range for tolerance level i.e. 0.243 & 0.439, and VIF = 2.278 & 4.122 satisfy the threshold level for all the variables.

Table 4. Variance inflation factor

	VIF
EC1	3.084
EC2	2.137
EC3	3.266
EC4	3.569
FP1	4.054

FP2	3.248
FP3	2.965
FP4	3.168
IC1	3.796
IC2	2.998
IC3	4.071
IC4	3.543
ITC2	3.455
ITC3	3.194
ITC4	3.092
ITC1	3.176

Next to collinearity test is the examination of structural models' relationship significance and relevance. Observing the path-coefficients of structural model provides the hypothesized association between the models' constructs [31]. The structural or inner model examine the direct association among the variables, path coefficients and t-values. However, the PLS path coefficient is similar as the regression beta-coefficient.

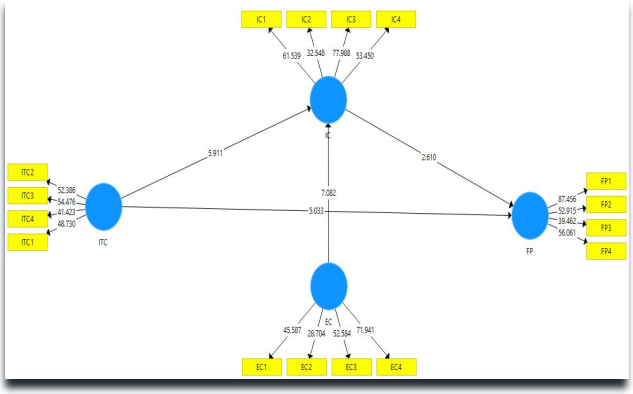

Figure 3. Inner model

Afterwards, t-values, standard errors, and path coefficients were presented, providing detailed information that could support the proposed set of hypotheses. Therefore, the study carried out a t-test by performing a bootstrapping method, and using 5000 bootstrap samples, following Hair, et al. [31] suggestion. The critical values obtained from the 1-tailed test were observed to determine the level of significance.

Table 5. Direct Relationship

	(O)	(M)	STDEV	|O/STDEV|	P Values	Status
EC -> FP	0.115	0.124	0.052	2.230	**0.026**	**Accepted**
EC -> IC	0.526	0.532	0.074	7.082	**0.000**	**Accepted**
IC -> FP	0.219	0.230	0.084	2.610	**0.009**	**Accepted**
ITC -> FP	0.572	0.573	0.076	7.524	**0.000**	**Accepted**
ITC -> IC	0.407	0.401	0.069	5.911	**0.000**	**Accepted**

The mediation of IC in the relationship between IC in the relationship between EC and firm performance and in the relationship between ITC and firm performance.

Table 6. Mediation

	(O)	(M)	(STDEV)	(|O/STDEV|)	P Values	Status
EC -> IC -> FP	0.115	0.124	0.052	2.230	**0.026**	**Accepted**
ITC -> IC -> FP	0.089	0.092	0.037	2.407	**0.016**	**Accepted**

The value of the model coefficient shows the predictive accuracy of the underlying model. The coefficient value is obtained by squaring the existing correlation among the actual and the anticipated endogenous construct values. Hair, et al. [31] suggested that it shows the combined effects the exogenous variables pose upon the endogenous constructs. Basically, the value for coefficient of determination shows the level of predictive accuracy, which ranges between 0-1, the greater the value within this range the more the predictive accuracy in explaining the dependent variable, and vice versa. There is no suggested rule of thumb for R^2, however if the R^2 equals 0.25, 0.50, or 0.75, then it is termed as weak, moderate, or substantial level of predictive accuracy, respectively [22, 24]. Most researchers try to achieve parsimonious model, which gives desirable explanation with as minimum predictor variables as possible.

Table 7. R-Square

	R Square
FP	0.465
IC	0.821

Lastly, to determine the model's predictive relevance, it is important to estimate the effect size (Q^2) as it estimates the underlying model's predictive capacity [27].

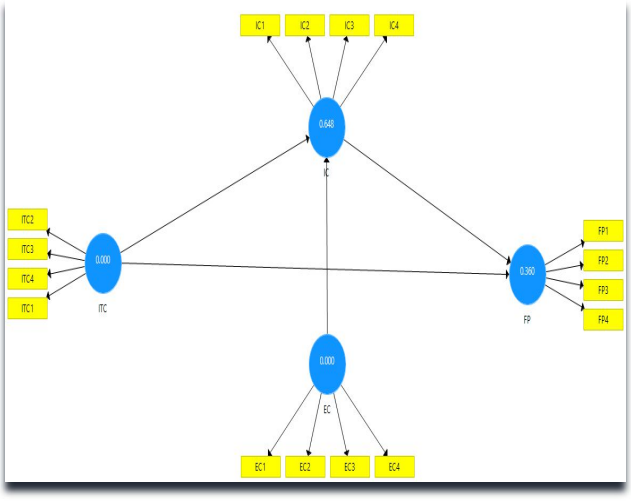

Figure 4. Q^2

Thus, $Q^2<0$ indicates no predictive relevance and $Q^2>0$ shows that model has some level of predictive relevance. However, it can only be adopted in case of single item variable or endogenous reflective variable [31]. The effect size (Q^2) is obtained by performing blindfolding method, as presented in Table 8.

Table 8. Q²

	SSO	SSE	Q² (=1-SSE/SSO)
EC	868.000	868.000	
FP	868.000	555.557	0.360
IC	868.000	305.214	0.648
ITC	868.000	868.000	

5. Dissuasion and Conclusion

There are two steps in this process [32]. In the first step, measurement model is developed using CFA (confirmatory factor analysis). The relevant latent factors are identified at this stage. The association between the observed and unobserved variables is tested.

A direct and significant influence is created by IT on the external and IC. The crucial role played by IT in the organization is underestimated by this finding. It is suggested by research that collaboration is not similar to IT. However, a separate construct is developed for IT, which improves the association of internal and EC. It can be noted that companies often perceive that collaboration exists with the informational technology in place.

Collaboration is supported by IT and is a result of human interactions. Funding for different IT programs is considered by managers and this is a crucial point for them. There is need to give high consideration to the efforts, which promote collaboration. A key finding of this study is the influence of IC on the performance of firm. This finding has been suggested by several research studies, but it does not confirm the crucial role served by IC. It has been suggested by the significant influence of IC on firm's performance that there is need for companies to make strategic investment, which increases integration and cooperation across the organizational functions. Investments should be made by companies in different IT programs as it promotes IC in the organization. Finally, IC is influenced by EC as supported by the research model. This in turn improves the performance of firm. The previous findings are supported by this. However, it is not surprising to know that high IC is resulted from EC. The advantages of collaboration are synergistic in nature. The organizational members are supported to access information in timely manner and use this efficiency for decision making within and across the organization.

There are certain limited for this study, which gives directions for conducting future research. The influence of certain information technologies has not been compared in this study, which is important to be considered in future. For instance, Hwang, et al. [33] provided one functional IT classification in which it has been aggregated into six groups. These include decision support systems, transaction-processing systems, communication systems, collaborative work systems, and inter-organizational systems. Wynne-Jones, et al. [34] provided a simple IT classification in which it has been divided into two categories namely coordination oriental IT and production-oriented IT. Irrespective of the classification, these technologies have a direct influence on collaboration as compared with other technologies. There is need to elaborate the influence of specific information technologies on the performance of firm and collaboration in future research studies.

A sequence has been suggested by some studies for using IT to achieve integration in supply chain [35]. In order to implement IT in a successful manner, there is need to develop a functional relation and coordination between IT utilization and stage of integrating supply chain. Supply chain integration has an integration part i.e. collaboration. Therefore, it can influence collaboration as well. This directs towards the complexity of problem. In this research, a simple model has been tested. This relationship can be expanded in future studies by incorporating the stage of integrating supply chain.[36]. There is need to recognize the association between specific information technologies and their relationship with needs of collaboration in future studies. This can bring useful insights and findings for using IT in businesses.

Because of the empirical nature of study, this research has some limitations. The first limitation is related to the empirical nature of data. Differences can be caused in scales because of random errors in the empirical data using CFA analysis with varied data sets. There is need to develop scale, purification, and validation across different sets of data and longitudinally. Similarly, the measures used in this research can be re-examined in future research.

The second limited is linked with sample characteristics, on which hypothesis are tested. Results can be generalized based on broader samples in larger studies. Another limitation of this study is linked with sample characteristics, on which the hypotheses have been formulated. However, IT is persistent in ever industry. The focus of the study was on large manufacturing firms, which increases the measures' validity. There is need to develop similar measures for a broad range of firms in the service sector. Irrespective of the limitations, this research supports the positive influence of IT on capabilities, collaboration, and firm's performance. The tangible benefits related with increasing expenditures on IT have been questioned by some researchers. This is motivated for future empirical research to highlight this issue. This type of empirical evidence has been provided by our study through clarifying the IT role in the organizations.

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