



SUPPLY CHAIN MANAGEMENT MATURITY: AN ALL-ENCOMPASSING LITERATURE REVIEW ON MODELS, DIMENSIONS AND APPROACHES

Mohsen Cheshmberah¹, Safoura Beheshtikia²

1) Malek Ashtar University of Technology, Isfahan, **Iran**, 2) Isfahan University of Technology, Isfahan, **Iran**

ABSTRACT. Background: In recent years, organizational maturity has disseminated its concepts to various management domains, for instance, Supply Chain Management (SCM). The present paper is an attempt to review the developments in the realm of SCM over the past two decades. In the domain of SCM maturity, different models, dimensions (areas) and approaches are advanced for maturity measurements.

Methods: Research studies conducted and presented in the literature, including papers on conference proceedings, articles in journals and technical reports, are reviewed; the review covers a time span from the early 1990s to the present time (2019). Also provided in this review are the previous models, dimensions (areas/ elements), and approaches for measuring SCM maturity techniques. Additionally, research gaps are identified, analysed and discussed.

Results: After reviewing, the research studies in the field and the dimensions found in the works are placed into different categories. The current study aims to present a review of the literature, ultimately providing help to researchers in realizing gaps and opportunities in the field of SCM maturity. There are also different approaches to supply chain maturity models. For example, one approach may solely focus on integration while another might concentrate on SC visibility and traceability. In more recent research studies, more attention is paid to such specific areas of supply chain as flexibility and sustainability. The results of the present paper point to gaps, which indicate that more research works are required. In addition, it is assumed that the materials presented here may help establish more comprehensive SCM maturity models.

Conclusions: It is seen that supply chain management is rapidly shifting toward e-SCM, and some other technologies like blockchain. Also, supply chain sustainability comes to the fore as a significant approach. It should be reminded that other strategic features of supply chains like leanness, agility, resilience, sustainability, integration, green and reverse logistics etc., also play their own role in the field. Combining these strategic features can be an effective idea for developing more comprehensive models for SCM maturity. To sum up, the results of the present survey indicate that the published works need more adequacy and treatment research, and that more research is called for to bridge the gaps in the realm of SCM maturity.

Key words: organizational maturity, supply chain management (SCM), SCM maturity, maturity model, literature review.

INTRODUCTION

Organizational maturity is defined as the ability to maintain or develop performance such that persistent satisfaction of the organization's stakeholders is guaranteed over time. Organizational maturity will not come about unless the organization can identify environmental changes and exploit them to

update strategic goals and plans. In order to achieve the requisite maturity, the organization must continuously monitor changes in environmental issues and other relevant developments.

Organizational maturity models provide a simple yet effective way to study and improve processes and, although maturity model approaches emerged within the field of

software engineering, it quickly spread to other domains [Wendler 2012]. In particular, over the past two decades, the adoption of maturity models has been considered in most organizational milieus. Generally speaking, the maturity model is an explanation of the processes that must be implemented such that the highest level of maturity is obtained. Maturity models are rooted in the field of quality management, where Philip Crosby's Quality Management Maturity Network is considered a key element in this regard.

In the literature on the issue of maturity models, various models have been developed in such varied branches as strategic management, knowledge management, project management, process management, IT management, and related fields. As was pointed out earlier, the concept of the maturity model is commonly associated with Information Technology and software development; in this regard, a model designated as the Capability Maturity Model (CMM) was evolved [Lockamy, McCormack, 2004].

In recent years, a number of researchers have seriously focused their attention on reviewing the processes of supply chain management and tried to improve their efficiency and responsiveness through supply chain maturity approaches [Varoutsas, Scapens 2015]. Hence, supply chain management is an area where the measurement of progress requires a roadmap and a compass; maturity assessment allows a roadmap to be drawn up, based on which progress can be checked, and the continuation of the path can be guaranteed [Sun et al. 2005, Netland et al. 2007].

Supply chain management focuses on acquiring advanced information technologies and systems; best practices in business processes, including cooperative and trustworthy relationships between supply chain partners; and achieving optimum support and the highest level of managerial commitment. To that end, the realization of maturity is based on a specific model in the organization's supply chain management for accomplishing responsive and efficient performances [Sun et al. 2005, Netland et al. 2007].

Various maturity assessment models are available in the field of supply chain management – Netland et al. [2007] studied different maturity models in the realm of supply chain management [Netland et al. 2007]. These models range from simple self-assessment tests to detailed cause and effect analyses. Naturally, different maturity tests are considered for different causes, which accordingly have different designs and contents. In general, the following six criteria characterize maturity models [Netland et al. 2007]:

- They usually have a number of maturity levels
- There is a special term dedicated to each level.
- There exist certain descriptions for each level.
- The model includes a number of dimensions or areas
- There are a number of activities defined for each process area.
- There is a clear description to each activity at any maturity level.

A REVIEW OF PUBLISHED WORKS

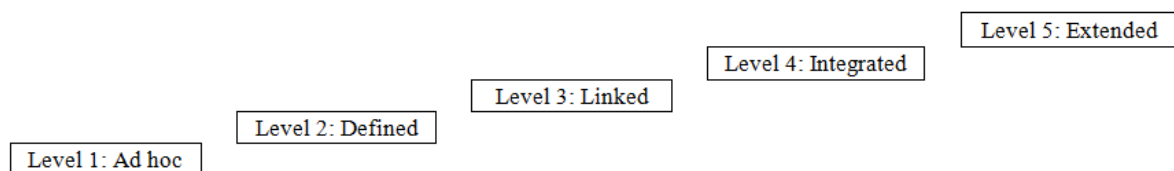
In the domain of SCM maturity, different models and dimensions (areas) are advanced for maturity measurements; reliable research works – including conference proceeding papers, journal articles, and technical reports – published by authors as sources, are reviewed in as much detail as space allows. The following provides some of the models produced in the literature.

Hanson and Voss [1995] introduced organization and culture, logistics, manufacturing systems, lean production, concurrent engineering, and total quality as proper areas for maturity assessments [Hanson, Voss 1995]. Lambert and Cooper [2000] suggested product flow, customer relationship management, demand management, order fulfillment, production flow, logistics, product development and commercialization, as well as returning (reverse logistics) to investigate maturity levels [Lambert, Cooper 2000].

Bowersox et al. [2000] described supply chain (management) maturity in terms of the level of realization of integrated supply chain and collaborative supply chain as well. They believe ten (10) mega trends will shape the future of supply chain management (such as transition from customer service to relationship management and adversarial to collaborative relationships).

Van Landeghem and Persoons [2001] considered employees, planning and control, production and assembly, research and development (R&D), distribution, order fulfillment, purchases and suppliers, markets and service providers to audit the supply chain and logistics management.

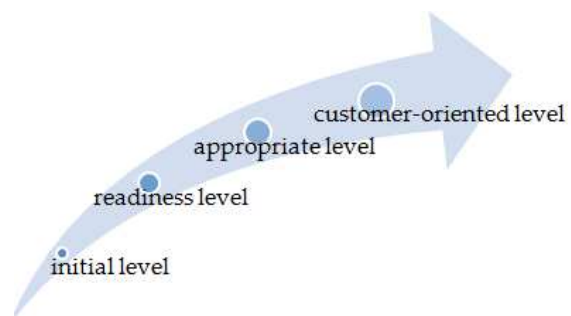
Lockamy and McCormack [2004] examined the relationship between the supply chain management maturity processes and the overall performance of the supply chain. The result of this study, while confirming the strong relationship between the two variables, showed that metrics, such as "cycle times" and "inventory levels", depend upon the maturity of the supply chain processes. In this model, five levels of maturity are considered. They are as follows: Level 1: Ad hoc; Level 2: Defined; Level 3: Linked; Level 4: Integrated; Level 5: Extended [Lockamy, McCormack, 2013]; Figure 1 shows Lockamy & McCormack's maturity model.



Source: the author's own work

Fig. 1. Lockamy & McCormack's maturity model

Leem and Yoon [2004] developed a Customer Satisfaction Maturity model based on four levels of initial maturity (regardless of customer feedback), readiness level (generating a product / service in a general way. They also develop strategies to increase customer satisfaction), appropriate level (providing different products/services for a segmented market), and customer-oriented level (customized products/ services according to the expectations of individual customers) [Leem, Yoon 2004]; Figure 2 gives a schema of Leem and Yoon's maturity model.

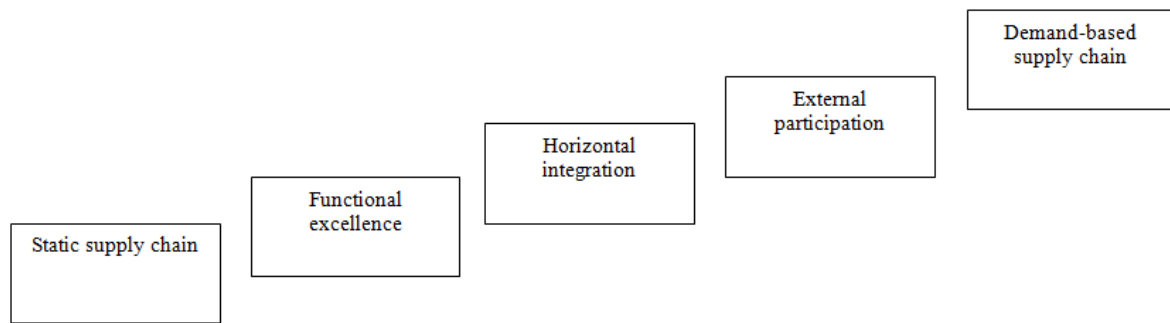


Source: the author's own work

Fig. 2. Leem & Yoon's maturity model

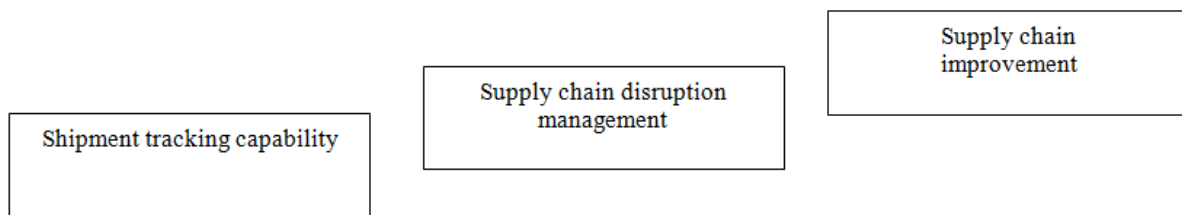
IBM [2005] has developed a model, which in conformity with the level of supply chain integration provided a basis for maturity level measurements. The five levels that characterize the model are: "Static supply chain", "functional excellence", "horizontal integration", "external participation" and "demand-based supply chain". Figure 3, presents the IBM maturity model.

The Aberdeen Group [2006] presented a model known as "Roadmap for the Visibility of Supply Chain" providing a methodology for assessing the visibility degree of the supply chain. This model examines supply chain maturity status at three levels: "Shipment tracking capability", "supply chain disruption management" and "supply chain improvement"; Figure 4 shows the roadmap developed by Aberdeen.



Source: the company's own report

Fig. 3. The maturity model of IBM



Source: the company's own report [Aberdeen Group 2006]

Fig. 4. Aberdeen Group Roadmap

Daozhi, et al. [2006] presented a three dimensional supply chain management maturity model: Environment (law and regulations, communications, industrial monopoly and so forth), resources (material, knowledge, human resource, capital and information), and management (flexibility, risk management, forecast ability et cetera).

Jaklic et al. [2006] presented a five-level maturity model for the supply chain. This model combines the SCOR framework with that of the Lockamy and McCormack model. The levels included in this model are: Level 1 (Ad hoc), Level 2 (Defined), Level 3 (Linked), Level 4 (Integrated) and Level 5 (Extended).

The SCOR (Supply Chain Operations Reference) [Ver.11, 2012] model provides a framework linking business process, metrics and best practices to support communication among supply chain partners which ultimately improves the effectiveness (responsiveness) of supply chain management; the maturity model presented by Jaklic et al. is exhibited in Figure 5.

Pache and Spalanzani [2007] suggested five maturity levels shaping the inter-organizational relationships in terms of intra-organizational level, inter-organizational level, extended inter-organizational level, multi-chain level, and social level. Figure 6 displays their model.

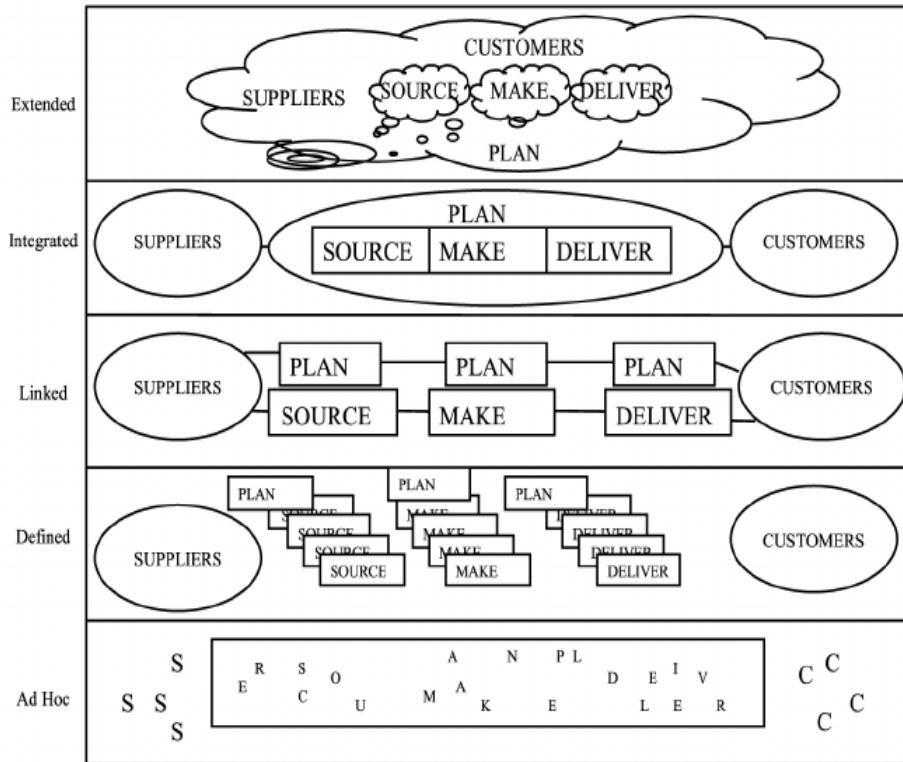
Netland et al. [2007] suggested exploiting the EFQM Excellence Model for measuring supply chain maturity level. Still another model proposed in the field of SCM maturity is that of the SCM-CMM [2010], which follows the CMM model approach. It is worth noting that the CMM model was developed by Carnegie Mellon. Five maturity levels are defined for the SCM-CMM model: Ad hoc (contingency), primary, defined, extended, and networked [Sun et al. 2005].

Garcia [2008] developed a model of SC capability maturity. The model provides a roadmap for enterprise improvement, covering multiple dimensions (suppliers, production, inventories, customers, human resources, information systems & technology, and performance measurement systems) as well as abstraction levels of the supply chain

(undefined, defined, manageable, collaborative and leading). In general, it provides useful tools for bringing about improvements in businesses.

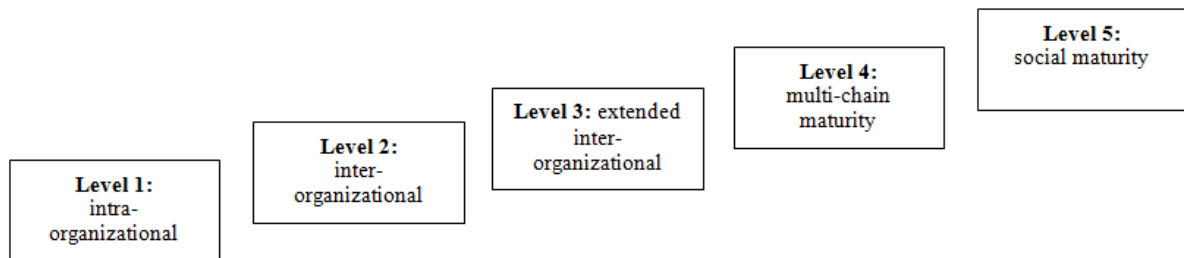
Lahti, et al. [2009] considered a four-stage SCM maturity model for implementation as developed by ABB – a corporate research center in Finland. The model included four

stages designated as functional focus, internal integration, external integration and cross-enterprise collaboration. This research designed a questionnaire to assess both the maturity of different supply chain process areas and the maturity of the practices of the supply chain participants. Figure 7 illustrates the ABB’s SCM maturity model.



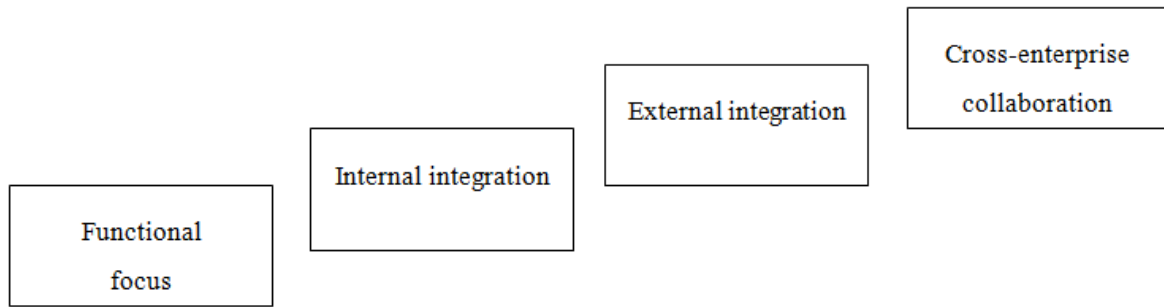
Source: the author’s own work

Fig. 5. Maturity model by Jaklic et al. [2006]



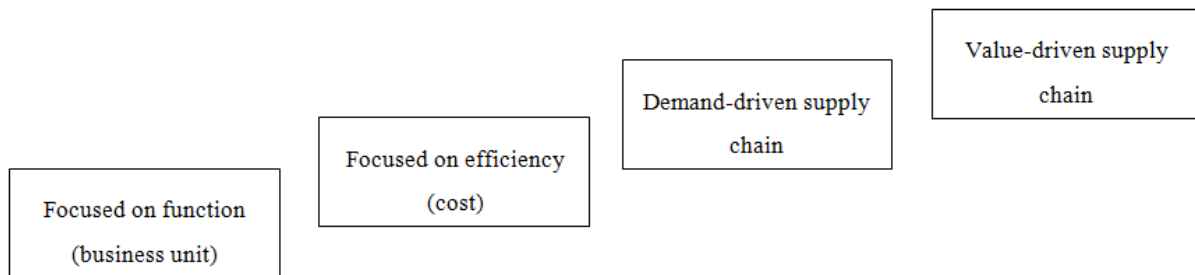
Source: the author’s own work

Fig. 6. Pache and Spalanzani's maturity model



Source: the author's own work

Fig. 7. ABB's SCM maturity model



Source: the author's own work

Fig. 8. Accenture maturity model

Accenture Company [2012] sets four stages for supply chain maturity starting with discrete decision-making in the chain and ending with value-driven supply chain. These steps include supply chains focused on tasks and business units, supply chains focused on efficiency and cost, demand-driven supply chains, and value-driven supply chains [Goblet 2012]. Figure 8 shows the Accenture maturity level.

Hameri, et al. [2013] proposed a model of six phases as regards SCM maturity. The model is based on six steps, the first three of which are regional, dealing with initial sourcing, chain organization, and chain expansion. The next three steps concern the international and global operations with chain restructuring, chain redesign, and lean supply chain management.

Huang and Handfield [2015] investigated the effects of implementing enterprise resource planning (ERP) systems on supply management performance. The results of their analysis suggest that ERP users are more mature than non-ERP users considering three key indicators: strategic sourcing, category

management, and supplier relationship management.

Fischera et al. [2016] have focused on assessing the maturity of Supply Chain Flexibility (SCF). The researchers identified three maturity levels of SCF: reactive, proactive, and paradigmatic supply chain levels, in the order stated. Each level includes five (5) dimensions: collaboration, information technology, information flow, internal flexibility and performance measurement.

Ho et al. [2016] considered a framework based on a Capability Maturity Model Integration (CMMI) approach as a diagnostic tool for analyzing current collaboration practices in organizations as well as a roadmap to guide organizations toward advancement levels in supply chain collaboration.

Radosavljevic et al. [2016] studied SCM maturity in several Serbian companies. The results obtained indicate that best practice elements are not very popular in enterprises in Serbia.

Sarkar et al. [2016] consider carbon emission costs in a three-echelon supply chain (supplier, manufacturer and retailer). Their model aims to reduce supply chain costs, including variable transportation and carbon emission costs arising from shipment problems.

Sartori and Frederico [2017] discussed and identified three categories as regards the maturity of supply chain management. These include management components (processes management, technology and tools, performance measurement and risk and project management), supply chain structure (collaboration, strategic focus, responsiveness and environmental resources), and business process. Baraniecka et al. [2017] examined the maturity of supply chain management based on a classification tree and its respective levels.

Reefke and Sundaram [2018], drawing upon the Delphi method, studied the design and validation of models for sustainable supply chain management at the ongoing maturity development of sustainability. In another study, Asdecker and Felch [2018] developed a model to apply Industry 4.0 maturity models to outbound logistics to the already researched manufacturing processes.

In recent developments, blockchain technology has emerged as the new information technology. The application of this technology to supply chain management has become a recent topic of discussions among researchers in the field. Schniederjans et al. [2019] believe that the digitization of industry (Industry 4.0), is a newly emerging trend in supply chain management. In their study, they consider how to enhance the supply chain digitization research paradigm in future research projects.

Kamilaris, et al. [2019] examined the impact of blockchain technology in ongoing projects of the agriculture and food supply chain sector discussing overall implications as well as challenges facing the maturity of the latter projects. Indeed, blockchain is an emerging digital technology permitting ubiquitous financial transactions among parties while needing no intermediaries.

Their study approach is novel in the supply chain context, where visibility and transparency of product flows are the major challenges [Azzi et al. 2019]. In other words, blockchain is a distributed and immutable database using cryptography, thus enabling more efficient and transparent transactions [Schmidt and Wagner, 2019].

Azzi et al. [2019] attempted to describe the way blockchain can be integrated into the supply chain architecture so that a trustworthy, transparent, reliable and secure system is established.

Gustafsson et al. [2019] developed a maturity model in retail supply chains of product fitting where three levels of digitalization and potential outcomes for each level are specified. As a matter of fact, digital product fitting is an emerging operational practice in the retail domain implementing digital models of products and customers for matching the product supply to the customer's requirements. The three levels referred to are: corpus, virtusize and volumental.

Researches and models: An analysis

After reviewing, the research studies referred to above and classifying the dimensions which appear in the literature, the most striking areas (dimensions) to be expressed are given in Table 1. These areas (dimensions) are:

- Planning and policy making
- Demand and customer management
- Make (internal) or ISCM (internal supply chain management)
- Logistics
- Supply
- IT/ IS (information technology/ information systems)
- Collaboration
- Cost
- Product design and commercialization
- Reverse logistics/ closed loop supply chain
- Focus on processes
- Human resources

Table 1. Categorizing dimensions (areas) of the SCM maturity in researches issued to this time

	Human resource	Process view	Reverse logistics/ closed loop SC	Design/Commercial ization product	Cost	Environment	Social responsibility	collaboration and inter-organizational relationships	IT/IS	Supply	Logistics	Make (Internal)	Demand/ customer	Planning (policy making)
Hanson, Voss (1995)					*					*	*	*	*	*
Lambert, Cooper (2000)			*	*						*	*	*	*	*
Van Landeghem, Persoons (2001)	*			*						*	*	*	*	*
Lockamy, McCormack (2004)										*	*	*	*	
Leem, Yoon (2004)													*	
IBM (2005)								*						*
Aberdeen Group (2006)											*		*	
Daozhi et al. (2006)	*					*			*					*
Jaklic et al. (2006)					*			*		*	*	*	*	
Pache, Spalanzani (2007)							*	*						
Netland et al. (2007)	*	*								*			*	*
Garcia (2008)	*							*	*					*
SCM-CMM (2010)	*	*											*	
Accenture (2012)								*					*	*
Hameri et al. (2013)								*		*				
Fischer et al. (2016)		*						*	*					
Sarkar et al. (2016)					*	*								
Sartori, Frederico (2017)		*				*		*						*
Reefke, Sundaram (2018)					*	*	*							
Asdecker, Felch (2018)									*					
Schniederjans et al. (2019)									*					
Kamilaris, et al. (2019)									*					
Azzi et al. (2019)									*					
Gustafsson et al. (2019)									*					

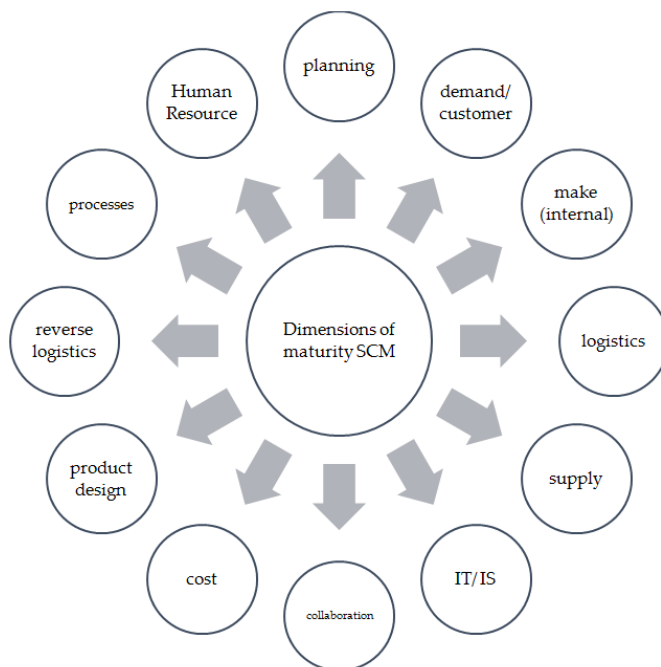


Fig. 9. Categories of SCM maturity dimensions (areas)

Table 2 shows the relevance of each dimension (areas) to the investigated works in the literature. Figure 10 further illuminates the

most crucial dimensions raised in the published works. The dimensions brought up in Figure 9 can provide a basis for the development of

more powerful and comprehensive maturity models in supply chain management. These dimensions provide an all-embracing prospect for supply chain management. By defining the appropriate levels for each dimension, it is possible to draw up an appropriate roadmap for SCM maturity.

In depth and accurate examinations reveal that there are various approaches to the assessment of SCM maturity. Certain studies, by introducing the dimensions (areas), measure the so make the organizational managers aware of the organization's situation as regards

supply chain management and its maturity level.

In some other studies, supply chain integration levels are considered, and in others serious attention is given to the customer. The level of technology deployment, especially information technology, is a conspicuous approach in some particular studies. In more recent research studies, focus is directed towards such specific areas of the supply chain as flexibility and sustainability. Table 2 displays the approaches on SCM maturity issues, as can be observed in the literature.

Table 2. Approaches to SCM maturity identified in previous researches

Approaches	dimensions (criteria)	integration (collaboration)	Excellence approach	Supply chain sustainability	Supply chain flexibility	Customer orientation	Application of technology (IT/IS/ERP)	shipment tracking	Environment considerations in	Mega Trend(s)
Researches										
Hanson, Voss (1995)	*									
Lambert, Cooper (2000)	*									
Bowersox et al. (2000)										*
Van Landeghem, Persoons (2001)	*									
Lockamy, McCormack (2004)		*								
Leem, Yoon (2004)						*				
IBM (2005)		*								
Daozhi et al. (2006)	*									
Aberdeen Group (2006)						*	*	*		
Jaklic et al. (2006)	*	*								
Pache, Spalanzani (2007)		*		*						
Netland et al. (2007)			*							
Garcia (2008)	*	*								
Lahti et al. (2009)	*									
SCM-CMM (2010)	*									
Accenture (2012)						*				
Hameri et al. (2013)	*	*	*							
Huang, Handfield (2015)							*			
Fischer et al. (2016)	*				*					
Ho et al. (2016)		*								
Sarkar et al. (2016)									*	
Sartori, Frederico (2017)	*									
Reefke, Sundaram (2018)				*						
Asdecker, Felch (2018)							*			
Schniederjans et al. (2019)							*			
Kamilaris, et al. (2019)							*			
Azzi et al. (2019)							*			
Gustafsson et al. (2019)							*			

Some models have contemplated specific approaches, for example, tracking and visibility capabilities in the supply chain (especially from the shipment point of view). That is, if the supply chain performance is more transparent and in case tracing is facilitated, Supply Chain Management develops in a more mature manner.

Besides investigating the dimensions of the maturity of supply chain management and the relevant approaches in the field under investigation, there are different designations employed by maturity models for maturity levels. Table 3 shows the diverse terminologies used for maturity levels.

Table 3. Levels nomenclature in maturity SCM models

Author(s)	Number of levels	Names of levels
Lockamy, McCormack (2004)	Five (5)	Ad Hoc, Defined, Linked, Integrated, Extended
Leem, Yoon (2004)	Four (4)	Initial, Readiness, Appropriate, Customer-Oriented
IBM (2005)	Five (5)	Static supply chain, Functional excellence, Horizontal integration, External collaboration, On-demand supply chain
Aberdeen Group (2006)	Three (3)	"shipment tracking capability", "supply chain disruption management" and "supply chain improvement"
Jaklic et al. (2006)	Five (5)	Ad hoc, Defined, Linked, Integrated, Extended
Pache, Spalanzani (2007)	Five (5)	intra-organizational, inter-company collaboration, extended inter-organizational, multi-chain, social
Garcia (2008)	Five (5)	Undefined, Defined, Manageable, Collaborative and Leading
SCM-CMM (2010)	Five (5)	Ad Hoc, Initial, Defined, Extended, and Network
Accenture (2012)	Four (4)	focused on tasks & business units, focused on efficiency (cost), demand-driven, value-driven
Fischer et al. (2016)	Three (3)	SC reactive, proactive, and paradigmatic
Gustafsson et al. (2019)	Three (3)	corpus, virtusize and volumental

Executive and managerial considerations

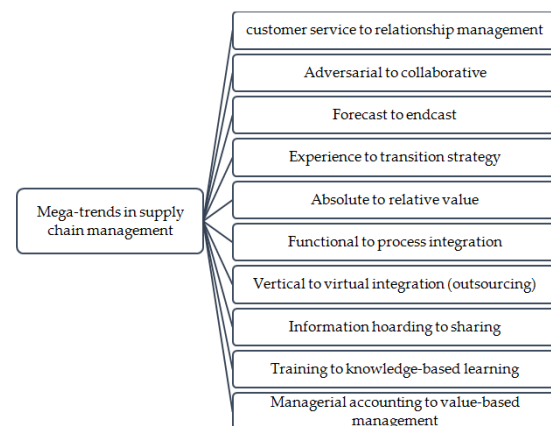
The results of this study might provide assistance in directing students' research programs and improving managers' insights. In their practices, by studying and analyzing the maturity models of supply chain management, certain topics are highlighted. There are different targets set in the field. Some of these targets are cost reduction, supply chain integration, increasing customer satisfaction, enhancing flexibility/agility, embedding sustainability into supply chains, removing waste from supply chains (Leanness), and upgrading supply chain technologies. Further, the results of the present survey indicate that the published works are not sufficiently rich and more robust research is called for to bridge the gaps in the realm of SCM maturity.

The following mega-trends might prove useful to practicing and would-be managers. They need transitions from Bowersox et al. [2000]:

- Customer service to relationship management
- Adversarial to collaborative relationships (arm's length to partnership)
- Forecasting to endcasting in demand management
- Experience to transition strategy
- Absolute to relative value
- Functional to process integration
- Vertical to virtual integration (outsourcing and e-SCM)
- Information hoarding to sharing

- To knowledge-based learning
- Managerial accounting to value-based management

Figure 10 provides a schematic impression of these mega trends.



Source: the author's own work

Fig. 10. Mega trends in SCM

GAP ANALYSIS IN THE EXAMINED WORKS AND CONCLUDING REMARKS

Besides the prospective research work trends referred to above, other areas in the field of SCM, e.g. supply management and distribution management, will witness a plethora of published work. Moreover, strategic characteristics of the supply chain, like leanness, agility and resilience, will be the pivotal issues in future research work on the

maturity of supply chain management. In this regard, Fischera et al. [2016] can be cited as an example of research specifically aiming to investigate the maturity of supply chain flexibility. Table 4 shows a gap analysis in the research works explored.

It should be remembered that there exist many gaps in research works in the field under

study. That is, more investigation is required on the issue of supply chain management in order to achieve the desired goals; the present era is characterized by chaotic conditions and a turbulent environment, and so organizations should set high levels of maturity as the defined targets in their supply chain management.

Table 4. Gap analysis in works surveyed

Researches	Focus Areas	Cost reduction	SC FLEXIBILITY	SC integration - Collaboration (SRM)	SC integration (CRM)- customer satisfaction	SC agility	SC visibility & traceability	Value driven SC	SC sustainability	SC leanness	ERP - IT-based SCM	Inventory management	Return (reverse logistics)	Concurrent engineering	Environmental protection
Hanson, Voss (1995)										*				*	
Lambert, Cooper (2000)					*								*	*	
Bowersox et al. (2000)				*	*										
Van Landeghem, Persoons (2001)				*										*	
Lockamy, McCormack (2004)												*			
Leem, Yoon (2004)					*										
IBM (2005)				*	*										
Daozhi et al. (2006)			*												
Aberdeen Group (2006)							*								
Jaklic et al. (2006)				*	*										
Pache, Spalanzani (2007)				*	*										
Lahti et al. (2009)				*	*										
Accenture (2012)								*							
Hameri et al. (2013)										*					
Huang, Handfield (2015)				*	*						*				
Fischer et al. (2016)			*												
Ho et al. (2016)				*											
Sarkar et al. (2016)		*													*
SARTORI, FREDERICO (2017)			*												*
REEFKE, SUNDARAM (2018)									*						*
ASDECKER, FELCH (2018)							*				*				
SCHNIEDERJANS ET AL. (2019)							*				*				
KAMILARIS, ET AL. (2019)							*				*				
AZZI ET AL. (2019)							*				*				
Gustafsson et al. (2019)							*				*				

As can be seen, supply chain management is rapidly shifting toward e-SCM. In fact, new and advanced information and communication technologies such as blockchain are expected to play an important role in future developments [Asdecker, Felch 2018, Schniederjans et al. 2019, Kamilaris et al. 2019, Azzi et al. 2019].

Also, more serious attention will be paid to the issue of supply chain sustainability. As there are severe constraints in available resources (from an economic viewpoint), social responsibilities are becoming more important and there is a need to safeguard the living environment, supply chain sustainability is expected to be the key approach in future research work [Reefke, Sundaram 2018].

As a final word, supply chains might need to provide a combination of such strategic features as leanness, agility, resilience, sustainability, integration, greater and more effective use of information and communication technologies (ICTs), a movement toward e-SCM, green and reverse logistics and other such relevant issues. Combining these strategic features may provide an effective idea/solution for developing a comprehensive paradigm for supply chain management maturity models.

ACKNOWLEDGMENTS AND FUNDING SOURCE DECLARATION

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

- Asdecker B., Felch V., 2018. Development of an Industry 4.0 maturity model for the delivery process in supply chains, *Journal of Modelling in Management*, 13, 4, 840-883, <http://doi.org/10.1007/978-3-319-67383-7-10>
- Azzi R., Chamouna R.K., Sokhn M. 2019. The power of a blockchain-based supply chain, *Computers & Industrial Engineering*, 135, 582-592, <http://doi.org/10.1016/j.cie.2019.06.042>
- Baraniecka A., Jajko-Siwiek A., Szuster M., Szymczak M., Wieteska G. 2017. Relativism in the Approach to Managing Supply Chain Maturity, *Procedia Engineering*, 182, 50-57, <http://doi.org/10.1016/j.proeng.2017.03.113>
- Bowersox D.J., Closs D.J., Stank T.P., 2000. Ten mega trends that will revolutionize supply chain logistics, *Journal of business logistics*, 21, 2, 1-16.
- Daozhi Z., Liang Z., Xin L., Jianyong S., 2006. A New Supply Chain Maturity Model With 3-Dimension Perspective. *Information Technology and Innovation Conference*, Hangzhou, <http://doi.org/10.1049/cp:20061046>
- Fischer J., Thomé A., Scavarda L.F., Hellingrath B., Martins R. 2016. Development and application of a maturity measurement framework for supply chain flexibility. *Fischera J., Thomé A., Scavardab L.F., Hellingratha B., Martinse R., Procedia CIRP*, 41, 514-519, <http://doi.org/10.1108/14637159510798220>
- Garcia H., 2008. A Capability Maturity Model to Assess Supply Chain Performance, Florida Int. University (Dissertation).
- Garcia H., 2008. A Capability Maturity Model to Assess Supply Chain Performance. *FIU Electronic Theses and Dissertations*.191 <http://digitalcommons.fiu.edu/etd/191>
- Goblet Ch., 2012. How to understand and use the key drivers and trends in today's pharmaceutical market? *Accenture Management Consulting*.
- Aberdeen Group, 2006. The supply chain visibility roadmap – Moving from vision true business value.
- Gustafsson E., Jonsson P., Holmström J. 2019. Digital product fitting in retail supply chains: maturity levels and potential outcomes, *Supply Chain Management: An Int. Journal*, <http://doi.org/10.1108/SCM-07-2018-0247>
- Hameri A.P., McKay K.N., Wiers V.C., 2013. A maturity model for industrial supply chains, *Supply Chain Forum: An Int. Journal*, 1, 14, 3, 2-15, <http://doi.org/10.1080/16258312.2013.11517317>
- Hanson P., Voss C., 1995. Benchmarking best practice in European manufacturing sites, *Business Process Re-Engineering & Management journal*, 1, 1, <http://doi.org/10.1108/14637159510798220>
- Ho D., Kumar A., Shiwakoti N. 2016. Maturity model for supply chain collaboration: CMMI approach, *Int. Conference on Industrial Engineering and Engineering Management*, <http://doi.org/10.1109/IEEM.2016.7797996>
- Huang Y., Handfield Robert. 2015. Measuring the benefits of ERP on supply management maturity model: a big data method, *Int. Journal of Operations & Production Management*, 35, 2 – 25,

- <http://doi.org/10.1108/IJOPM-07-2013-0341>
- Jaklic J., Trkman P., Groznic A. 2006. Enhancing lean supply chain maturity with business process management, *Journal of information and organizational sciences*, 30, 2
- Kamilaris A., Fonts A., Prenafeta-Boldó F.X., 2019. The Rise of Blockchain Technology in Agriculture and Food Supply Chains, *Trends in Food Science & Technology*, <http://doi.org/10.1016/j.tifs.2019.07.034>
- Lahti M., Shamsuzzoha A.H.M., Helo P., 2009. Developing a maturity model for Supply Chain Management, *Int. J. Logistics Systems and Management*, 5, 6, 654–678, <http://doi.org/10.1504/IJLSM.2009.024796>
- Lambert D.M., Cooper M.C., 2000. Issues in supply chain management, *Industrial Marketing Management*, 29, [http://doi.org/10.1016/S0019-8501\(99\)00113-3](http://doi.org/10.1016/S0019-8501(99)00113-3)
- Leem C., Yoon Y., 2004. A maturity model and an evaluation system of software customer, *Industrial Management & Data Systems*, 104, 4, 347-354, <http://doi.org/10.1108/02635570410530757>
- Lockamy A., McCormack K., 2004. The Development of a Supply Chain Management Process Maturity Model Using the Concepts of Business Process Orientation, *Supply Chain Management: An Int. Journal*, 9, 4, <http://doi.org/10.1108/13598540410550019>
- Lockamy A., McCormack K., 2013. The Effect of on Supply Chain Performance: An Empirical Study, 1st Annual Int. Interdisciplinary Conference (Aiic), Azores, Portugal.
- Netland T.H., Alfnes A., Fauske H., 2007. How Mature Is Your Supply Chain?– A Supply Chain Maturity Assessment Test, EurOMA Conference, Ankara, Turkey.
- Pache G., Spalanzani A., 2007. La gestion des chaines logistiques multi-acteurs: perspectives strategiques, Ed. PUG. [Management of logistics chains by multistakeholders, strategic perspective].
- Radosavljevic M., Barac N., Jankovic-Milic V. 2016. Supply chain management maturity assessment: challenges of the enterprises in Serbia, *Journal of Business Economics and Management*, <http://doi.org/10.3846/16111699.2016.1191038>
- Reefke H., Sundaram D., 2018. Sustainable Supply Chain Management: Decision Models for Transformation and Maturity, *Decision Support Systems*, <http://doi.org/10.1016/j.dss.2018.07.002>
- Sarkar B., Ganguly B., Sarkar M., Sarla P., 2016. Effect of variable transportation and carbon emission in a three-echelon supply chain model, *Transportation Research Part E*, 91, 112–128, <http://doi.org/10.1016/j.tre.2016.03.018>
- Sartori J., Frederico G., 2017. Maturity and Conceptual Dimensions of Supply Chain Management: Establishing a Structural Model, *Global Journal of Management and Business Research*.
- Schmidt C.G., Wagner S.M.. 2019. Blockchain and supply chain relations: A transaction cost theory perspective, *Journal of Purchasing and Supply Management*, <http://doi.org/10.1016/j.pursup.2019.100552>
- Schniederjans D.G., Curado C., Khalajhedayati M., 2019. Supply chain digitisation trends: An integration of knowledge management, *Int. Journal of Production Economics*, <http://doi.org/10.1016/j.ijpe.2019.07.012>
- IBM Business Consulting. 2005. Follow the leaders – Scoring high on the supply chain maturity model, IBM.
- Sun H., Ren Y., Yeo K., 2005. Capability Maturity Model for Supply Chain Management, Int. conference on Management Science and Applications, Chengdu, China.
- Supply Chain Council (SCC), 2012. The Supply Chain Operations Reference (SCOR)-Ver.11, Texas.
- Van Landeghem R., Persoons K., 2001. Benchmarking of logistical operations based on a causal model, *Int. Journal of Operations & Production Management*, 21, 1/2, 254-267,

<http://doi.org/10.1108/01443570110358576>

Varoutsas E., Scapens R.W., 2015. The governance of inter-organisational relationships during different supply chain maturity phases, *Industrial Marketing Management*,

<http://doi.org/10.1016/j.indmarman.2015.01.006>

Wendler R., 2012. The maturity of maturity model research: A systematic mapping study, *Information and Software Technology*, <http://doi.org/10.1016/j.infsof.2012.07.007>

DOJRZAŁOŚĆ ZARZĄDZANIA ŁAŃCUCHEM DOSTAW: PRZEGLĄD LITERATURY W KONTEKŚCIE MODELI, WYMIARÓW ORAZ UJĘCIA TEMATYKI

STRESZCZENIE. Wstęp: Ostatnio zagadnienie dojrzałości organizacji pojawia się jako koncepcja w wielu różnych obszarach tematycznych, np. w obszarze zarządzania łańcuchem dostaw (SCM). Prezentowana praca jest próbą przeglądu rozwiązań w zakresie zarządzania łańcuchem dostaw w okresie ostatnich dwudziestu lat. W obszarze dojrzałości SCM istnieje wiele modeli, wymiarów oraz podejść stosowanych dla pomiaru tej dojrzałości.

Metody: W prezentowanej pracy poddano analizie różne materiały naukowe, obejmujące artykuły z konferencji naukowych, artykuły publikowane w czasopiśmie naukowych jak i raporty techniczne. Dokumenty, które poddano analizie, pochodzą z okresu od wczesnych lat 90-tych zeszłego stulecia do chwili obecnej (2019). W pracy zaprezentowano również metody, wymiary oraz podejścia stosowane wcześniej dla pomiaru dojrzałości SCM. Zidentyfikowano luki w prowadzonych wcześniej badaniach, poddano je analizie i dyskusji.

Wyniki: W wyniku przeprowadzonej analizy, uszeregowano różne wymiary w odpowiednie kategorie. Praca ma na celu zaprezentowanie przeglądu literatury w celu wykrycia luk badawczych i dostarczenie w ten sposób pomocy naukowcom dla dalszych badań w obszarze dojrzałości SCM. Istnieje wiele różnych podejść do modeli dojrzałości łańcucha dostaw. Jedne modele koncentrują się na jego spójności, podczas gdy inne na przejrzystości łańcucha dostaw i możliwości śledzenia poszczególnych operacji. W najnowszych badaniach, więcej uwagi jest poświęcone takim obszarom łańcucha dostaw jak elastyczność i zrównoważony rozwój. Wyniki pracy wskazują na luki badawcze w określonych obszarach, które wymagają dalszych badań. Dodatkowo, materiały prezentowane w pracy pozwalają na stworzenie bardziej wszechstronnych modeli dojrzałości SCM.

Wnioski: Na podstawie uzyskanych wyników można wyraźnie zaobserwować trend w zarządzaniu łańcuchem dostaw w kierunku e-SCM oraz innych technologii jak blockchain. Równie istotny jest zrównoważony rozwój organizacji. Należy też wspomnieć, że także inne strategiczne cechy łańcuchów dostaw, jak szczupłość, zwinność, odporność, zintegrowanie, zielona logistyka, itd., odgrywają istotną rolę w tym obszarze. Połączenie tych strategicznych cech może być efektywną ideą stworzenia bardziej wszechstronnych modeli dojrzałości SCM. Uzyskane wyniki wskazują, że pożądane są dalsze badania w celu pokrycia istniejących luk w obszarze dojrzałości SCM.

Słowa kluczowe: dojrzałość organizacji, zarządzanie łańcuchem dostaw, dojrzałość łańcucha dostaw, model dojrzałości, przegląd literatury

Mohsen Cheshmberah ORCID ID: <https://orcid.org/0000-0003-3282-1527>

Malek Ashtar University of Technology

Faculty of Industrial Engineering

Department of Industrial Engineering

Isfahan, Iran

e-mail: mcheshmberah@mut.ac.ir

e-mail: mcheshmberah66@gmail.com

Safoura Beheshtikia ORCID ID: <https://orcid.org/0000-0002-5863-7974>

Isfahan University of Technology

Researcher in Management Field

Isfahan, Iran

e-mail: sbeheshtikia@gmail.com