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From Supply Chain Connectivity (SCC) to Supply Chain agility (SCA), Adaptability and Alignment: Mediating Role of Big Data Analytics Capability

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Abstract- The main aim of the current study is to analyze the effect of SCC on the large information analysis capability and to analyze the impact of this big data analytics capability on the agility, adaptability and alignment of the supply chain. For this purpose, the current study used RBV as supporting the idea because the idea of RBV suggests that a firm can build its capabilities based on its resources. The data for the current study was collected from 300 employees of manufacturing firms of Thailand through questionnaires and the sample was selected through purposive sampling technique. The analysis and results revealed that SCC has a significant positive role in building big data analytics capability of the firm. Furthermore, it has been found that big data analytics capability enhances the SC qualities to cope with external environment and fluctuations because it significantly positively influences the SCA, adaptability and alignment. The current study and its findings have implications in practice as well as theory because they are expected to make value contributions in both fields.

Keywords; *SC connectivity, big data analytics capability, SC agility, SC adaptability, SC alignment*

1. Introduction

In this modern globalized era, the firms need to react properly to the consistently developing business and market environment. In this era, the market demands, and conditions show rapid fluctuations that need rapid modifications of firms [39]. If a firm fail to cope with such fluctuations and changes then there are chances that firm can lose its market share and position and can face failure [1, 2]. The external challenges and uncertainties really need to be considered by the firms in order to compete and survive in modern globalized era. There are three key qualities of the firms and their functions that make them differentiated from other firms in the market while coping with such challenges. These three qualities are "agility, adaptability and alignment" [3-6]. There are many significant researches found in existing literature about the importance of these three qualities of the firms and their role in gaining different benefits for the firm e.g. [4, 7, 8]. The agility, adaptability and alignment in Supply chain (SC) of the firms have a great role in enhancement of SC performance and thus, organization's performance

because they can have positive outcomes by improving the cost performance as well as functioning performance of the SC [8, 40-41]. The great contribution of these qualities in determining the performance of the firm and various departments has leaded many researchers to conduct studies on the role of these qualities in the firms. However, the studies on combined impact of these three qualities of the firms, particularly in matter of SC seem limited in the existing literature.

It is found through literature review that most of the existing studies about agility, adaptability and alignment have focused on the effects and outcomes received through these qualities while the research on their determining elements is scarce. There are certain factors that can enhance the agility, adaptability and alignment of SC of the firms including SC connectivity, capability, data distribution and information analytics capability etc. however, the existing research on predictors and determining elements of SC agility, alignment and adaptability is limited. The research is aimed to fill these blanks in the information and data by conducting a study on the determinants of SC agility, adaptability and alignment. In this regard, the first objective of the current study revolves around examining the impact of SCC on the SC agility, alignment and adaptability and understanding that how SCC can significantly enhance these qualities of supply chain. The second research objective of the present research is to analyze the impact of big data analytic capability on the SC agility, adaptability and alignment because this capability can enhance the responsiveness, quickness, and adjustment of the SC to the external changes [9, 10]. In this regard, the "resource-based view" (RBV) is used in the current study to emphasize the development of SC agility, alignment and adaptability through firm's capabilities because the SC management literature highlights the importance of reserve heterogeneity, utilization and proper alignment in development of various capabilities of the firm that can ultimately support the firm in gaining competitive advantage. The remaining part of this paper consists of literature review, methodology, analysis, results, discussion and conclusion of the study.

2. Literature Review

The agility and adaptability of SC are considered as the active competences of the firm based on RBV and it is suggested that dynamic capabilities of the firm play a

great role in enabling the organization to deal external changes and to gain competitive advantage [11]. The "SC agility" is the ability of the SC to deal and respond rapidly to the external changes. It means this ability is associated with the quickness and effectiveness of the response of the firm to market changes [2]. The "SC adaptability" is the capability of the SC associated with its modification and adjustments to the external changes. It is the ability to adapt and amend supply network, policies, strategies, technologies, and operations of SC according to the environmental conditions [3, 12, 13]. This ability of the SC is clearly associated with the willingness of the SC to adjust with new changes and to redesign and reshape the policies and strategies of SC in accordance with the external fluctuations. The third ability is the "SC alignment" which is associated with the capability of the SC to confirm the unbiased and equal distribution of uncertainties, costs and benefits among all members. It means that this capability enables the SC to confirm that different processes of SC including buying, manufacturing, supplying and logistics are aligned in external as well as internal context throughout the firm [14-16]. Therefore, these capabilities should be developed within firm to gain competitive advantage. An entity that will increase these qualities is big data analytics capability that is the quality of an organization to analyze and process large datasets acquired by the firm in order to make strategic decisions and operational modification based on big data [17, 18].

2.1. Impact of SCC on big data analytics capability

The SCC is the main predictor for the big data analytics ability because the connections with participants enable the firm to get large datasets and to enhance analytics capability and thus, to ultimately enhance the SC agility, alignment and adaptability [4]. The SCC is basically about the association of SC with related information and technology which means that SCC is the ability of the firm to use "communication and information technology" quickly for generating information to make decisions and goals [19, 20]. RBV suggests that a firm can create its competitive advantage based on its resource heterogeneity, resource utilization, and resource alignment because the proper organization and utilization of resources can enable the firm to build different capabilities useful for creation of competitive advantage [21, 22]. The big data analytics capability is developed when the SCC enhances because in this case the firm has connectivity and access to large datasets and information that can be beneficial in enhancing the capability of the firm related to big data analysis [23]. It is suggested that SCC is about the IT infrastructure of the firm and this is a very important tangible resource of the firm that can be used to build big data analytics capability because the firm becomes able to access, assemble, integrate and deploy big data for making enhancement in SC and adapting to the changes of environment [4]. The research work of [24] also provides supportive argument about the role of SCC in enhancement of data and knowledge sharing capability. Therefore, the first hypothesis of the current study is:

H1: "SCC has a significant positive impact on big data analytics capability."

2.2. Impact of big data analytics capability on SC agility, adaptability and alignment

Scholars define agility of SC as the capability of the firm to modify strategies and operations of its SC quickly to respond to the market and external alterations [25, 26]. The SC adaptability is the capability which requires the SC management to be flexible so that it can make required modifications and adjustments without being tied to the previous ones. According to [4], "SC adaptability is the property of a SC which allows the members to cope with the dynamics associated with supply chain." The SC alignment capability ensures that all the processes of SC including buying, manufacturing, supplying and logistics are aligned and the risk and benefits have been distributed equally among all participants [14-16]. The agility, adaptability and alignment qualities of the SC require the SC management to have enough insights and experience about the big data and its processing as well as analysis so that they can make assessments of the external changes and then they can make required modifications in the SC and its policies. The current study has used RBV as underpinning theory to emphasize this model because RBV suggests that a firm can achieve a competitive advantage based on its resources and capabilities. The RBV is based on the logic that firms have to integrate and utilize their strategic resources to build different capabilities that make the firm differentiated from other firms [24, 27]. Therefore, there is need to gather datasets and to process as well as to analyze them to make different operational decisions and strategies of the firm in modern globalized era because big data is very helpful for the firms in order to cope with large external changes however, the firm must have the capability to utilize and analyze its data [17].

The firms must be able to utilize the additional information gathered through big data for improving the SC mechanism and qualities. This capability of the firm to integrate and utilize the big data and resources of big data is known as "big data analytics capability" that makes an organization able to deploy the information and big data resources to enhance the SC quality and to cope with external fluctuations that are ultimate foundation of modest benefits for the firm [9, 10, 18]. RBV provides enough support that these capabilities in relation to SC can be developed through proper deployment of resources for example, [17] also suggested that physical resources, human resources and intangible resources (culture, intellectual capital etc.) are important sources of organizational capabilities. It is suggested by many scholars that the capabilities of the firm related to big data enable it to gain distinct position in the market due to its improved capability to gather, integrate, deploy and analyze the big data and sources. The big data analytics capability of the firm makes it able to understand the external changes through additional information and to assess those changes in effective manner [9]. When the firm is able to assemble understand and analyze the big data then, it is more likely to build effective and right

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strategies and policies that are exactly needed to enhance SC in changing external environment [28]. The big data analytics capability enables the SC management to understand the changing market and environmental conditions quickly and to respond in rapid way to those changes because the firm has capability to utilize and analyze the big data efficiently [9, 18]. Therefore, based on theoretical grounds the current study hypothesizes that:

H2: "Big data analytics capability has significant positive impact on SC agility."

Besides SC agility, the adaptability of SC also enhances due to the big data analytics capability because it is argued that the big data analytics capability plays an important role in enhancing collaboration which is the ultimate source for building the adaptability in SC[29]. The study of [30] makes suggestions that ability to track and assess macro factors through big data analytics capability enables the firm to match and adapt its SC with market requirements. Therefore, the current study hypothesizes that:

H3: "Big data analytics capability has significant positive impact on SC adaptability."

The SC alignment is also influenced through big data analytics capability because the SC management need to have enough ability and understanding to exploit big data for making equal distribution of risk and benefits among all participants [31, 32]. [24] also suggested that when the information is shared effectively and big data is analyzed then the distribution of risk among all participants of SC becomes equal and so, the alignment is SC is ensured through proper analytical capability [23]. Therefore, it is hypothesized here that:

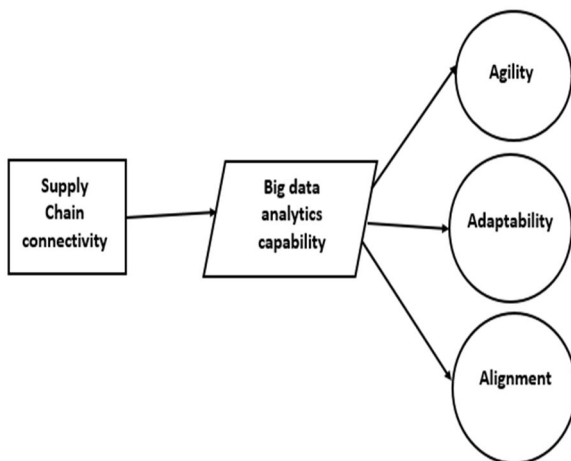H4: "Big data analytics capability has significant positive impact on SC alignment."

Figure 1. Research Model

3. Methodology

3.1. Sample, procedures and instrument of the study

The current study is a quantitative study which has been conducted to explain the relationship of SC connectivity, big data analytics capability and SC agility, adaptability and alignment. To analyze the impact of SCC on big data and SC agility, adaptability as well as alignment, the current study used survey strategy based on questionnaire.

The current study has been conducted in manufacturing sector of Thailand so, the population for the current study was the manufacturing firms of Thailand. The purposive sampling technique was used to decide sample from the population through which, 300 employees of manufacturing firms of Thailand were selected because the purpose of the current study is to analyze the impact of SCC on the big data analytics capability and to assess the influence of this capability on SC agility, adaptability and alignment in context of Thailand. The online structured questionnaires were used that were sent to respondents in order to gather data about their views about variables under current discussion in relation to their firms.

3.2. Measures of Variables

The current study encompasses five variables among which the SCC is the independent variable while there are three dependent variables in the current study i.e. "SC agility, SC adaptability and SC alignment". There is a mediator in the current model which is "big data analytics capability". The previous measures of these variables have been used in the current study. To measure SC connectivity, the scale used by [33] and [24] has been used in the current study. The sample item of this scale is, "Adequate information systems linkages exist with suppliers and customers." The dependent variables (agility, adaptability and alignment) are measured by using scale of [34] whose scale items are used in the current study to measure respective variables. The sample item of scale for agility is, "the organization works hard to develop collaborative relationships with suppliers." and the sample item of the scale for adaptability is "the organization evaluates needs of ultimate consumers - not just immediate customers." While the sample item of the scale for SC alignment is "the organization lays down roles, tasks, and responsibilities clearly for suppliers and customers". The mediator of big data analytics capability is measured by using scale previously used by [35], [36], [17] and [37] in their researches. The sample item of this scale is "We integrate external data with internal to facilitate high-value analysis of our business environment".

4. Data Analysis

In order to check the hypothesis status for this study, the collected data from 233 respondent was analyzed by using SPSS and AMOS, the results of the demographical profile are the following;

Table 4.1. Demographic Profile

Characteristic	Category	Frequency	Percentage
Gender	Male	105	45.1
	Female	128	54.9
Age	20-31 years	67	28.8
	31-41 years	97	41.6
	41-50 years	59	25.3
	Above 51 years	10	4.3
Education	Graduation	33	14.2
	Post-graduation	92	39.5
	Master	85	36.5
	Other	23	9.8

Demographical profile of the respondent showing that there is 105 male and 128 females participated in the study. Data is collected from the manufacturing sector of Thailand. The findings of age showing that most people are falling in young age. Where 92 respondents have post-graduation degree and 85 respondents have master's degree.

Reliability Test

The researcher used KMO and Kaiser-Meyer-Olkin (KMO) to measure the reliability of data for factor analysis and then run Rotated Component Matrix. KMO. KMO returns values between 0 and 1. A **rule of thumb** for interpreting the statistic. The results of the KMO test indicated our data is suitable for factor analysis and factor analysis also a good fit. See table 4.2 and 4.3.

Table 4.2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.911
Bartlett's Test of Sphericity	Approx. Chi-Square	3868.484
	df	231
	Sig.	.000

Table 4.3. Rotated Component Matrix^a

	Component				
	1	2	3	4	5
BD1	.858				
BD2	.863				
BD3	.824				
BD4	.824				
BD5	.828				
BD6	.815				
SC1				.762	
SC2				.765	
SC3				.761	
AI1					.785
AL2					.750
AL3					.768
AQ1		.810			
AQ2		.732			
AQ3		.804			
AQ4		.693			
AQ5		.656			
AD1			.745		
AD2			.823		
AD3			.843		
AD4			.648		
AD5			.603		

Data Normality and Descriptive Statistics

To check the normality of the data skewness test was performed run and descriptive statistics also check in order to investigate any outlier in the data

Table 4.4. Data Normality and Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
BD	233	1.00	5.00	3.4964	1.04042	-.369	.159
SC	233	1.00	5.00	3.6624	1.10662	-.628	.159
AL	233	1.00	5.00	3.5923	1.09255	-.601	.159
AQ	233	1.00	5.00	3.6206	1.01959	-.810	.159
AD	233	1.00	5.00	3.6369	.98882	-.727	.159
Valid N (listwise)	233						

The threshold range for skewness test -1 to + 1 and the results of the study indicated that all construct has their skewness value between the range, so data is normal. Finding also stated that there is no outlier in the data because the minimum and maximum value lies under the range.

Discriminant and Convergent Validity

Discriminant validity is the degree in which the variable is, in fact, differing from each other experimentally. On the other hand, Convergent validity is the extent of assurance a researcher has that a character is well evaluated by its measures [38].

Table 4.5. Discriminant and Convergent Validity

	CR	AVE	MSV	MaxR(H)	AD	BD	AL	AQ	SC
AD	0.888	0.617	0.441	0.908	0.785				
BD	0.947	0.747	0.329	0.967	0.488	0.865			
AL	0.853	0.6	0.521	0.972	0.535	0.574	0.812		
AQ	0.885	0.607	0.441	0.977	0.664	0.52	0.582	0.779	
SC	0.839	0.636	0.521	0.98	0.589	0.521	0.722	0.599	0.797

Above mentioned table present the discriminate and convergent validity of the research model. Findings show that both validities are proved because the value of composite reliability for each construct is above from .70 and every construct is describing from others.

Confirmatory Factor Analysis

The confirmatory factor analysis (CFA) is "a multivariate arithmetic process which is utilized in order to examine how good the studied constructs signify the figure of variables." The following table shows the findings;

Table 4.5. Nested Confirmatory Factor Analysis

	Model Fit Indices		Threshold Range	Observed Values
Nested Model	χ^2			512.288
	Df			199
	χ^2 / df		Lesser than 3	2.574
	GFI		≤ .80	.837
	IFI		≤ .90	.918
	CFI		≤ .90	.917
	RMSEA		≥ .08	.080

Above table shows the threshold range and observed value. The model above displayed the GFI=0.837; IFI=0.91; CFI=0.91 and RMSEA=.08. Above stated five indicators prove the CFA of the study except for GFI, but it is near to range.
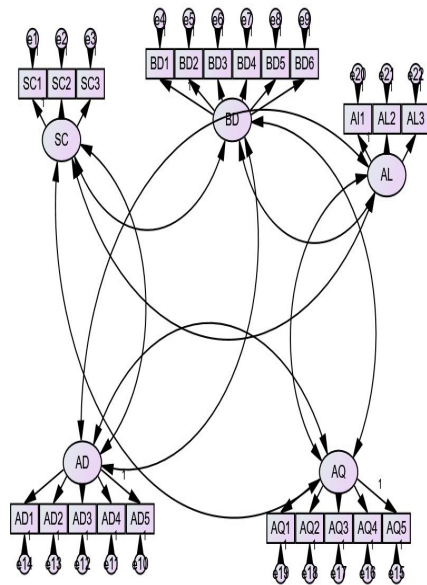

Figure 2. CFA

Structural Equation Modeling

Structural equation modeling is the latest technique, which used to check the relationship of the hypothesis of the study at the same time;

Table 4.6. Structural Model Results

Effects	Hypothesized Path	B	S. E	P value	Conclusion
Linear Effects					
Hypothesis 1 (+)	SC→ AQ	.352	.052	.000	Accepted
Hypothesis 2 (+)	SC→ AD	.398	.054	.000	Accepted
Hypothesis 3 (+)	SC→ AL	.475	.051	.000	Accepted
Mediation Effect					
Hypothesis 3 (+)	SC→ BD→ AQ	.140	.033	.010	Accepted
Hypothesis 4 (+)	SC→ BD→ AD	.132	.033	.010	Accepted
Hypothesis 4 (+)	SC→ BD→ AL	.135	.036	.010	Accepted

Table 4.6 showing the results of structural equation modeling, Finding indicated that SCC has a positive and significant impact on adaptability, which means that if one unit of SCC increased it will bring 39.8% positive impact on adaptability. Same as, hypothesis 1 and 3 showing that SCC has a positive and significant impact on alignment and agility. This study has big data as a mediator, results showing that big data analysis expertise significantly mediates between SCC and agility with 14%, next, in SCC and adaptability with 13.2%, and 13.5% between SC inactivity and alignment.

The following figure below is a screenshot of structural equation modeling while running in SEM in AMOS and shows the standardized regression weights between the variables.
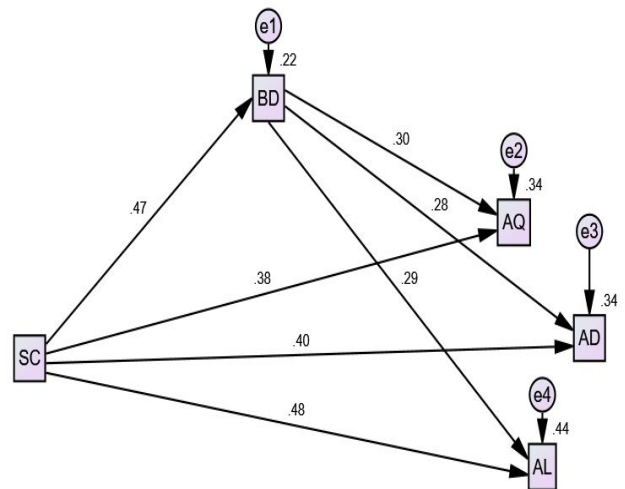

Figure 3. Research Model

5. Discussion of Results

This study is aimed to assess the positive influence of SCC on the big data analytics capability and then the impact of this capability on the SC qualities including "agility, adaptability and alignment". In response to the first hypothesis of the current study, the analysis and results revealed that SCC showed a significant positive impact on big data analytics capability so, the first hypothesis is accepted. The results align with previous results and similar past studies provide sufficient support to these studies. For example, the research work of [18] and [9] provide support to the current findings that big data analytics capability can be developed and enhanced through SCC because supply chai connectivity is a tangible resource for the firm and the RBV suggests that capability of firm can be built through firms' resources. The current research findings are also in line with the research works and findings of other researcher discussing the big data analytics in relation to organization resources and capabilities e.g. [9, 17]. The suggestions and findings of [24] are also in line with these findings.

In response to the second, third and fourth hypotheses of the current study, the analysis and results revealed that big data analytics capability enhance the quality of SC to quickly respond to external changes (agility), to modify the operations and policies according to external changes (adaptability) and to align the SC(alignment) so, all these three hypotheses are accepted. These findings are in line with previous researches. For instance, the discussion and findings of [4], [12], [3] and [5] are also supporting the current findings. Hence, all the current findings are in line with present literature.

6. Conclusion

Aim of current study was to assess the influence of SCC on the big data analytics capability and the impact of big data analytics competence on the important qualities of SC to cope with external changes named as "agility, adaptability, and alignment". To accomplish the

objectives of the current study, the data was collected from manufacturing sector of Thailand through questionnaire-based strategy and analysis was run on the collected data. The results revealed that SCC has significant positive impact on big data analytics capability and the big data analytic capability has the significant positive impact on SC agility, alignment and adaptability so, all hypotheses of the current study are accepted. These findings and discussion are expected to contribute significantly in literature of RBV, organizational capabilities, SC management, and big data analytics capability. Practically, the current study will enhance the understanding of firms to develop and improve their supply chains and their quality in order to cope with external changes. However, these findings are limited to the manufacturing sector of Thailand while the results may be different for other sectors or other countries. Therefore, the current study suggests future researchers to conduct cross culture examination of the determinants of SC agility, adaptability and alignments. Furthermore, the current study only examined three qualities of SC to cope with external changes while future researchers may conduct alike studies with more qualities e.g. sustainability.

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