

## **Modelling the Digital Supply Chain enablers using TISM and MICMAC approach**

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### **ABSTRACT**

The purpose of this article is to select digital supply chain enablers (DSCEs) to find its contextual relationship for successful digital supply chain (DSC) implementation. Total interpretative structural modelling (TISM) is used to develop the relationship among selected DSCEs. The findings of TISM are worked for the Matriced Impacts Croises Multiplication Appliqueeaun Classement (MICMAC) approach to identify the driving and dependence power of DSCEs. This paper identified 10 DSCEs and developed an integrated model using TISM and the FMICMAC approach. The model is used to recognize and organize the important enablers and show the direct and indirect relationship and effects of each enabler on the DSC implementation.

**Key words:** digital supply chain; digital supply chain enablers; total interpretive structural modelling; MICMAC.

### **INTRODUCTION**

Digital technologies almost changed the system the people will connect and intermingle around them. New scientific innovations and tools shift the manner how companies' use and share information (Mentzer et al., 2001). Digital Supply Chain (DSC) is a novel for organizations concern with new digitized analytical approach for effective supply chain (SC). DSC is the process of managing the SC using adoption of innovative technologies (Buyukozkan & Goçer, 2018). Digital adaptation is the main component to compete in today's commercial ecosphere because of rapid pace of innovations. There were several benefits of using DSC for manufacturing organizations, however the DSC implementation is not an easy task because it involves many risks, high capital investment and changes involved. However, DSC has some enablers which enhances the probability of its implementation. Some of the enablers identified within the literature are real-time analysis of the company, better overall SC decisions. Thus, it

is important to establish the interrelationship between DSC enablers. Analysis of the enablers increases the probability of DSC implementation and enablers interrelationship can provide significant evidence to management. This study investigates the enablers to DSC based on present literature survey and belief of selected experts. DSC implementation is generally supported by these enablers. Total Interpretive structural modelling (TISM) is an important method for finding relations between identified parameters. TISM is an advanced version of ISM which involves qualitative modeling technique (Sushil, 2012; Dubey et al., 2017; Jena et al., 2016). In present work, DSCs have been analyzed using the TISM and Matriced Impacts Croises Multiplication Appliquee au Classement (MICMAC) method, that provides mutual relationship of different DSCs, their driving and dependence power.

This paper contains four sections. Section one presents introduction of this work; Section two contains the literature of DSC and identification of various DSCs; Section three presents the TISM method and its steps for modelling DSCs and then brief description of MICMAC analysis and categorizing the DSCs into different clusters. Section four presents the conclusions of this research.

## **LITERATURE REVIEW**

Radanliev et al., (2019) studies the planning principles for emerging perception within the procedure of mixing small and medium scale industries digital supply chains within the Industrial Internet of Things. Digital adaptation needs to understand consumers wants and demands throughout their life. DSC is related to manage supply chain processes with the help of wide variety of innovative technologies (Büyükožkan and Göçer, 2018). Penthin and Dillman, 2015 finds that regarding three fourth of the people across the globe can now have internet facility while 50 per cent amongst these people are using social media. additionally, almost every internet user using online shopping. This high use of digital platform has changed consumers purchasing actions. Everyone can buy online from abroad also due to which volatility in demand have increased. Use of new digital tools can be useful for minimizing some competitions (Farahani et al., 2015). To deal with competition challenges, industries from different areas or streams are fusing investment to digitize its SC. Mueller et al. (2018) finds that almost three-fourth of production companies are effectively increasing their level of digitization by 2020. Digitalization of SC have high probability to have customer satisfaction, increased visualization, healthier association within SC (Pradabwong et al., 2017). Various industries around the globe have tried adopting DSC but only a few are satisfied with their approach (Dougados and Felgendreher, 2016). A modern estimation framework with the application of ERP is prepared, which makes continuously analysis of

sellers at each delivery (Tekez et. al.,2019). The number of companies failed to require business gain of digitization because of the lack of research in the area and absence of supporting DSCEs (Agrawal et al. 2019). Some of the enablers obtained through extensive literature review are given in table 1.

**Table 1.** DSCEs

DSC Es	Name of DSCEs	Description	Authors
E1	Real-time analysis of the company	Real-time analysis permits businesses to gain knowledge and to act on data instantly. Real-time analysis plays a very significant part in the acceptance rates and life-cycle development of big data.	Penthin & Dillman (2015), Hines, (2004)
E2	Better overall decisions	SCM The decision regarding overall SCM betterment helps in increasing company's image.	Schmidt et al, (2015), Cecere,2016
E3	Increased flexibility	SCM Flexibility is an important differentiator in the current marketplace. The need to incorporate flexibility to react to changing customer demand.	Xu, (2014), Sharma et.al., (2014), Cecere, (2016)
E4	Lower inventory and warehousing cost	The Cost reduction in inventory management is significant in a market that is continuously attracting more competition. As competition grows, logistics businesses must take a couple of simple steps to level back inventory costs to remain within the competition.	Schmidt et al, (2015), Hanifan et al, (2014), Cecere,2016, Agrawal & Narain, (2018)
E5	Lower supply chain risk	Digital concepts such as artificial intelligence, big data analytics, unmanned aerial vehicles, and fewer distribution facilities reduce total supply chain risks. SC risk develops from different areas, as natural calamities, during war or terrorism, supplier economic failure etc.	Rakowski, (2015), Cecere, (2016), Agrawal & Narain, (2018)
E6	More efficient supply chain	An efficient SC minimizes costs, reduces time, and maximum resource utilization.	Hanifan et al, (2014), Cecere,(2016), Raj & Sharma (2014)
E7	Higher product and service quality	Products and Services which fulfills customers need and wants results in customer	Raj & Sharma (2014), Schmidt et al, (2015), Rakowski, (2016),

		satisfaction. Quality is the fits for purpose or use and fulfill customers' expectations. Product quality designates a product's capability to meet customers' standards. It creates faith with your customers which reduces customer complaints and bad feedback.	Cecere,(2016)
E8	Robust inbound supply chain	Reliable and robust supply chains influence the cost and reduce the risk of not obtaining a supply. Reliable chains have fewer chances of disruption, whereas robust chains still perform very well in the case of disrupted supply channels.	Rakowski, (2016), Cecere, (2016)
E9	Lower transport and logistics administration cost	The real-time information on the use of resources in the warehouse, Lower transport, and logistics administration cost due to optimized operations like design of optimal picking routes and machine programming.	Schmidt et al, (2015) Dougados, & Felgendreher ,(2016).
E10	Lower supply chain complexity	If the company has more than one supply chains, then it can reduce supply chain complexity. Analysis of those into their natural segments, they become more easily understood and managed.	Raj & Sharma (2014), Hanifan et al, (2014),

## METHODOLOGY

The DSCEs were identified from literature and expert's opinion. Finally, 10 DSCEs have been chosen for the research. Using TISM and MICMAC approach the final model of DSC implementation has been prepared. The steps of TISM is adopted from Rajesh (2017) is as follows.

### Steps of TISM analysis

Step I: Identify and define the DSCEs

Step II: Determining the contextual relationship amongst the DSCEs

Step III: Experts decide the pairwise comparison of DSCEs in table 2 in the form of V, A, X, and O, defined in the referred article and is known as Structural self-interaction matrix (SSIM).

**Table 2.** Structural self-interaction matrix (SSIM)

$\begin{matrix} j \\ i \end{matrix}$	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	1	X	V	V	V	V	V	V	V	V
E2		1	X	V	V	V	V	V	V	V
E3			1	V	V	V	V	V	O	V
E4				1	X	A	O	O	O	O
E5					1	X	A	A	O	A
E6						1	V	A	V	V
E7							1	A	O	A
E8								1	V	V
E9									1	A
E10										1

Step IV: The SSIM has been converted into a binary matrix, called the initial reachability matrix, by substituting V, A, X and O by 1 and 0, as per the given case taken from the referred article.

Step V: The initial reachability matrix is checked for transitivity according to rule, if “a relates to b” and “b relates to c” these imply “a necessarily relates to c.” Accordingly, the final reachability matrix with transitive links is prepared (table 3).

**Table 3** Final Reachability matrix

$\begin{matrix} J \\ I \end{matrix}$	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	1	1	1	1	1	1	1	1	1	1
E2	1	1	1	1	1	1	1	1	1	1
E3	1*	1	1	1	1	1	1	1	1*	1
E4	0	0	0	1	1	1*	0	0	0	0
E5	0	0	0	1	1	1	1*	0	1*	1*
E6	0	0	0	1	1	1	1	0	1	1
E7	0	0	0	0	1	1*	1	0	0	0
E8	0	0	0	1*	1	1	1	1	1	1
E9	0	0	0	0	0	0	0	0	1	0
E10	0	0	0	0	1	1*	1	0	1	1

Step VI: Level partition of the DSCEs is done by finding the reachability and antecedent set for each DSCEs. The common element of these sets is identified and for whom the reachability and the intersection sets are same were assigned a level (table 4).

**Table 4** Level partition of DSCEs

Enablers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,5,6,7,8,9,10	1,2,3	1,2,3	IV
2	1,2,3,4,5,6,7,8,9,10	1,2,3	1,2,3	IV
3	1,2,3,4,5,6,7,8,9,10	1,2,3	1,2,3	IV
4	4,5,6	1,2,3,4,5,6,8	4,5,6	I
5	4,5,6,7,9,10	1,2,3,4,5,6,7,8,10,	4,5,6,7,10	II
6	4,5,6,7,9,10	1,2,3,5,4,6,7,8,10,	4,5,6,7,10	II

7	5,6,7	1,2,3,5,6,7,8,10,	5,6,7	I
8	4,5,6,7,8,9,10	1,2,3,8	8	III
9	9	1,2,3,5,6,8,9,10	9	I
10	5,6,7,9,10	1,2,3,5,6,8,10	5,6	II

Step VII: TISM model development

Using Table 4, the TISM model is developed (Figure 1).

### Steps of MICMAC analysis

The MICMAC method has two steps: first, a MICMAC graph is prepared using the driving and dependence power of DSCEs and based on it a MICMAC rank is obtained. The driving and dependence power of DSCEs is obtained by adding corresponding elements of row and corresponding elements column to obtain the final matrix.

The MICMAC graph is developed by locating the DSCEs on a graph using its driving and dependence power and classifying the graph into four categories namely autonomous variables, dependent variables, linkage variables and independent variables. The MICMAC graph is presented in Figure 2.

The analysis of MICMAC graph is as follows:

#### Autonomous DSCEs

Autonomous DSCEs are weak drivers and weak dependent. They do not influence the system. The MICMAC graph indicates that there is no autonomous enabler in the process of DSC implementation.

#### Dependent DSCEs

The dependent DSCEs have strong dependence but are weak drivers. Lower inventory and warehousing cost (DSCE4), higher product and service quality (DSCE7), Lower transport and logistics administration cost (DSCE9), and lower supply chain complexity (DSCE10) fall in this group. This shows that availability enablers minimise the effect of these DSCEs in DSC management.

#### Linkages DSCEs:

Linkage DSCEs have high driving power and high dependence. There are two DSCEs Lower supply chain risk (DSCE5) and more efficient supply chain (DSCE6) in this group. Any change occurring to these DSCEs will influence other enablers.

#### Driving or Independent DSCEs:

Driving or Independent DSCEs have high driving power and low dependence. Real-time analysis of the company (DSCE1), Better overall SCM decisions (DSCE2), Increased SCM flexibility (DSCE3), and Robust inbound supply chain (DSCE8) falls in this category. Thus, top management need to deal with these DSCEs more carefully, as these are the basis of handling all other DSCEs too

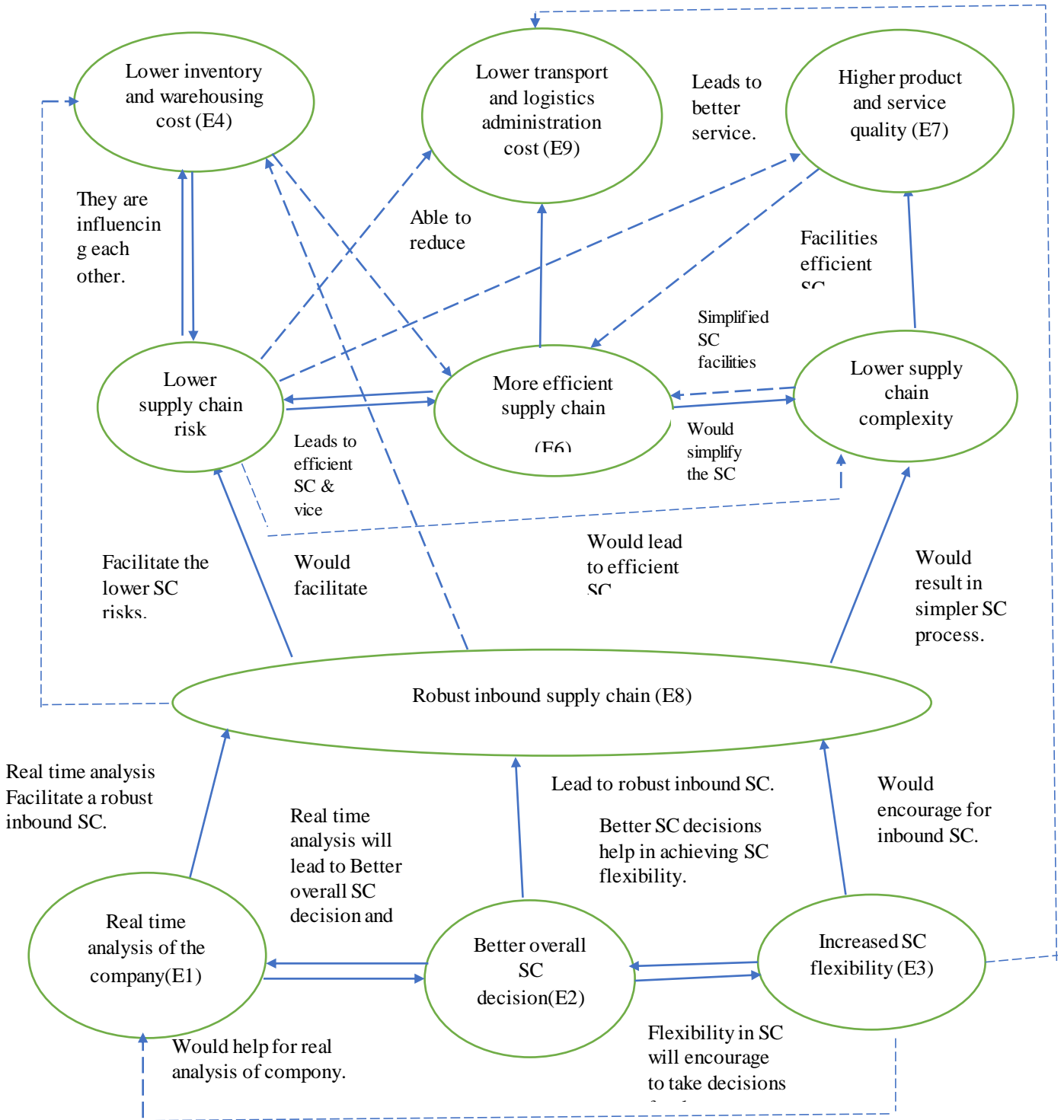


Figure 1 TISM model with significant transitive links

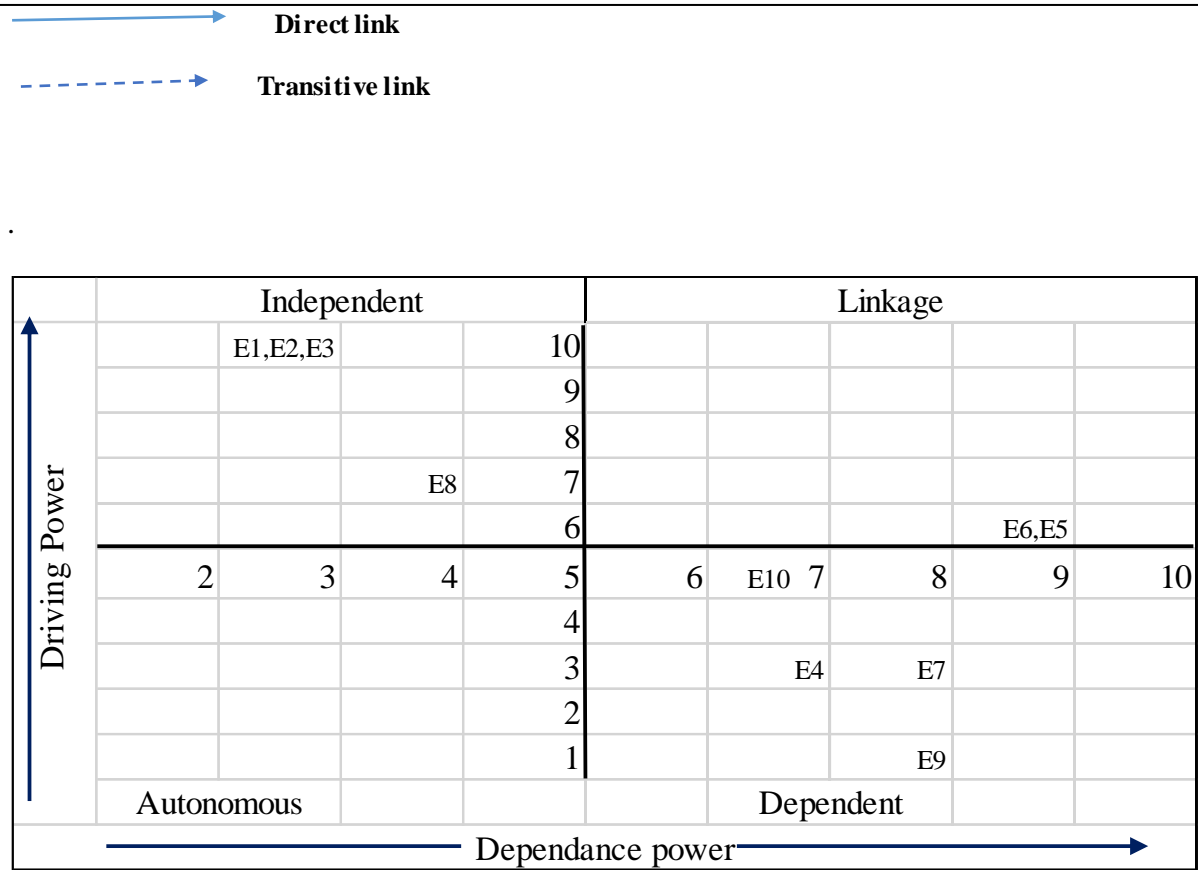


Figure 2 The MICMAC graph

### CONCLUSION

The DSCEs are dependent on each other and have connections among them. It becomes more important to identify the relationship of DSCEs with each other. An integrated model of TISM and the MICMAC is developed that can be helpful for SC managers to use this model effectively. This may be helpful to find and categorize the essential DSCEs for their industrial benefits. The academician may use this model to effectively analyse the interdependencies of these identified DSCEs for successful DSC implementation.

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