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The Impact of Technical Characteristics of Supply Chain on Data Integrity: Mediating Role of Management Interaction

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This study investigated the impact of the technical characteristics on the data integrity by examining the mediating role of management interaction on the manufacturing companies of Indonesia. Data was collected from the top management of the supply chain department in each manufacturing company of Indonesia. PLS-SEM technique was used to analyze the data for getting the results. The results exposed that technical characteristics of the supply chain (TCSC) have positively influenced the data integration of the firms. The results also proved that the management interaction mediated the association between TCSC and the data integration characteristics of the firms. This study recommended to the policymakers that they should boost up the management interactions regarding the technical benefits of the supply chain (SC) that enhance the data integration of the firm.

Key words: *Technical Characteristics, Management Interaction, Data Integrity, Supply Chain.*

Introduction

Growing competition and the globalization of the business environment required an effective system that enhances the business quality and performance (Forman & Jørgensen, 2004; Jermsittiparsert, Sriyakul, & Rodoonsong, 2013). The best solution to this requirement is the effective practices of SC, especially in the growing economy such as Indonesia (Jermsittiparsert, Siriattakul, & Wattanapongphasuk, 2019; Jermsittiparsert, Namdej, & Sriyakul, 2019; Jermsittiparsert & Sommanawat, 2019). The manufacturing sector is the

growing and prominent sector in the economy of Indonesia because it contributes 18.1% in the GDP of the country which is worth $156 billion to the economy of Indonesia. Table 1 given below showed the contribution of different manufacturing businesses in the whole contribution of the manufacturing sector of the country (Gelos & Werner, 2002). Food and beverages are the biggest contributors in the manufacturing sector, as mentioned in Table 1 is 30.84%. Although other businesses also have a meaningful contribution, it is one third less than the food and beverages business. Table 1 regarding the contribution of each business in the manufacturing sector is as follows:

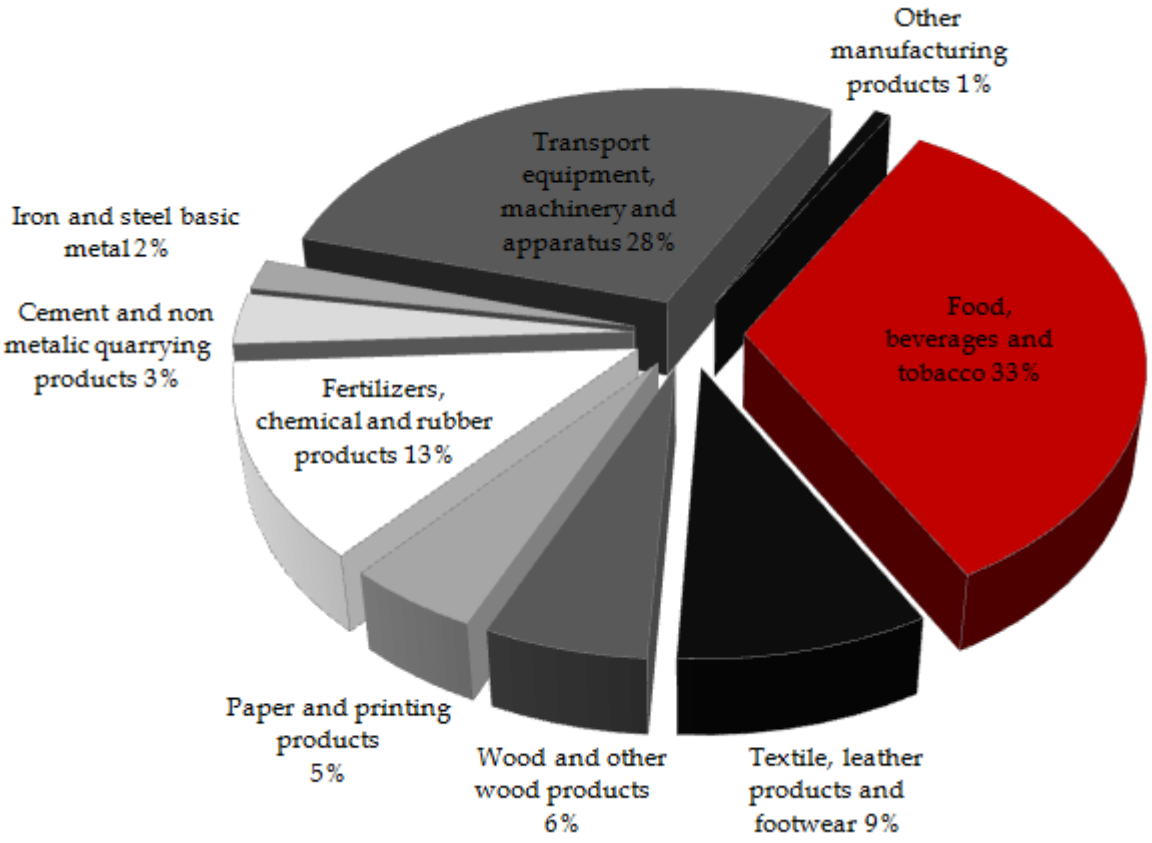
Table 1: Indonesia's Manufacturing Industry Contribution

Sector	**Contribution to the Manufacturing Sector**
Food & Beverage	30.84%
Metal Goods, Electrical & Electronics Equipment	10.81%
Transport Equipment	10.50%
Chemicals, Traditional Medicines & Pharmaceuticals	9.98%
Textiles & Apparel	6.65%
Tobacco Processing	5.19%
Primary Metals	4.31%
Paper Products, Reproduction & Printing	4.19%
Plastics, Rubber & Rubber Products	4.10%
Excavation goods (non-Metals)	3.98%
Wood, Wood Products	3.71%
Machinery & Equipment	1.78%
Footwear, Leather & Leather Products	1.50%
Furniture	1.49%
Others	0.99%

Source: Bisnis Indonesia

Moreover, these businesses also have a major contribution to the GDP of the country separately. Figure 1 below shows the contribution of each business to the GDP. Tobacco, food, and beverages businesses are also at the top in contribution with 33% of GDP of the whole manufacturing industry contribution to the GDP of the country. In addition, transport, equipment, and machinery is 28%. Furthermore, the contribution of fertilizers, chemicals, and rubber products is 13%. While all other business has less than 10% contribution to the GDP of the whole manufacturing industry's contribution to the GDP of the country. Figure 1 regarding the contribution of each sector to the GDP is given below:

Figure 1. Contribution of Manufacturing Sector in GDP



These figures show the importance of the manufacturing sector to the economy of the whole country. Thus, there is a need to explore this sector globally so that it could further improve the economy of the country. However, there are a lot of challenges faced by the industry in order to survive in the global market. One of the ways to handle these challenges is to adopt the effective practices of Supply Chain (SC) which improve the business quality, processes, and the product quality that are necessary to compete in the global market. Thus, this study also focused on the TCSC that enhance the integrity of the data by modifying the top management interaction towards the implementation of SC practices in the business.

Literature Review

This part of the study showed the critical literature on operational definitions of the constructs used in the study and also elaborated the literature on the relationships among the variables.

Data Integrity

Data integrity refers to the consistency and accuracy of the firm's data that cannot be altered by an unknown person and can be used for the business processes to be effective. Data integrity can be managed by applying standard procedures and rules. It can be maintained by regular error checking as well as regular validation practices. Moreover, "data integrity is the assurance that digital information is uncorrupted and can only be accessed or modified by those authorized to do so. Integrity involves maintaining the consistency, accuracy, and trustworthiness of data over its entire lifecycle" (He, Nguyen, Liuy, Nahrstedt, & Abdelzaher, 2008). In addition, it is also defined as the reliability and the accuracy of the data over the entire lifecycle. Data integrity means the unchanged stay characteristics of the data that can be used for the purpose of analysis to enhance the productivity and performance of the business entity. Similarly, "data integrity is defined as the quality of information collected, specifically that the data is whole, complete and correct. When a database does not have an accidental or deliberate modification, this is an example of good data integrity" (Harris et al., 2009). Thus, data integrity is necessary for the security of the data that is useful in the performance of the business entity, and this study used this variable as the main variable of the study.

Reliable Technical Characteristics

Reliable technical characteristics refer to those characteristics that are dependable to achieve any task in the organization. It also refers to the characteristics of the people that they are trustworthy and accurate in response to any challenge faced by the organization. Moreover, "technical characteristics are those characteristics of people that pertain primarily to the engineering principles involved in producing equipment possessing desired military characteristics, for example, for electronic equipment, technical characteristics include such items as circuitry as well as types and arrangement of components" (Papuga & Burke, 2011). In addition, reliability means the accuracy and honesty of the people in doing the day to day business tasks that help in achieving the organizational goals. Similarly, a study by Renzulli, Siegle, Reis, Gavin, and Reed (2009) defined that "reliable technical skills are the abilities and knowledge needed to perform specific tasks. They are practical and often relate to mechanical, information technology, mathematical, or scientific tasks. Some examples include knowledge of programming languages, mechanical equipment or tools." Thus, reliable technical characteristics are necessary for the security of the data that is useful in the performance of the business entity and this study used this variable as a predictor in the study.

Ability to Control

Ability to control refers to the ability of the person of the organization controlling the business activities to do so at a desirable place. However, it also refers to the ability of the person to control the relevant data that is necessary to control the firm's performance. Furthermore, "it refers to the capability of a person to manage and control the organizational matters in a way that they positively influence the performance of the firm" (Paik & Sohn, 2004). Similarly, it means to handle the personal skills that influence the control of important data that are necessary for the firm's performance (Blair & Razza, 2007). Thus, the ability to control technical characteristics are necessary for the security of the data that is useful in the performance of the business entity, and this study used this variable as a predictor.

Ability to Maintain

Ability to maintain means the technical characteristics of a person who maintains or manages the organizational matters to do so in a way that they positively influence the firm's performance. However, it also refers to the ability of the personnel to manage the relevant data that is necessary to control the firm's performance. Moreover, it refers to the capability of a person to manage and maintain the organizational matters in a way that they positively influence the performance of the firm (Hope, Bally, Webb, & Cullis, 1985). Similarly, it means to handle the personal skills that are an influence on management and maintain important data that are necessary for the firm's performance (Gollob et al., 2000). Thus, the ability to maintain technical characteristics is necessary for the security of the data that is useful in the performance of the business entity, and this study used this variable as a predictor in the study.

Management Interactions

Management interactions is defined as the web service that facilitates the interaction of customers and the organization to improve the efficiency of the company (Hoejmose, Brammer, & Millington, 2012). Likewise, "management interaction is a term some companies use to describe a class of Web services that support online relationships (called communities) and transactions between employees, customers, partners, and suppliers. Services might include messaging and chatting, file sharing, expertise and skills directories, and polling or rating services" (Klerkx, Aarts, & Leeuwis, 2010). Similarly, it means the management interaction system that helps in the interaction of customers with the entity. Moreover, "a customer interaction management solution is a software or system that facilitates the interaction between the company and its customers" (Hatfield & Walthall, 2015). Thus, management interaction system is necessary for the security of the data that is useful in the performance of the business entity, and this study used this variable as a mediator in the study.

Reliable Technical Characteristics and Data Integrity

The people who have reliable technical characteristics can increase the integrity of confident and important data of the firm. These characteristics are developed through the strong SC practices that train the personnel of the firm in a way that they handle all types of data of the entity (Brown & Keys, 1999). Similarly, a study by Zafar et al. (2017) argued that the organization that implemented the strong practices of SC have a more reliable workforce that improves the integrity of the relevant data that is important for the firm's performance. Moreover, reliable characteristics of the employees can increase the integrity of the data because technical reliability is positively associated with data security (Edwards, 2009). Thus, data integrity depends upon the technical reliability characteristics of the person of the entity. So, this study investigated the impact on the data integrity of reliable technical characteristics of the manufacturing companies in Indonesia and developed the hypothesis as follow:

H1: There is a positive association between the reliable technical characteristics and data integrity of the firm.

Ability to Control and Data Integrity

The personnel who have the ability to control the activities of the entity are able to increase the integrity of confident and important data of the firm. These characteristics can be developed by supply chain practices that train the personnel in a way that they handle all the types of data of the entity (Barney, 2012). Likewise, Forbes et al. (2012) mentioned that the organization who implemented supply chain have the workforce that has the ability to control the business processes and improve the integrity of the relevant data that is important for the firm's performance. Furthermore, the ability to control the business activities characteristic of the employees can increase the integrity of the data because it has a positive association with data security (Germain, Claycomb, & Dröge, 2008). Thus, data integrity depends upon the characteristic of the ability to control the activities of the entity. So, this study investigated the impact on the data integrity of the ability to control characteristic of the manufacturing companies in Indonesia and developed the hypothesis as follows:

H2: There is a positive association between the ability to control and data integrity of the firm.

Ability to Maintain and Data Integrity

The ability to maintain and manage the activities of the entity increases the integrity of confident and important data of the firm. Supply chain practices have the ability to develop these characteristics in the employees of the entity that train the personnel in a way that they handle all types of data of the entity (Cockcroft, 2004). Moreover, a study by Hsu, Tan,

Kannan, and Keong (2009) found that an organization that has implemented supply chain has the ability to manage and maintain the business processes and improve the integrity of the relevant data that is important for the firm's performance. Furthermore, the ability to manage and maintain business activities can increase the integrity of the data because it has a positive association with data security (Jabbour & Jabbour, 2016). Thus, data integrity depends upon the characteristic of the ability to maintain and manage the activities of the entity. So, this study investigated the impact on the data integrity of the ability to maintain characteristic of the manufacturing companies in Indonesia and developed the hypothesis as follow:

H3: There is a positive association between the ability to maintain and data integrity of the firm.

Mediating Role of Management Interaction

A management interaction system can enhance the reliability characteristics of the employees that improve the integrity of the data (Mom, Van Den Bosch, & Volberda, 2009). Moreover, management interaction is the outcome of the effective supply chain, and this system improves the personal reliability of technical skills, and these skills improve data integrity (Reed, 2001). In addition, management interaction systems increase the interactions of customer and owners. These interactions enhance the employees' technical characteristics, which are necessary for data integration (Bland & Nepustil, 1998). Data integration is the demand of the organization to meet the requirement, demand, and preference of the customers, and this integration can be achieved through the reliable skill of employees with the help of management interaction. Thus, management interaction improves the reliable skills of the employees regarding data integrity. So, this study investigated the mediating role of the management interaction system between the reliable technical skills of employees and data integration.

H4: Management interaction systems significantly mediates the relationship between reliable technical characteristics and data integrity.

A management interaction system is able to improve the ability of the control of the employees that improve the integrity of the data (Corneliussen et al., 2007). Moreover, supply chain introduces the concept of management interaction, and this system improves the ability of the control skills of the personnel, and these skills improve the data integrity (Jaya, Tiong, & Clark, 2012). In addition, management interaction systems enhance the interactions of customer and the organization. These interactions improve the ability of control of employees which is necessary for data integration (Carr, Eacmen, Pena, & Wesley, 2006). Data integration is the demand of the organization to meet the requirement, demand, and preference of the customers, and this integration can be achieved through the control ability of employees with the help of management interaction systems (Darnall, Jolley, & Handfield, 2008). Thus, management

interaction improves the control ability of the employees regarding data integrity. So, this study investigated the mediating role of management interaction between the ability to control the skills of employees and data integration.

H5: Management interactions significantly mediates the relationship of ability to control and data integrity.

A management interaction system is necessary to improve the ability to maintain and manage the employees that improve the integrity of the data (Hermjakob et al., 2004). Moreover, the supply chain is required to implement the management interaction, and this system improves the ability to manage skills of the personnel, and these skills improve the data integrity (Huo, 2012). In addition, management interaction systems enhance the interactions of customer and organization (Flynn, Schroeder, & Sakakibara, 1995). These interactions improve the ability to maintain and manage employees which is necessary for data integration (Kuei, Madu, & Lin, 2001). Thus, management interaction improves the ability to manage and maintain the employee regarding data integrity. So, this study investigated the mediating role of management interaction between the ability to maintain skills of employees and data integration.

H6: Management interactions significantly mediates the relationship of ability to maintain and data integrity.

Research Methods

This study investigated the manufacturing sector of Indonesia by using the survey method and the simple random sampling technique of data collection. The manager of the supply chain is the respondent of the study. Data was collected from the 164 manufacturing companies that are registered with the Jakarta Stock Exchange (JSE) (Ibrahim, Sulaiman, Kahtani, & Abu-Jarad, 2012). Structural equation modelling (SEM) was used to analyse the data that were collected from the manufacturing firm in Indonesia. Five-point Likert scale was used to answer the items of the adopted questionnaire used in the study.

Measures

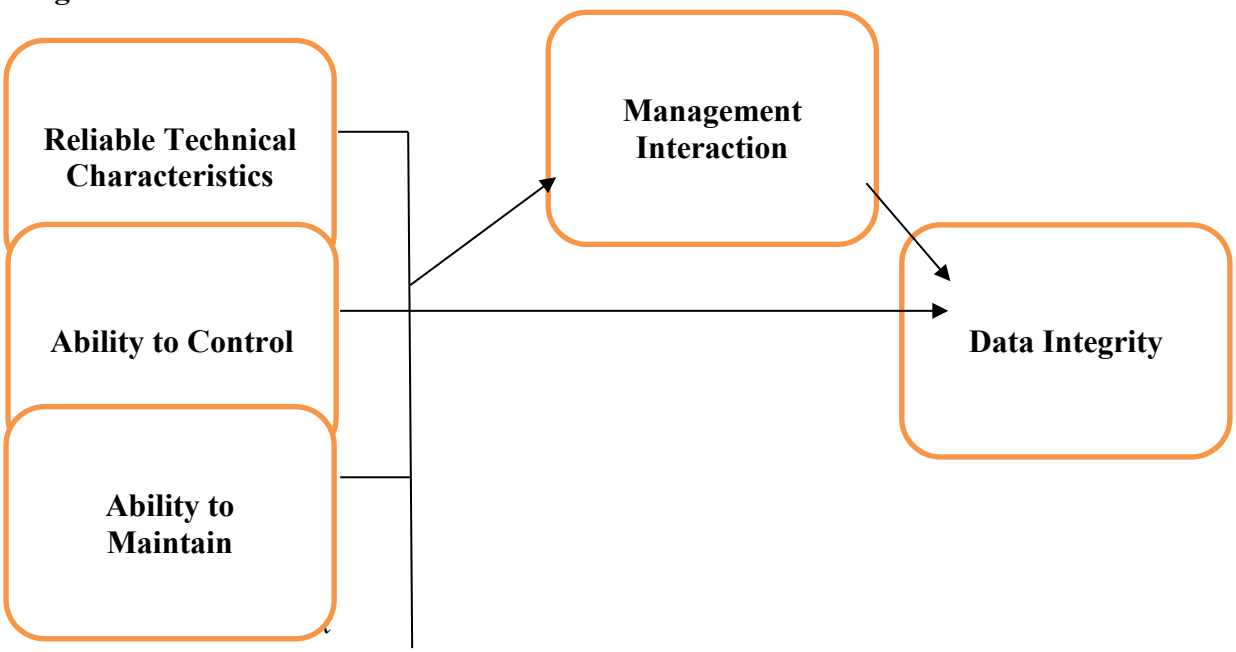
Data integrity (DI) was used as a dependent variable in the study, and it has only one dimension and seventeen items (Craighead, Patterson, Roth, & Segars, 2006). While technical characteristics such as reliable technical characteristics (RTC), ability to control (AC) and ability to maintain (AM) were used as predictors with only one dimension and have fifteen, thirteen and eighteen items respectively (Craighead et al., 2006). Moreover, management interaction (MI) was used as a mediator with one dimension and has thirteen items (Craighead

et al., 2006). Five-point Likert scale was used to answer the items of the adopted questionnaire used in the study.

Data Collection Procedure

Several manufacturing companies are working in Indonesia, but this study selected the 164 companies that are registered with the Jakarta Stock Exchange (JSE). A list of these companies, along with contact details, was obtained from the Jakarta Stock Exchange (JSE). An email was sent to each supply chain manager of the companies to gauge the willingness of the company to allow data collection. Only 145 of the managers responded and a survey questionnaire was mailed to them. After fifteen days, 130 valid responses were received from the respondents, that is approximately 79.29% response rate.

Figure 2. Theoretical Framework



Results

Structural equation modelling (SEM) was applied to the data for analysis by using the Smart-PLS. There are two models used for analysis; first was the measurement assessment model for the validity of the items and constructs, and the second was a structural assessment model for examining the relationship among the variables. There are three tests applied for the convergent validity of the items: first is factor loading greater than 0.50 for all items while second is composite reliability (CR) greater than 0.70 and the third is AVE greater than 0.50. Results showed that there is no problem with convergent validity of the items and constructs. Table 2 highlighted the convergent validity given below:

Table 2: Convergent Validity

Constructs	Items	Loadings	Alpha	CR	AVE
Ability to Control	AC1	0.714	0.885	0.907	0.523
	AC10	0.759			
	AC11	0.752			
	AC12	0.694			
	AC13	0.795			
	AC3	0.756			
	AC6	0.725			
	AC8	0.628			
	AC9	0.668			
Ability to Maintain	AM11	0.462	0.845	0.884	0.526
	AM13	0.744			
	AM15	0.786			
	AM18	0.703			
	AM2	0.788			
	AM5	0.811			
	AM8	0.726			
Data Integrity	DI10	0.751	0.900	0.917	0.502
	DI11	0.756			
	DI12	0.655			
	DI13	0.711			
	DI14	0.757			
	DI15	0.730			
	DI17	0.724			
	DI3	0.684			
	DI4	0.558			
	DI7	0.699			
	DI9	0.742			
Management Interaction	MI10	0.724	0.907	0.922	0.519
	MI11	0.729			
	MI12	0.714			
	MI13	0.691			
	MI2	0.728			
	MI4	0.703			
	MI5	0.735			
	MI6	0.629			
	MI7	0.718			

	MI8	0.778			
Table 2 (Continue)					
Constructs	**Items**	**Loadings**	**Alpha**	**CR**	**AVE**
	MI9	0.765			
Reliable Technical Characteristics	RTC1	0.773	0.836	0.887	0.558
	RTC10	0.869			
	RTC11	0.883			
	RTC15	0.261			
	RTC4	0.890			
	RTC5	0.888			
	RTC7	0.814			
	RTC9	0.780			

Two tests exist to check the discriminant validity of the constructs: first is Fornel Lacker, and second is Heterotrait Monotrait Ratio (HTMT). The Fornel Lacker is the old criteria, and most researchers discourage it. Thus, HTMT ratio is used to test the discriminant validity. Table 3 highlighted the HTMT, and the values of HTMT are less than 0.85, that shows the discriminant validity is perfect.

Table 3: Heterotrait Monotrait Ratio (HTMT)

	AC	**AM**	**DI**	**MI**	**RTC**
AC					
AM	0.573				
DI	0.751	0.763			
MI	0.729	0.721	0.895		
RTC	0.492	0.370	0.567	0.705	

Table 4 below showed the direct and indirect relationship among the understudy variables. Results showed that positive association between reliable technical characteristics and data integrity. Moreover, results also exposed the positive association between the technical characteristics of the ability to control and data integrity. Similarly, results also uncovered a positive association between the technical characteristics about the ability to maintain and data integrity. In addition, results also revealed that management interaction mediates between relationships mentioned above.

Figure 3. Measurement Assessment Model

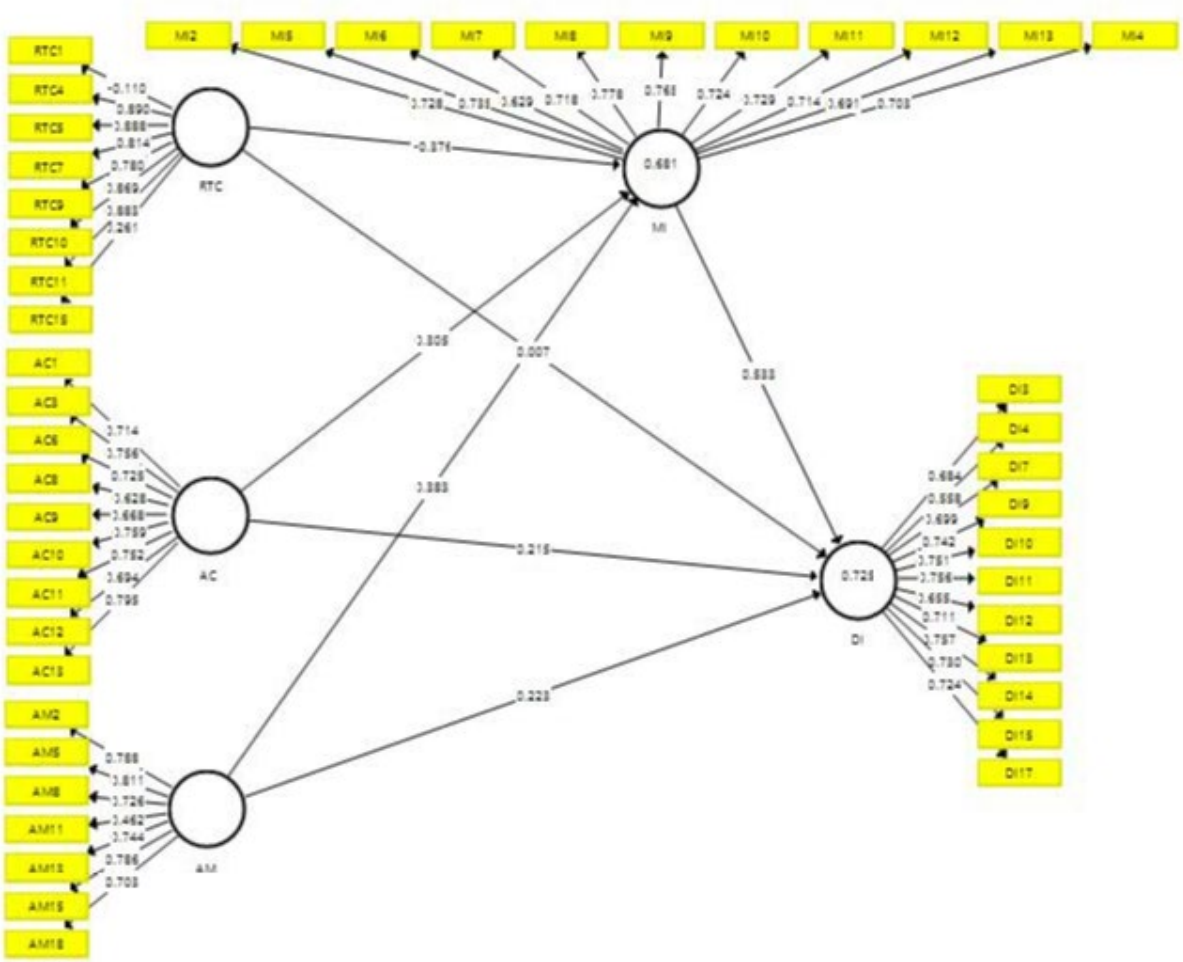
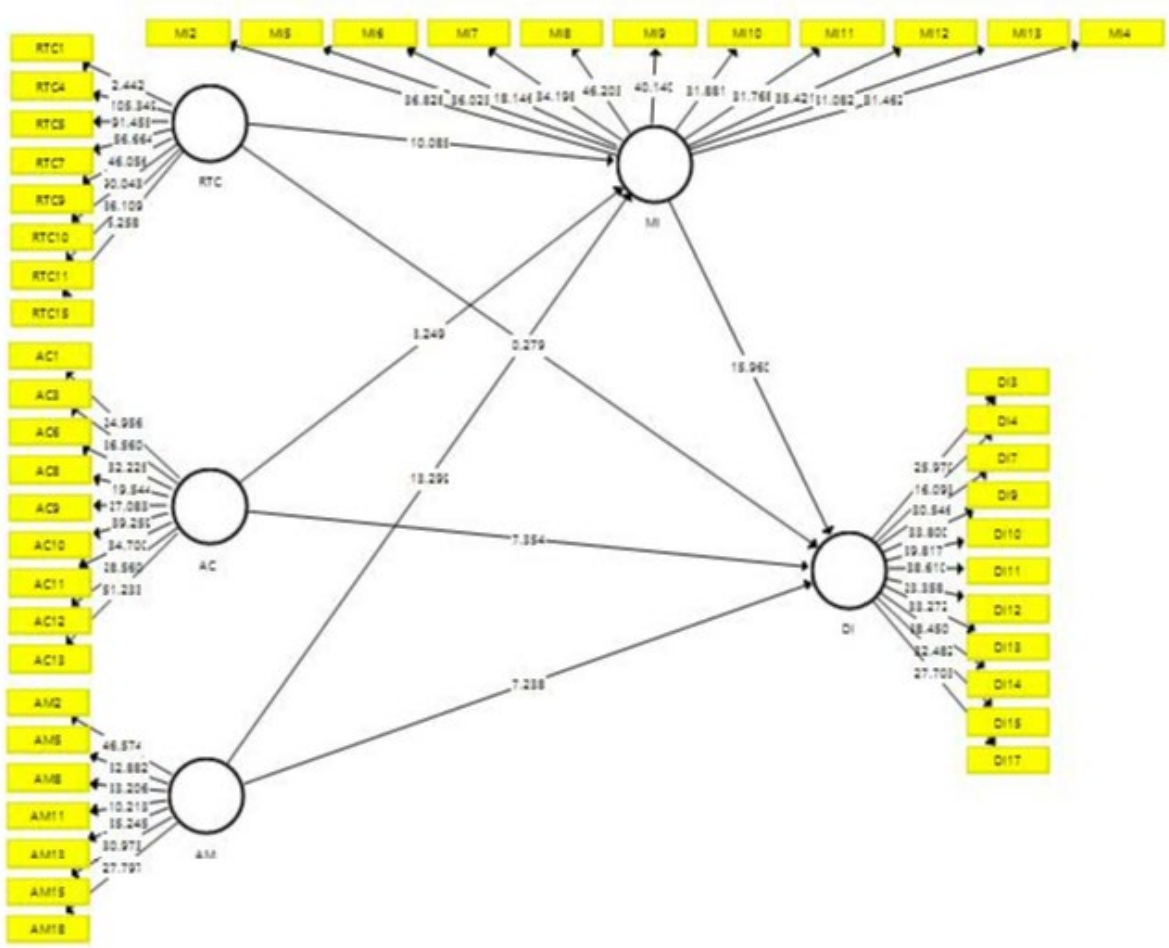


Table 4: Path Analysis

	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values
AC -> DI	0.215	0.215	0.031	6.996	0.000
AM -> DI	0.223	0.226	0.030	7.541	0.000
RTC -> DI	0.376	0.379	0.035	10.629	0.000
AC -> MI -> DI	0.162	0.162	0.023	7.095	0.000
AM -> MI -> DI	0.204	0.203	0.021	9.841	0.000
RTC -> MI -> DI	0.201	0.201	0.021	9.524	0.000

Figure 4. Structural Assessment Model



Discussion

The supply chain is an essential element for the organizations to improve their processes of the business entity. Thus, this study evaluated the technical characteristics of the employees that are developed by the practices of the supply chain. Results exposed the positive association between reliable technical characteristics and data integrity. These results match with the results of Mora, Parker, Vieth, and Delanty (2002) who also examined the positive association between reliable technical characteristics and data integrity. Moreover, results also showed a positive association between the ability to control technical characteristics and data integrity. These findings are similar to Zhu and Sarkis (2004), who also investigated the positive association between the ability to control technical characteristics and data integrity. The findings also revealed the positive association between the ability to maintain technical characteristics and data integrity. Moreover, results also discovered that management interaction improves the technical characteristics of reliable, ability to control and ability to maintain of the employees of the firms that enhance the integrity of the data that is essential

for a firm's performance. These findings match the findings of Alfes, Shantz, Truss, and Soane (2013) who also exposed the mediating impact of management interaction on data integrity and personal technical characteristics.

Conclusion

Finally, this study concluded that the personal technical characteristics such as reliable technical characteristics (RTC), ability to control (AC) and ability to maintain (AM) of the employees influenced the data integrity of the firm. Moreover, it also concluded that management interaction mediates personal technical characteristics and data integrity. Thus, supply chain is considered as an essential element to improve the processes of the business entity.

Limitations and Future Directions

The present study suggested to the policymakers that they should implement the management interaction system into the manufacturing organization to enhance the data integrity of the firm. In addition, the current study also suggested to the future researchers that they should consider other factors that affect data integrity. Moreover, the present study also recommended that other industries and countries should be included to expand the scope of the study.

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