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Mediating Effect of Supply Chain Capabilities on the Relationship of Data Driven Supply Chain Management and Business Performance: A Study of the Manufacturing Industry

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Abstract- **Despite the data driven supply chain (DDSC) significance, the extant researches have a limited attention on how the DDSC effects to supply chain capabilities (SCC) to enhance the business performance (BP). Based on this gap, the main objective of the study is to investigate how DDSC effect to BP through the SCC in the manufacturing industries of the Indonesia. To achieve this objective, data has been collected from the 600 supply chain managers who were working in the food industry of Indonesia by using a simple random sampling technique which yield a 55% response rate. To analyze the results Smart PLS 3 software and structural equation modeling (SEM) was employed. The SEM findings has shown that in the direct effect DDSC has a significant and positive association with the BP, DDSC also have a significant and positive association with the SCC and SCC also has a positive and significant association with the BP. On the other hand, the indirect effect also shows that SCC is partially mediates in the relationship of DDSC and BP of the manufacturing industry of Indonesia. These findings show that SCC is considered to be a significant mediator in the relationship of DDSC and BP. Based on these findings, it could be considered that SCC is an important contribution which added a body of literature in the extant empirical studies. The findings of the current study could also be helped to supply chain managers to provide guideline to the supply chain mangers to know about the importance of the DDSC to increase the BP of the organization. The research limitations and future directions of the study also explained at the end of the study.**

Keywords; *Data driven supply chain management, business performance, supply chain capabilities, Indonesia, manufacturing industry*

1. Background of the Study

At the present time, organizations have a main concerned to invest on the information technology like, enterprise resource development to track the operations and merchandise, optimization of the inventory level, automatic inventory level and also for other supply chain management (SCM) decision making [1, 2, 43]. A large number of data flowing is generated by these technologies in the real time in every field of the worldwide economies [3]. The data creation scale is considerable along with the approximation of 2.5 Exabyte's of generated data every in the 2012, and in the meantime, this volume is to be doubling since [4, 5]. In line with this, this data is to be consist of burgeoning size of transactional data that is associated along with the trading partners [6]. Therefore, the scope of this data has a greater prospective to transform the performance of supply chain, possibly by the supply chain capabilities (SCC) in the organization [2]. This is a reason, the managing department of the SCM is leveraging the data which is coming into the system that could derives a useful insight towards in the improvement of the SCC [7, 8]. In the actual fact, the supply chain managers have taken a great concerned on such data to be considered a critical source for the competitive advantage and value creation of the organization [9], because they believed that this is the data which assists them to gain the prominence in the expenditures, to support in process and planning control, to identify developments in the performance, production optimization and also in inventory monitoring [9, 10]. Despite the fact, some of the manufacturing companies like Sony, Dell, and BMW are played an important role to employing the big data to take improvement in the process of supply chain and also open a new opportunity for the business and also some firms are still considered to be in the early stages in the adoption of big data due to lack of understanding and lack of knowing about the management of the data [11]. In spite of significance of the data driven supply chains (DDSC) for the organizations, still there is a lack of research which is talking the DDSC impact on the SCC and business performance (BP) [12], accordingly work for this theoretical improvement [13].

In relation, stranded with the theoretical background of the resources based view (RBV), the current study is to examine the association among the DDSC and SCC, which could influence BP. The main attribute of the RBV is to gain the BP by utilizing efficiently critical resources and organizational capabilities of the companies [14]. The organization capabilities which are recognized by the supply chain researchers is considered to be an important

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source of organizations BP [1, 15]. The supply chain management (SCM) has been occurred as a dynamic capability which depends on the development of the specific capabilities like ability to develop the strategic relationship along with the suppliers and customers, also information sharing between the partners of SCM and provide rapid response according to the market demands [15]. With the RBV viewpoint, the DDSC are considered important intangible resources of the organization [16]. Both of DDSC and also SCC are considered to be a portion of an developing capability that could be able to change the way in the SCM [12].

Furthermore, in line with the RBV theory, the effective management of the resources like big data could be helped to gain a significant profit of the organization [4]. This had been argued in the extent literature that the big data which is practical to the supply chain will be helped to decrease the organization costs and also create competitive advantage through the improvement of the supply chain operation efficiency and effectiveness [11]. After seeking the significance of the big data in the success of the business, most of managers are not still lacking advantage to achieve the competitive advantage of the organization. For instance, a research conducted from "The Conference Board and Stanford University" demonstrations that approximately seven percent boards of directors integrate big data in the decision-making of their organizations [13]. For this purpose, the main reason is that most of organization did not accomplish their information which they have. In addition, they did not properly distinguish how this could be organizing and analyze in a proper way that could enhance the market understandings and then also make the product change in order to response the new visions which is produced [17]. "Until a company learns how to use data to support its operating decisions, it will not be in a position to benefit from big data" [17]. Therefore, currently for the supply chain managers is a big challenge to know the link within the big data, SSC and BP. Unfortunately, there is a lack of guidelines from the data driven for the supply chain mangers to gain a maximum BP from the SCC [12]. In addition, the most of the previous studies on the SCC and BP has a main concerned on the developed countries but there is a little attention on the developing countries, especially, Indonesia manufacturing industry that is to be considered a big industry in the Indonesia in the perspective of social and economic development.

Based on the forging discussion, the objective of the study is to investigate the mediating impact of SCC, in the relationship of DDSC and BP of manufacturing industry of Indonesia. Consistent with the previous research of Wu et al. (2006), in the current study, SSC is to be conceptualize into four components, namely, coordination, supply chain responsiveness and intrafirm activity. The current study is divided in the following sections, literature review, methodology, analysis and conclusion. At last, the practical and theoretical implication and limitation and future directions of the study are also explained.

2. Literature Review and Hypothesis Development

2.1. Supply Chain Capabilities

supply chain capabilities (SSC) are refers with the network ability, to form, assimilate, and also reconfigure the internal along with the competencies which are external to address all the widely changing environment [18, 45-46]. In the same vein, [23] further explained that there is an explicit link which is created between exceptional profitability and capabilities. In line with this, Day [19] explains the capabilities into the three terms. Firstly, in the outside- process capabilities which provide help to the companies to compete through the predicting and active changes in the market by developing sound relationship with suppliers, customers, and consumers [20]. Secondly, inside-out processes capabilities which consists of internal capabilities which enables to the firms in achievement of the opportunities in the contemporary competent environment [20]. On the other hand, also provides help to facilitate the companies in providing information in the proper manner which helps to brings value for the customers and convinces the capability of the organization in the long- run. Thirdly, capabilities which are called spanning process capabilities that are related with all the process which provides help to support the predicted needs that is being fulfilled through the business [21]. They can do so mainly by appropriately assimilating the "outside-in and inside-out capabilities".

2.2. Data-driven supply chains

In the contemporary environment, supply chain practitioners and professionals are swamped along with the data that provide help to create the business in a new way which enhance the supply chain performance [10]. The usage of the big data is consisting of phenomena that reflect to increase the importance of the data with respect to the burgeoning volume, velocity, veracity, and value of the business [2, 22]. This argument is further in line with the other literature streams of supply of [23] who explained that big data is considered to be a data which consist of both of quantitative and qualitative techniques which aimed is to improve the supply chain competitiveness. Even though, the data has got a great importance because it pays an integral role to increase the business performance (BP) of the organization [24]. In other words, it has argued that not all type of the firms is able to make investment on the information technology infrastructure to enhance the performance [25]. In this regards, within the context of resource based view (RBV),

the capability to leverage the big data could be considered as one the main asset among the other assets of the firms [26] because it is a firms strategic concentrating replication and could be become a unique that is considered to be a difficult to imitate in the nearer to intermediate positions [27]. In addition, some of the organizations are previously have a main concentration on the big data to gain a profit and also classify a business prospects and also to know about the process design of the product, and the demand of customer, and supplier according to the market [28,30]. Therefore, for instance, [28] explained that how the responsiveness of call centers are to be increase by the big data usage.

Therefore, deploying the strategy of big data in the SCM potentially lead to take improvement in the effectiveness and efficiency of business by the activities like monitoring the activities, to check the forecasting of the demand in advance and supply chain planning and also help to understand the suppliers and customer behavior which could help to enhance the performance of the business [29]. This is reason, the companies use the big data to update about the various supply chain functions, such as production, purchasing, operations, sales and marketing and distribution [30, 31]. In line with this, the firms by using the supply chain process in the real time, firms could manage their demand planning from side to side prolonged initiatives and global supply chains though decreasing shortcomings and rework of the plants which produce the product [23]. Furthermore, firms with the good DDSC could be able to improve the collaborative association along with the suppliers and customers based on the market demand understandings which could help to enable the supply chain to provide the response more rapidly to change demand of the customers and suppliers [24]. For instance, big data could help to the manufacturer to increase the development in product on time from 20-50% and could also eliminate the prior production defects by the proper testing and stimulation [6].

Attaining the supply chain efficiency and competence of the supply chain requires a proper entrance to data from the various useful parts of an organization and from the various partners of supply chain in the business [1]. Nonetheless, the main contest is that various supply chain members could use various systems of information to gain the access till the storage tower of the data driven. To maximize the profits, information should be proper shared across the process and not merely inside the organization but also organization outside to view all of the supply chain partners. In the DDSC process, information is to be a shared through the supply chain partners and also arrange for till the end supply chain data access of the organizations [29]. Such type of DDSC provide help to the firms to build a strong strategic collaboration with the supplier partners and conduct with the supplier. In the overall context, DDSC in firms could help to firms through the proper insights and understanding their SCM on the global, complex and extended value chains in the more innovative ways from side to side collaborative product development based the data of customers, advance predicted demand and supply chain development and production [33]. Based on the previous discussions, it is hypnotized that.

H₁: There is a significant association between DDSC and business performance of manufacturing industry of Indonesia.

H₂: There is a significant association between the DDSC and SSC of manufacturing industry of Indonesia.

2.3. Data driven supply chain, supply chain capabilities and business performance

According to the RBV theory, organizational capabilities are considered to be important to achieve the competitive advantage of the organization [30]. Also, in the previous researches, the researchers also have widely acceptance based on the empirical studies which used the RBV theory that the resources capabilities of the firms influence their performance of the organization [30, 31]. Nevertheless, there are not too many studies have been investigated on the relationship of SSC and Business performance and none as expansively. One of the study is conducted by [32] who used the SSC as a second order construct to examined the impact on the marketing and business performance. They further suggested that SCC also effect to the business performance (BP) indirectly in a proper way. By taking this into consideration, this study contributed an integral deeper consideration of the association nature within the DDSC, SSC and BP. Based on the forging arguments and with respective to the RBV theory, it is hypnotized that:

H₃: There is significant association between SSC and business performance of manufacturing industry of Indonesia.

H₄: There is significant association between SSC and business performance of manufacturing industry of Indonesia.

3. Research Framework

This study is investigated under the theoretical lens of RBV [34], which developed a conceptual framework that posits that DDSC and SCC are considered to an important organizational capability for the organizations to sustained and achieve the competitive advantage and business performance. Therefore, based on this, DDSC is an independent variable, SCC is a mediating variable, while business performance is a dependent variable. All of these variable is depicted in the Figure 1, which shows the current conceptual framework of the study.
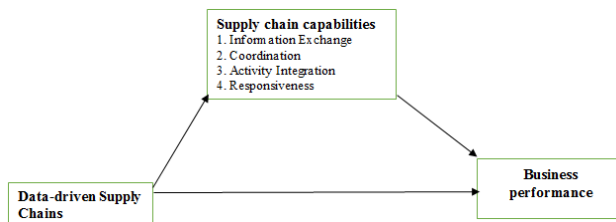
Figure 1. Framework of the study

4. Methodology

This study employed quantitative approach, employed self-administered questionnaire, and cross-sectional research design to examine the research framework and proposed hypotheses. This techniques in primary study is considered an important practical approach for providing the data which could be used for the wider generalization of the study [32]. For this purpose, all the respondents were selected from the manufacturing industry and get the responses from the multiple industries that has been listed through works industrial work department and Ministry of Industry of (Indonesia). For the key respondents, the researchers selected the key informants randomly from the manufacturing firms who held a minimum position of directors, president, CEO and general manager. The Questionnaire that was distributed to the respondents along with the cover letter was explained that objective of study. From the target sample the survey was conducted on the 600 samples, 330 responses have been used for all the analysis. Thus, the response rate was about 55%. The questionnaire was comprising of demographic and 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree) to collect the responses from the respondents to each mode of the hypotheses.

4.1. Research Instrument

The current study is based on three main variables, data drive supply chain (DDSC) is an independent variable, supply chain capabilities (SCC) is a mediating variable and business performance (BP) is a dependent variable. Based on following discussion, SSC has been measured as a multidimensional construct and items for this variable has been adapted from the study of Wu et al. (2006). Business performance was measured by four indicators which were adopted from the study of [33]. Lastly, DDSC was measured by the four items which are adopted from the study of [3]. In addition, the questionnaire for the business performance has been adopted from the study of [3].

5. Data Analysis

Several prior studies adopted partial least square – structural equation modelling (PLS-SEM) approach in testing the direct and indirect relationship of variables [36-38]. Therefore, the research hypotheses of present research were assessed through PLS-SEM. The

measurement and structural model of the study were assessed by using Smart PLS 3 software. PLS-SEM approach is appropriate in case of non-normal data or small sample size [33]. This study is in line with the study of [34] who also used the Smart PLS for analyzing their results. The following measurement and structural model has been explained in the following discussion below.

5.1. Measurement model

To test the model, we used the structural equation modelling (SEM) technique through using the partial least squares (PLS) with Smart PLS 3.0 [35] software.

This software is called a second generation software that could be used to test the complex model along with the latent variables. Table 1 is shows the results which were obtain by the measurement model. Based on the table 1, it could be clearly seen that all of the loading are above the 0.70 that is called the threshold value that is suggested by [36]. The AVE (average variance extracted) of all the constructs which has exceeding value 0.5 [37]. As it is explained by that minimum value of composite reliability (CR) should be 0.70 [35]. So, we can conclude that convergent validity has been achieved. Table 2 and 3 further shown the discriminant validity results. Hence, it is explored by [38] and [39] that minimum value of AVE in the measurement model should be minimum higher than the cross loading. As it is shown in the table 6.3 all values meet the criteria of discriminant validity.

Each construct AVE should always be the higher than the correlation between all of these. It is clearly shown in the tables that all the constructs fulfill the criteria for the discriminant validity. Accordingly, it is suggested by [40] that measured variable loading should always be higher than the cross loading through at least 0.1 that is considered sufficient for the discriminant validity. As such we can conclude that discriminant validity is achieved.

Table 1. Confirmatory Factor Analysis

Constructs	Items	Loadings	Alpha	CR	AVE
Data driven supply chain	DDSC1	0.837	**0.851**	0.9	0.693
	DDSC2	0.785			
	DDSC3	0.879			
	DDSC4	0.825			
Information exchange	IE1	0.758	**0.758**	0.839	0.512
	IE2	0.702			
	IE3	0.793			
	IE4	0.704			
Coordination	COR	0.703	**0.774**	0.8	0.5

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	1		47	26
	COR 2	0.701		
	COR 3	0.705		
	COR 4	0.814		
	COR 5	0.796		
Activity integration	AI1	0.795	**0.834** 0.7 98	0.6 54
	AI2	0.809		
	AI3	0.839		
	AI4	0.768		
Responsiveness	RES 1	0.806	**0.876** 0.8 0	0.6 45
	RES 2	0.786		
	RES 3	0.719		
	RES 4	0.657		
Business performance	BP1	0.591	**0.898** 0.9 17	0.7 04
	BP2	0.786		
	BP3	0.704		
	BP4	0.757		

Note: DDSC-data driven supply chain, IE- Information exchange, COR- Coordination, AI- Activity integration, RES- Responsiveness, BP- Business performance.

Table 2. Fornell and Larcker Criterion for Discriminant Validity

	DDSC	IE	COR	AI	RES	BP
DDSC	**0.755**					
IE	0.436	**0.722**				
COR	0.522	0.437	**0.736**			
AI	0.434	0.51	0.563	**0.70 9**		
RES	0.353	0.686	0.407	0.47 2	**0.72 2**	
BP	0.51	0.473	0.463	0.56 3	0.65 4	**0.65 5**

Note: DDSC-data driven supply chain, IE- Information exchange, COR- Coordination, AI- Activity integration, RES- Responsiveness, BP- Business performance.

Table 3. HTMT Analysis for Discriminant Validity

	DDSC	IE	CO R	AI	RES	B P
DDS C						

IE	0.436				
CO R	0.533	0.43 7			
AI	0.434	0.51	0.56 3		
RES	0.353	0.68 6	0.40 7	0.472	
BP	0.51	0.47 3	0.46 3	0.563	0.72 0

Note: DDSC-data driven supply chain, IE- Information exchange, COR- Coordination, AI- Activity integration, RES- Responsiveness, BP- Business performance.

5.2. Structural Model

In order to test the hypotheses, PLS-SEM was applied using Smart PLS 3.0. The model contains two endogenous variables i.e. supply chain capabilities (SSC) and business performance (BP) which having R^2 of 0.32, 0.25 and Q^2 0.15, 0.15, 0.12 respectively (see Table 6) that establish the substantiality of the Model. The Following Q^2 or predictive relevance analysis has been done through using the blindfolding procedure [28]. If the value of $Q2$ is larger than 0, we could have concluded that the model has adequate predictive relevance [31]. Table 4 presents the results of PLS bootstrap algorithms that confirms the significant direct relationship of data driven supply chain (DDSC) and business performance (BP) ($\beta = 0.407$, t value = 5.905, p value = 0.000). Moreover, the relationship between the DDSC and SSC also shown the positive and significant association ($\beta = 0.22$, t value = 3.117, p value = 0.002). In addition, the direct effect of SSC also shown the significant and positive association with the BP ($\beta = 0.205$, t value = 2.913, p value = 0.004). The following findings supports to all of the following direct hypothesis (H1, H2, H3). These findings have shown that both of the DDSC and SSC are considered to be a significant predictor to enhance the BP of the manufacturing industry of Indonesia. Consequently, it enables the organizations to improve their BP [40] by improving profits and sales through sustainability activities [41].

Table 4. Direct Effect

Hypothesis	Beta	S.E	T Value	P Valu e	Decision
DDSC -> BP	0.40 7	0.06 9	5.90 5	0.000	Supporte d
DDSC-> SSC	0.22 0	0.07 1	3.11 7	0.002	Supporte d
SSC-> BP	0.20 5	0.07 0	2.91 3	0.004	Supporte d

Note: DDSC-data driven supply chain, IE- Information exchange, COR- Coordination, AI- Activity integration,

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RES- Responsiveness, BP- Business performance. * Significance level = 0.05

Similarly, the findings (see Table 5) inferred that supply chain capabilities (SCC) partially mediates the relationship of DDSC with BP (β = 0.229, t value = 5.18, p value = 0.000) which supports to the (H4). These findings suggest that SSCMP and SCDC has substantive direct impact on organization's BP. In addition, the SCC partially mediates the relationship between DDSC and BP. These results replicate the findings of several prior studies [41, 42]; who found the significant indirect role of SCC in enhancing organization's BP. These findings not only provide the mechanism for enhancing the organization BP, but will also motivate the managers to adopt the DDSC to enhance their competitive strength and overall business performance.

Table 5. Indirect Effect

Hypothesis	Beta	S.E	T Values	P Values	Decision
SSCMP -> SCDC -> EcoP	0.229	0.044	5.181	0.000	Supported

DDSC-Data driven supply chain, SCC- supply chain capabilities, BP-business performance * Significance level = 0.05

Table 6. R^2 and Q^2 of Endogenous Variables

Endogenous variables	R^2	Q^2
SCC	0.32	0.15
BP	0.25	0.12

Note: SCC-supply chain capabilities, BP-Business performance.

Figure 2. Structural model of the study

6. Conclusion and discussions

The aim of the study is to investigate the mediating impact of supply chain capabilities (SCC) in the relationship of data driven supply chain (DDSC) and business performance (BP) of the manufacturing industry of the Indonesia. To achieve this objective, in the light of recent literature, this study assesses four hypotheses out of them three represents the direct effect among the variables, whereas one 0f them proposed indirect effect of variables among the predictor and the outcome construct. As per the best knowledge of the researcher, this study is considered to be first attempt study who empirically investigate the relationship between DDSC, SSC and BP of the manufacturing industry of the Indonesia. The findings of the current study are to be consistent along with the previous studies of [5, 6]. The empirically findings of the current study offered that DDSC and SCC are considered to be a valuable firm's resources which could provide help to enhance the BP of the organization. Thus, based on the findings it has very important managerial implications. Since, most of the firms, as presented through the main part of the Indonesia manufacturing industry do not have major resources. From this time, it is very essential that they should be cleared all the significances for the investment of the resources and also emerging the capabilities which could match their strategies of the business.

However, the current study is rigorous and systematic, therefore the current study has some limitations which can show the opportunities for the future research. At first, the respondent was the singular due to this the responses were suffered from the individual distinctive perspective and also has limited access along with the same responses through the upper management [43]. At second, the current study was limited on some indicators of data driven supply chain (DDSC), therefore to enhance the importance of DDSC improve the BP should be assessed other such type of variable that could effect on the BP. Therefore, for the future research could be done other indicators, such supplier involvement and business strategy. In addition, further research could be done for testing the interactive special effects between different components to examine the incompatible belongings to between them for forecasting the different types of performance. At last, this is an exploratory study in nature which has mainly focused on the full manufacturing industry, therefore the findings of the current study could not be generalize on the on single industry, in this regards, a future research could be done on a single manufacturing industry, such as the, pharmaceutical, electronics, and automotive industry, etc. By itself, all of these sectors might be helped for future research. Lastly, this study is cross sectional in nature in which the data is collected at one point. This is a reason, this study could not be established for a longer period, this
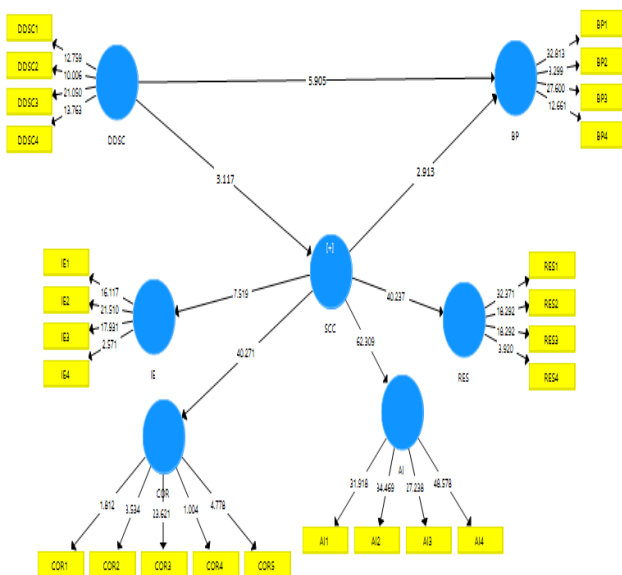
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shows that this is a need of time to conduct a longitudinal study in future.

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