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Defining Supply Chain Management: In the Past, Present, and Future

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The article titled "Defining Supply Chain Management" published in 2001 in the Journal of Business Logistics has been cited over 4,900 times in the last 17 years. In this paper, we first provide a historical review of how the article originated and the contributions the article made to both the theory and practice of supply chain management (SCM). Next, we highlight the key market and technological changes that have emerged in SCM followed by how the theory proposed in the 2001 article can still be relevant to support SCM research and practice going forward. We also propose ways of configuring a supply chain and partnering across companies to serve customers in an optimal way. We conclude with a call for research on developing new frameworks to better describe, explain, predict, and shed light on the evolving nature of SCM.

Keywords: supply chain management; customer centric; personalization; blockchain; additive technology; data science; sustainability

INTRODUCTION

In the late 1990s, as information technology capabilities improved, there was a greater adoption of supply chain management (SCM) practices, such as sharing demand information along the supply chain to reduce inventory in many Fortune 500 companies. As SCM gained popularity, there were several academic articles as well as practitioner articles that extolled the benefits of SCM, and some even attempted to define the term SCM but they were inconsistent. It was during this time that the article titled "Defining Supply Chain Management" was written in an attempt to shed light on the nature of supply chain management by better describing, explaining, and predicting the phenomenon. As of November 1, 2018, "Defining Supply Chain Management" published by the *Journal of Business Logistics* (JBL) in 2001 was cited over 4,925 times. We appreciate the JBL editorial team giving us the opportunity to reflect on our article and to discuss the continued relevance of "Defining Supply Chain Management" in light of the many changes that have happened since 2001.

As business academics, many of us believe it is our duty to provide theoretical frameworks for emerging business phenomena so that managers can better understand, predict, and control issues arising out of new phenomena in the market. The phenomenon of SCM was at a crossroad in the late 1990s when companies realized that normative statements about supply chain written in 1950s (e.g., Forrester 1958) needed to be adapted in the era of increased global competition. The SCM phenomenon is once again at a crossroad in the age of Industry 4.0 (or the Fourth Industrial Revolution) with the rapid development of information-led technologies. In this context, Zinn and Goldsby (2017b) suggest that theory building should not be separate from the substance of the phenomenon of our interest when it is scant and/or dispersed in the field. Therefore, as was the case when we wrote "Defining Supply Chain Management" we discuss the changing as well as unchanging nature of SCM and based on the ever-changing market we attempt to project the future of SCM.

In presenting the relevance of "Defining Supply Chain Management," we first introduce the historical review of our study. We then discuss the contributions our 2001 JBL article made to theory and practice of SCM. Next, we delve into the environmental changes surrounding SCM. And finally, we suggest that aspects of our article can still provide a relevant framework to support SCM research and practice.

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HISTORICAL REVIEW OF "DEFINING SUPPLY CHAIN MANAGEMENT"

The later part of the 1990s is remembered as the time when the use of the terms supply chain and supply chain management rose to prominence. Accordingly, supply chain faculty and Ph.D. students in the University of Tennessee's (UT) Marketing, Logistics, and Transportation (MLT) department, and those in similar academic departments around the world were studying industry trends and identifying research opportunities related to SCM.

Research team

The research leading to the article "Defining Supply Chain Management" was initiated by the late Dr. John T. (Tom) Mentzer, who had the Harry and Vivienne Bruce Chair of Excellence in Business and the Chancellor's Professor at the University of Tennessee. Long recognized as a prolific researcher in both marketing and logistics disciplines with over 180 publications, Dr. Mentzer was an early advocate for improving the explanation of supply chain management. As part of his efforts, Tom formed a research team called "The Supply Chain Research Group" that consisted of logistics and marketing Ph.D. students at the University of Tennessee.

The team's make-up was unique in their scope and depth of experience that included individuals who had previously held senior level management positions at medium-sized firms and Fortune 500 organizations. The professional experiences of team members extended to business consulting, engineering, logistics, marketing, purchasing, and transportation, which were very useful in the vigorous and challenging discussions that led to the holistic framework offered in the 2001 article.

Research background

The late 1990s was characterized by a greater drive toward globalization and a shift in market power from manufacturers to retailers. Customers along the supply chain came to expect "more benefits for less money" (i.e., increasing customer value). They also required higher degrees of customization to fit their unique needs and wants. Globalization meant increased competition as the distances between product source and market consumption grew geographically in search of higher quality or lower cost.

As competition in the midst of globalization intensified, companies employed a variety of strategies to adapt to changing market demands including: (1) personalizing product features with the input of the end-customer, (2) providing additional packages with the standard product, (3) customizing core differentiating element of the product for different customer segments, (4) reformulating the product per end-customer need under an identical brand (cf. Gilmore and Joseph Pine 1997). Common across these approaches to customization was a heightened need for interfunctional coordination within the firm. Sales and marketing demanded input more frequently from research & development, engineering, logistics, and even production, both within a firm and across firms, in order to learn and respond to individual end-customers' unique requirements. For example, a snack food company collaborated with its retailer partners to coordinate activities between sales and production, customizing the packaging to accommodate different end-customer demands (Gilmore and Joseph Pine 1997).

Requirements for global sourcing and marketing increased supply and demand uncertainty involving lead time and quality due to spatial, temporal, and cultural distances. To keep ahead of competition in global markets, companies sought to integrate the upstream and downstream flows of products, services, information, and finance across supply chain partners. Organizations started to visualize the entire supply chain (both downstream toward end-customers and upstream toward raw material suppliers) and the potential benefits through a division of labor based on each other's core competence in attempts to maximize customer value. Thus, companies relied more on supply chain partners including end-customers and shifted their strategy toward coordinating functional activities not only within individual companies but across companies within a supply chain (Kotler 1997; Min and Mentzer 2000). Dell Computer's "Direct Model" exemplifies how firms moved away from "do-it-all mentality" to virtual integration (i.e., supply chain management)—dividing up customer value activities among supply chain partners before reintegrating the activities through an extant process among the partners. Dell organized and coordinated its customer value delivery process with its partners as though they belonged to the same company (Magretta 1998a). Dell's manufacturing model offered online customers a way to mix and match different components of a computer based on Dell's base models. Customers could define their own customized computer that would be assembled and delivered directly to their doorsteps. The similar core elements of Dell's own SCM model can also be found in Li & Fung's "Dispersed Manufacturing" model through which Li & Fung and its global partners deliver sophisticated and trendy products fast on a global scale (Magretta 1998b). As such, SCM in a global environment enabled mass customization with higher quality within a shorter lead time, ultimately maximizing customer value.

Extending enterprise resources on a global scale requires trust and commitment among supply chain partners, the building and maintaining of which are supported by ever-advancing information and communication technologies. Specifically, the Internet started to play a more significant role in helping companies share information along the supply chain to respond to changing demand and supply conditions and to make informed decisions based on inventory visibility. Supply chain activities started to be monitored and managed tier-by-tier (e.g., a focal company managed relationships with its immediate suppliers and customers while its immediate partners managed the relationships with its partners in the next tier, and so on) and resulted in improvements in operational efficiency and effectiveness.

In late 1990s, however, theory development for SCM lagged behind advancements in supply chain practices, and therefore, SCM knowledge existed in fragments, hindering a large-scale adoption of SCM by companies of different shapes, sizes, and industries. Academia was challenged to explicitly define the phenomenon and develop frameworks to explain SCM, subsequently prompting further research. Scholars began to explore a unified definition, scope, and boundary of SCM that would offer a means to coalesce future research programs around a single integrated model (cf. Lejeune and Yakova 2005; Frankel et al. 2008). The need for such a unified definition and framework led to the development of the "Defining Supply Chain Management" article.

Research contributions

The goal of the Supply Chain Research Group at the University of Tennessee was to develop a theory of supply chain management that drew from existing theoretical views, and more importantly, incorporated insights from practice. We started by reviewing most, if not all, of the existing literature that had the words "supply chain" in the title. To ground our research in practice, we performed 28 interviews with executives and high ranking managers from 20 companies who were involved in SCM practices. Our goal was to understand the prevailing views of what SCM is, how it is being performed, as well as preconditions and expected outcomes of it.

Based on the field interviews and literature review, we defined SCM as "...the systemic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." Our research also led us to outline a separate phenomenon we termed "Supply Chain Orientation (SCO)," which we defined as "...the recognition by an organization of the systemic, strategic implications of the strategic and tactical

activities involved in managing the various flows in supply chain," and posited SCO as a major antecedent of SCM.

Our study played a pivotal role in the advancement of academic research in the field of SCM as evidenced by the many citations found in the major SCM-related journals, for example, Journal of Business Logistics, Journal of Supply Chain Management, Journal of Operations Management, International Journal of Physical Distribution and Logistics Management, and International Journal of Logistics Management. According to articles of the above-mentioned journals, our study contributed to the body of knowledge in the following manner:

1 We identified a major source of confusion about defining SCM: researchers and practitioners referenced a range of different phenomenon in describing SCM. Therefore, we separated the different aspects of SCM to delineate and label them differently as "supply chain," "supply chain management philosophy," "supply chain orientation," and "supply chain management," respectively (cf. Gammelgaard 2004; Svensson 2004; Charvet et al. 2008).
2 By demarcating the related but different meanings of supply chain management, we helped scholars expand their inquiries into the nature of SCO and gain a better understanding of the relationship between a firm's SCO and organizational performance (cf. Stank et al. 2012). Our definition of SCO also encouraged scholars to refine, test, and extend the concept of SCO, as well as to theorize and test causal models of SCO.
3 Giunipero et al. (2008) argued that no other SCM definitions were as encompassing as ours. Similarly, Ellinger et al. (2011) suggested that our conceptualization of SCM allowed seeing SCM as an inherently holistic process that entails the management of multiple interdependent entities. Carter et al. (2007) also stated that our definition of SCM corresponds to the increased emphasis on a broader view of SCM. Therefore, our definition of SCM has served well as a guiding definition of SCM in future research (cf. Larson et al. 2007; Giunipero et al. 2008; Brockhaus et al. 2013).
4 We discussed SCM at a strategic level, apart from the operational level so that scholars and managers could recognize the strategic importance of SCM to obtain a competitive advantage in the midst of globalization and time- and quality-based competition (cf. Stank et al. 2005; Thomas 2008; Richey et al. 2010). Dealing with SCM at a strategic level not only helps to guide companies in (re)designing corporate culture, processes, organizational structure among others, but also recognizes the generalizable impact of SCM on business performances.
5 Authors (cf. Cheng and Grimm 2006; Zokaei and Hines 2007; Mackelprang et al. 2014) acknowledged that our conceptual endeavor commanded a paradigm shift in which all firms within a supply chain and all the functions within a firm integrate their processes and systems to develop innovative approaches to add value toward customer satisfaction.

WHAT HAS HAPPENED SINCE "DEFINING SUPPLY CHAIN MANAGEMENT"

As expected, in the intervening 17 years since we published "Defining Supply Chain Management," market environments (business, political, environmental, social, etc.) have continued to change. Below we briefly discuss the market and technology evolutions that have brought about recent changes in supply chain practices.

Market trends

Channel power has shifted even more toward the end-customer in the increasingly global economy. More frequently, customers demand not only improvements in product and service benefits but also reductions in price. First, shifting end-customer preferences toward ever more unique offerings coupled with technological innovation have required companies to come up with new ways to accommodate such personalization needs.

Second, customers have come to seek satisfaction in their entire shopping experiences or "customer journey" that involve the steps they go through in engaging with the company in terms of product, service, purchasing, after sale service, or any combination (Richardson 2010). According to Richardson (2010), the consumer journey starts with experiencing advertising or a store visit, then product purchase and use, followed by sharing about the experience with others, and finally upgrading, replacing, or choosing a competitor (i.e., starting a new journey with another company). In addition, customers demand the same level of convenience and availability across different channel options—either online or offline, via direct or indirect channels. When the expected product value is not realized, end-customers demand an instant, convenient means of return and refund.

Third, customers are starting to borrow and experience products rather than own them as they perceive satisfaction not through buying products, but through experiencing them. Referred to as a sharing, access, or on-demand economy (cf. Pine and Gilmore 1998; Moatti 2015; Eckhardt and Bardhi 2017; Gesing 2017), customer preference for short-term access to products over actual ownership is becoming more prevalent. For example, customers rent dresses and everyday clothes from companies such as Rent-The-Runway, which has about 10 million customers who use the company service 120 days per year on average, and subscriptions of which have been growing over 150% annum (Ackerman 2018). In experience-oriented consumption, consumers are less concerned with brand names and more with the intermediaries' capability to manage inventory availability and provide timely service throughout their experience.

Lastly, customers are also concerned about the impacts of their entire consumption experiences on their economic well-being, personal well-being, and more recently on the well-being of the society and the environment. They are more aware of breakdowns that occur upstream in a supply chain and the implications of them on their well-being, for example, outbreaks of illness (e.g., Chipotle's E Coli contaminated food), and injury (e.g., Mattel's lead paint toys, suicides at a Chinese iPhone manufacturer). Customers' supply chain concerns therefore require companies to offer ecologically friendly, ethically desirable, and fashionably up-to-date products (i.e., sustainable products).

Technological advances

A range of new and existing technologies are dramatically changing the business environment since we published "Defining Supply Chain Management." Examples of new technologies that

may affect the supply chain practices include the Internet of Things (IoT), data science (better known as big data and artificial intelligence or AI), blockchain, additive manufacturing (better known as 3D printing), and robotics among others. Waller and Fawcett (2013, 2014) claimed that the above-mentioned technologies are not simply buzzwords, but are actual phenomena that have become relevant to SCM. While these technologies seem separate, they are frequently interconnected.

The core of IoT is interconnectivity via Internet technologies across devices and users throughout the supply chain (customers, suppliers, etc.; Kranz 2017). The implementation of IoT requires open technology architecture, apart from proprietary systems and open organizational structure, away from organizational silos through which captured data are shared across expanded supply chains whenever possible.

Although big data and AI technologies are still in the early stage of adoption, they have begun impacting many functional activities in supply chain. By incorporating customer and operations data, these technologies can create capabilities that give companies new competitive edges. However, data need to be standardized in a format to be shared across functional and organizational boundaries in a data-driven culture to realize the data-driven capabilities (Sanders 2016; Davenport and Bean 2018).

Blockchain is another technology that has the potential to have a significant impact on supply chain practices. Blockchain will provide a means for companies to digitally encode and store transaction records in transparent, shared databases protected from deletion, tampering, and revision (Iansiti and Lakhani 2017). To this day, a typical supply chain spends significant time and efforts in verifying all the transactions that occur as value is added along the supply chain from raw material supplier to end-customer. Blockchain technology has the potential to significantly reduce the need for verification, thereby increasing the efficiency of SCM. Blockchain-based supply chain enables transparency in business culture where companies are more frequently recording transactions that are subsequently shared within and across companies along a supply chain for the purposes of improving functional coordination, interfirm cooperation, and eventually service quality.

3D printing is a method of building three-dimensional solid objects by layering materials in successive patterns as found in conventional manufacturing (Kückelhaus and Yee 2016). 3D printing consists of developing a digital model of the object through design software before feeding material through the printer which builds the final object layer by layer. 3D printing has been mainly used to build product prototypes with plastics as its primary feeder material. As new technologies such as laser sintering that enabled the use of special metals in 3D printing, 3D printing is now considered a potential option in low volume and customized production with speed. 3D printing also suggests a new supply chain design option whereby customers customize or personalize orders online, and manufacturers can produce the product in nearby factories and deliver the product to the customer in a very short cycle time (Sodhi and Tang 2017).

While the vision of robotics has a historical relevance from centuries past, the invention of computer integrated circuits and programming led to the rapid development and adoption of robotics technologies in the mid-twentieth century (Siciliano and Khatib 2016). The repetitive nature of tasks found in manufacturing operations such as automotive assembly has perhaps been the most visible area of robotics application as part of supply chain operations. The 2012 acquisition of Kiva Systems by Amazon brought even more attention to the potential contribution of robotics technologies in warehouse picking and packing. Recently, the combination of more powerful computer processors, the capture of detailed data via IoT and the employment of AI has spurred faster development and adoption of robotics in areas where process steps are not so clearly defined, leading to potential improvements in supply chain planning, execution, and control.

The influence of market and technological changes

Past editors (Waller and Fawcett 2014) and present editors of JBL (Goldsby and Zinn 2016) uniformly suggested that market and industry structure may lead companies to adopt disruptive technologies such as additive technology and IoT, which in turn together cause major changes in supply chains including the need for organization and infrastructure designs and skills to manage them. Therefore, it is necessary to start our discussion with the influences the market changes have on SCM. Zinn and Goldsby (2017a) argued that supply chains are becoming ever more customer centric to provide customers with an increasing number of product and service assortments. Consequently, it becomes essential for managers to develop the capabilities to sense shifting patterns in customer preferences and subsequent demand changes and to respond to the customers evermore demanding and sophisticated requirements at a nearly individual level.

Concerning the influences that technological changes may have on SCM, Mooney et al. (1996) proposed order of changes in creating business value that are driven by the adoption of technological changes (e.g., information technology). First-order changes are incremental in nature and result mainly from: (1) the automation of particular operational processes (i.e., automational effect) and/or (2) the availability of information for better decision making, control, and coordination (i.e., informational effect) in operational processes in a company. Second-order changes are innovative in nature in that they facilitate automating not only operational but also managerial processes and generate rich information about operational processes. In the second-order change, the automational and informational effects reinforce with each other to create synergistic effects. Finally, third-order changes are transformational in nature because it helps a company develop new capabilities and new ways of doing business. With the advancement of the Industry 4.0 or the Fourth Industrial Revolution, once fragmented but related technologies converge into systems or business models—for example, smart factory and anticipatory shipping—giving transformational effects to supply chain practices.

First, the potential for true mass customization or personalization is growing thanks to technological innovations. IoT is capturing larger volumes of product- and market- related data from source to consumption and, again, back to source. Advances in AI processing are helping to present information that reflects market demand and specific customer requirements. Once customer preference and demand changes are captured and analyzed, new manufacturing and distribution technologies, notably 3D

printing and robotics, become more actionable and applicable in customization and even personalization of product/service.

Second, being consumer-centric means focusing on your customers and serving them in holistic ways, providing universal customer experiences in any stage and shopping channels for customer consumption. The core idea of burgeoning omnichannel strategy is to provide customer service seamlessly across different shopping channels—retail customers are able to experience the same level of customer service via direct vs. retail channel, online vs. offline, or mobile vs. internet-based channels. For example, retail customers may want to browse products at a bricks and mortar store, order a product at an online store, pay for it at another store, and return it to a third store with a refund coming from another store if necessary.

A basic premise with omnichannel is that no matter what channel customers visit, they should be allowed full access to information about product, price, place, and promotion, enabling the customer to make purchasing, use, and disposal decisions at their own convenience. To make certain that end-customers will obtain reliable and timely product information throughout the customer journey, companies are working on the rapid integration of the larger volume of supply chain data and are beginning to apply big data and AI methodologies to better align inventory and other resources with their supply chain partners.

The customer journey has also become bidirectional: from cradle to grave and vice versa, meaning companies must better accommodate retail customers' expectation of easy product return and refund when they are dissatisfied with the purchase. To minimize cost and maximize asset recovery under easy return and refund policies, companies are strengthening reverse logistics operations in collaboration with reverse logistics specialists, customers, and suppliers. To further address these demands from end-customers, companies are seeking to use technologies that enhance market-sensing capability and minimize inventory deployment in the first place; that is, IoT, big data, and AI are mechanisms by which companies adapt quicker to what is hot and what is not for a specific customer segment, location, and point in time, so that companies can stop deploying unnecessary products into the supply chain to minimize reverse logistics costs.

A critical success factor in implementing omnichannel strategies is the ability to gain customer trust. For example, Amazon now fulfills a majority of customer orders from its own fulfillment centers that link and take control of flows of product, service, information, and finance in every stage of its supply chain operations. The same is true for Walmart that operates distribution centers dedicated to Walmart.com operation. For the same reason, Amazon now operates almost 600 physical retail locations across the United States with their purchase of Whole Foods Market while Walmart operates Walmart.com. Therefore, the competition is not only between brick-and-mortar vs. online stores, but across both channels that is between click-and-mortar stores.

Third, recent trends in customer interests extend beyond quality and the price of products but also include the social and environmental impact of their consumption. Accordingly, customers, nongovernment organizations, and regulatory bodies alike are demanding more detailed information about the products they consume (Marshall et al. 2016). Traditionally, companies have attempted to manage supply chain quality in the means of tightened auditing, an area that has become dependent on third-party auditors or first-tier suppliers who may outsource subassembly work to lower-tier suppliers listed on an approved vendor list. This hierarchical model of quality control was devised to deal with supply chain structures that have increased in complexity. Supply bases have gradually migrated from high-cost countries to low-cost countries where transportation and communication infrastructures are underdeveloped. In contrast, external stakeholders demand more scrutiny as the quality and sustainability of the product are determined by suppliers beyond the first tier in many cases. For example, Mattel's recall crisis due to the use of lead paint in 2007 was not caused by a 1st-tier assemblers but a second-tier subcontractor hired by the first tier to deal with increasing demand. In response to growing demand, leading industrials companies including Nike, Nestlé, and Apple Computer started to disclose supply chain information both in breadth across a single tier and in depth across multiple tiers.

The demand for more sustainable supply chains and the resulting transparency raise costs, and companies are being asked to devise a balanced approach in making their supply chains sustainable. Factors important to building sustainable supply chains include sharing collaborative philosophies across the supply chain as well as monitoring first mile (e.g., farms and fishery), as well as last mile (e.g., end-customers). This means that companies should engage with lower-tier (i.e., second and/or third tier) suppliers directly, passing first-tier suppliers and/or third-party auditors whenever necessary. For example, Starbucks cooperates with coffee bean farmers in the means of Coffee and Farmer Equity (C.A.F.E.) certification, training, and even financial assistance. Another example is Honda's implementation of directed buying (i.e., designating lower-tier buyers as sources of raw materials or subassembly based on close examinations by the OEM) to control not only cost, but more importantly quality and transparency within their supply chain (Choi and Linton 2011).

The sustainable supply chain capability may be based on IT technologies, including IoT, data analytics, blockchain, along with similar technology to form the infrastructure to capture data and share information about material transformations and changes in ownership. Recently, Walmart announced that it is mandating its fresh food suppliers to start collecting information (e.g., field locations and harvest times) and uploading it to the IBM Food Trust Network, which is based on blockchain technology (Clancy 2018).

In summary, supply chain management evolves around the market changes, and technological changes have "strategic and systemic" impacts to transform the way companies manage their supply chains.

Is "Defining Supply Chain Management" still relevant?

In a recent *Harvard Business Review* article, Lyall et al. (2018) declared that supply chain management, which has been the core of a company's operations, is dead. However, looking closely into their claim, an alternative interpretation is possible: the way supply chains are managed, including how to capture and analyze data and making optimal decisions, is changing. Regardless of the drastic technological changes in SCM since we published

"Defining Supply Chain Management, the core elements of SCM are still intact.

SCM is still strategic in nature

Supply chain management is still considered an importance source of competitive advantage. An important goal of SCM has always been building new capabilities of participating companies that will enable them to have an advantage over their competitors (Asthana 2018). In this context, Gezgin et al. (2017) argued that a clear supply chain strategy aligned with strategic goals of participating companies should drive business and technical capabilities even in the digital economy. However, the core of a company's supply chain capabilities has moved from integrating forecasting, planning, and execution activities layer by layer in a supply chain to seamless data management from end to end of the supply chain thanks to the up-to-the-minute visibility (Bughin et al. 2016). In addition, companies should equip their technological ability with people management capability to fully benefit from data management (Kumar et al. 2016). Academics (e.g., Esper et al. 2010; Tate et al. 2015; Stolze et al. 2016) also agreed with us that SCM is strategic in nature. As such, although the emphasis in the type of capability building has changed, the strategic nature of SCM has not changed since we wrote the article.

The whole purpose of SCM is still to create customer value

In our paper, we proposed that customer value creation is a core driver of the entire supply chain operations. Therefore, it came in no surprise that companies have continuously focused on anticipating and quickly responding to changing customer values while the way companies have done business has evolved dramatically. In fact, in the age of Amazon- and other e-commerce platforms, the customer value creation premise has become more relevant because supply chain partners are now able to interact with their customers directly and get to know their requirements better and faster (Bughin et al. 2016). In this context, Asthana (2018) argues that the ultimate goal of SCM still is to match supply to customer demand as accurately and efficiently as possible. The major difference between now and then is that digital transformation is coming of age, making possible demand-driven supply chain models. For example, companies are now able to utilize artificial intelligence (AI) for demand anticipation rather than data mining and heuristics. Thanks to improved analytic tools, companies dare to make seemingly counter-intuitive decisions. Amazon, for example, rather than eliminating brick and mortar operations, has kept adding physical distribution facilities and delivery lockers in convenience stores close to customers for on-time delivery and convenience. It is not only online retailers but also traditionally offline retailers such as Walmart and Best Buy that go against conventional ways of last mile delivery in order to meet customer requirements efficiently: They utilize their retail stores as distribution centers and hire their store workers as delivery personnel (Myerson 2018). Similarly, Stolze et al. (2016) posit that supply chain strategies aim to balancing customer demand and supply capabilities. Therefore, companies still focus on anticipating and responding to customer demand with greater accuracy, leveraging technological innovations and subsequent changes in their supply chain designs.

SCO is still a must for a successful implementation of SCM

In the 2001 JBL article, we argued that SCO occurs within the boundary of a firm while SCM happens across firms within a supply chain. Specifically, we theorized that SCO is an internal recognition of the systemic, strategic implications of the tactical activities and processes involved in managing the various flows in a supply chain, and the resulting readiness for SCM in the form of partner selection, streamlining internal processes, changing organizational culture, and establishing a support system. In other words, SCO is a company's readiness to implement SCM outside the company within a supply chain. The internal readiness should be based on top management support (Oliver et al. 2004). Our argument that top management support is a core of SCO is still relevant because lack of and/or misinterpretation of top management support on SCM is a major obstacle of supply chain collaboration (Benavides et al. 2012). Similarly, Lago and Verma (2017) argued that it is the leadership that should drive interdepartmental coordination within a firm and interorganizational collaboration within a supply chain. Scholars like Stolze et al. (2016) also proposed that SCM is dependent on the intrafirm integration such as supply chain orientation.

Fostering trust among the trading partner network is the catalyst to providing a real end-to-end information business process view. When a company shares its resources and system with its partners based on trust and transparency, it finds its supply chain more agile and resilient than guarded supply chains (Vitasek 2016). However, trust is a company's unilateral decision toward bilateral or multilateral agreement among partners because it is conceptualized as the company's willingness to rely on its partner in whom one has confidence (Moorman et al. 1993) and, so, accompanies risk in case the focal company's assessment of trustworthiness of its potential partner turns out to be incorrect (Coleman 1990). In this context, Wieland et al. (2016) argued that trust-related issues are still hampering interfirm cooperation and integration efforts. Supply chain process design and corresponding technologies may help companies overcome the vulnerable nature of trust and even build trust. For example, Amazon's Fulfillment by Amazon (FBA) requires suppliers send their products with proper inventory information to Amazon's distribution center where customer orders are picked and delivered to the customers. A core benefit of FBA to Amazon and its suppliers is to gain their customers' trust on the reliability of their on-time delivery options. By the same token, for FBA to work efficiently, there must be trust between Amazon and its suppliers.

The core of SCM is still interorganizational collaboration

We proposed that information sharing, risk and reward sharing, cooperation, and process integration among supply chain members based on partnerships are critical elements of SCM. Nearly two decades after publishing our paper, business consultants still suggest that companies should change the way they interact with their supply chain members, moving away from arms-length relationships toward more collaborative relationships (Lago and Verma 2017). In other words, supply chain collaboration has become even more critical in this age of the digital economy. For example, in today's highly competitive markets, consumer packaged goods (CPG) manufacturers' own success still depends on the ability of the retailers to grow and excel and vice versa (Kumar et al. 2016). As a result, CPG companies increasingly

try their best to support their retailer customers in innovative ways while more retailers prefer to partner with the CPG companies that are the most willing to support their marketing and sales efforts. Consequently, companies must conduct negotiations in such a way that encourages more collaborative behaviors among supply chain partners. Scholars (e.g., Stolze et al. 2016) also proposed in the age of customer experiences, marketing event execution is still dependent on interfirm relationships through which quality information flows and performance outcomes are shared among supply chain partners.

Supply chain collaboration is essential when it comes to making a supply chain sustainable. Supply chain partners are required to jointly manage the information, people, processes, and decisions on a product throughout its entire life cycle (Marshall et al. 2016). To do so, supply chain partners should be able to manage the information, people, processes, and decisions regarding a product throughout its life cycle via collaboration across the end-to-end supply chain. The largest opportunities to improve sustainability practices is to focus on supply chains that account for 80% of a consumer business's greenhouse-gas emissions and more than 90% of its impact on environment (Bové and Swartz 2016). Accordingly, companies are willing to work with their supply chain partners to reduce environmental impact in the forms of sharing technologies and information, monitoring performances, and providing incentives (Bové and Swartz 2016). For example, Walmart has worked with its thousands of Chinese suppliers to make their facilities more energy efficient, reducing energy consumption by an average of 10% (Gezgin et al. 2017).

We posited in the 2001 article that supply chain partners should agree on goals and objectives, and share risks and rewards accordingly. Our argument still holds to be relevant to companies' sustainability fronts. Marshall et al. (2016) proposed that the sustainability philosophy shared among supply chain partners is a must to make the supply chain responsible for the environment and the society. For example, Walmart sets their sustainability goals and share those goals with its suppliers through the use of sustainability index scores, with which the company evaluates its suppliers and provide incentives to those who obtained sustainability leader status (Bové and Swartz 2016). The digital transformation of SCM is very much dependent on the setting of performance goals and measuring their success (Gezgin et al. 2017). A noticeable difference in comparison with years past is the ease of performance measurement as companies are now able to carry out deeper, and more insightful performance evaluation. Alicke et al. (2017) claimed that integrating data from suppliers and others in a "supply chain cloud" would enable all stakeholders in the supply chain to make decisions based on the same facts. Accordingly, risk and reward sharing among supply chain partners now can be considered reliable and fair.

Concerning the role of technologies in today's supply chain management, Lago and Verma (2017) insisted that technological shifts should go hand in hand with cultural shifts to maximize customer value. When companies are able to obtain real-time information about customers' wants, information itself is not a source of competitiveness. Instead, sharing and collectively responding to information about customers' personalization requirements will make a difference. In the supply chain context, the main premise of IT technology utilization is interconnectivity among supply chain partnerships (Kranz 2017). For example, Amazon has recently launched order service called "Dash button service" to order frequently used items through pressing a single button. For the Dash button service to work, it is necessary for Amazon to work closely with its suppliers like P&G and *vice versa* to build and maintain the complex and expensive infrastructure required to keep up with end-customer expectations on speed and convenience (Kumar et al. 2016; Baum et al. 2017).

In summary, SCM that emphasizes the benefit of sharing information, risk and reward sharing, cooperation, all of which based on partnering relationships are still necessary to implement a company's omnichannel and sustainability strategies. Regarding technologies, as data becomes more ubiquitous, real-time information is no longer a source of competitive advantage; instead, competitive advantage will be based on providing individualized offerings while utilizing a supply chain-wide collective interpretation of the data.

FUTURE AGENDA FOR SCM RESEARCH AND PRACTICES

Stolze et al. (2016) argued that what is needed in the market is not to ask "what is the right supply chain for companies" but "what is the right supply chain for customers." In the age of a digital and sustainability economy, it is unlikely that there is an optimal form of a managed supply chain or an ideal way of partnering across companies within a supply chain. Instead, we suggest that various ways of configuring a supply chain and partnering across companies will evolve to continue to serve customers in an optimal way.

Changes in supply chain configuration

In the 2001 JBL article, we suggested that supply chains can range from a simple direct supply chain that consists of a focal company and its immediate supplier and customer, to one that is as complex as an ultimate supply chain that includes all the parties involved in customer value delivery from raw material source to consumption. We proposed that a feasible form of a managed supply chain would be determined between a direct supply chain and an ultimate one based on the criticality of the role each company plays and the resources available to manage the supply chain. In the age of a digital and sustainable economy, however, the following factors will strongly influence the configuration of a managed supply chain: (1) the need for serving microsegments for personalized customization, (2) the emergence of additive manufacturing, and (3) the reduction in resource constraints thanks to technological advancements. First, as customer demands diversify and, at the same time, global competition intensifies, companies will develop varying degrees of personalization in the design of their product. In addition, companies will adopt an omnichannel strategy that will necessitate different forms and types of supply chains ranging from a globally extended supply chain for commodities with high volume demand to a direct supply chain for custom goods with low volume demand. Finally, supply chain will be formed not only among vertical supply chain members but also among

competitors or supply chain members in horizontal relationships (Stolze et al. 2016).

Second, additive manufacturing will likely reduce the advantages attributable to economies of scale that companies used in sourcing, production, and distribution to stay competitive, making a large-scale supply chain network or facilities less critical (Ben-Ner and Siemsen 2017). Instead, additive manufacturing will promote a more simplified supply chain structure with just three major participants—a focal firm, its immediate supplier, and customer. In addition, as transportation volume (both inbound and outbound) will decrease due to small-scale customized production needs, the role of third-party logistics (3PLs) may decrease for medium-to-high value custom products but increase for low-to-medium value products. Furthermore, additive technology may change the physical network design in that production bases may move from low-cost countries to the major markets (mostly in high-cost countries) to meet ever-changing customer service requirements (Bughin et al. 2016).

Third, blockchain technology will alter the size and configuration of supply chain relationships. In the 2001 article, we implied that companies would tend to limit the size of its managed supply chain and accordingly number of partners in the chain to minimize transaction costs (e.g., economies of scale, opportunism, intermediation, quality, etc.). However, blockchain technology may help a focal company dramatically reduce transaction costs including the needs for intermediation, and justify doing business with numerous small- and micro-size partners no matter where they are located.

Finally, recent supply chain risks and the resulting supply disruptions have made companies rethink supply chain design. When we wrote the 2001 article, companies pursued achieving a "lean supply chain" in the form of supplier rationalization and process integration where select companies took the leading role in major functional subprocesses. Today's supply chain risks such as natural disasters, trade wars, terrorism, political turmoil will likely persuade companies to redesign their supply chains to be as resilient as possible. Being resilient means setting up contingency plans with alternative supply chains. Utilizing alternative supply chains requires companies to be able to integrate and analyze market intelligence and rapidly take action to minimize the impact of a certain disruption (Culp 2013). Recent research has already highlighted that supply chains need to be redesigned by creating more resilience across the entire system rather than managing risks at a local level. It is also possible that certain types of redundancy could also reduce disruptions (Wieland et al. 2016). Such supply chain capability is made possible by constantly improving information technology. However, maintaining alternative supply chains for potential supply disruptions will be costly.

In summary, current large-scale supply chain structure for mass customization will very likely coexist with small-scale home-based supply chains for customization and personalization (Durach et al. 2017).

Changes in supply chain partnering

In the 2001 paper, we suggested partnering is the core of SCM and that the importance of partnering will likely remain unchanged. However, the ways a company interacts and manages its partnerships will change. First, an open platform enables a focal company to build and directly interact with massive customer and supplier bases, making its supply chain ever more complex. On the supply side, Amazon allows two million third-party sellers to distribute products directly in its marketplaces and Alibaba invites more than ten million small merchants to operate on its platform; many of these participating businesses are called "micro-multinationals" due to their small size and geographical base (Bughin et al. 2016). On the customer side, direct interactions between companies and their customers necessitate building trust in hopes of developing long-term relationships. In other words, regardless of the number of relationships the focal company has in its supply chain, the company does not have the luxury to give up control over the speed and quality of their supply chain processes. Clearly, having a massive number of supply chain participants does not mean close relationships are needed with all the participants; traditional arms-length relationships can still be of value in commodity and noncritical supplies.

Second, data transparency and agile decision making based on IT technologies will help companies build, maintain, and improve partnerships with a larger number of supply chain members which, in turn, further expands product and service diversity and cost reductions. For example, as micro-multinationals have and will become major parts of an open platform-based, or an additive manufacturing supply chain, a focal company may wonder if an unknown, small business from a remote part of the globe is trustworthy in delivering required quality reliably and complying with codes of conduct. Blockchain technology will enable transparency in supply chain processes by recording and verifying not only the movement and transformation of materials running through a supply chain, but also verifying credentials of the parties involved in supply chain activities (Casey and Wong 2017). In addition, automatic payment upon transaction verification by a blockchain-based system will increase the sense of risk and reward sharing among partners, which in turn will further boost interorganizational trust.

Third, the digital and sustainable economy necessitates companies to reach out to the supply chain members in lower tiers of their supply chains and build as close partnerships with them as with the members in the first tier. In the 2001 article, we also proposed a multi-echelon, hierarchical structure of a managed supply chain where a first-tier supplier manages second-tier suppliers as a cost-effective way of managing supply chain relationships. However, a hierarchical management of a supply chain may not work well or be needed in the age of digital and sustainable economy. Choi and Linton (2011) argued that a tiered approach in managing supply chain partners may lead to the risk of losing control over critical resources and information available in lower tiers. The risk may be caused by the first-tier partner's opportunistic behaviors and/or lack of supply chain visibility as the focal company moves away from lower-tier partners. In either case, this tiered approach may negatively influence cost, quality, innovation, supply chain visibility, and sustainability.

Reaching out to lower-tier partners to share supply chain information will become a norm in the near future for several important reasons. To start with, important innovation may come from lower-tier suppliers and customers beyond the first-tier partners. For example, Apple Computer's groundbreaking user interface technology came from a lower-tier supplier, who Apple

maintained direct contact with (Choi and Linton 2011). Likewise, Chinese Xiaomi, a smartphone brand, has risen as a technology powerhouse thanks to the direct contact with its highly devoted end-customers who shared product improvement ideas and spread positive reviews about the company via word of mouth (Dong and Zhang 2016).

Next, the growing pressures from nongovernmental organizations have made major global brands disclose the list of most of their suppliers across different tiers (Marshall et al. 2016). Therefore, it is necessary for companies to reach out to low tier partners to establish common goals and objectives and collaborate to fulfill them. Especially since customers see the focal company as fully responsible for supply chain risks, the focal company should not limit its managerial boundary to the immediate tier in the supply chain.

In addition, the tiered approach will not be as necessary or as relevant when the focal company has access to real-time information about the movement and transformation of materials flows via blockchain technology. If the marginal cost to add/monitor additional supply chain members in distant tiers is minimal, there is an incentive for the focal company to consider adding them to its supply chain.

Finally, when we published "Defining Supply Chain Management," the main premise of supply chain partnership was within a closed supply chain in which companies are linked by monetary exchanges. In the age of a digital and sustainable economy, the partnership will go beyond the monetary exchanges and expand to value exchanges. For example, Campbell Soup Company partnered with the Environmental Defense Fund to offer farmers help to optimize fertilizer use and improve soil conservation (Bové and Swartz 2016). Another example of going beyond simple monetary exchange is Levi Strauss teaming up with the International Finance Corporation to found a $500 million Global Trade Supplier Finance program for the purpose of low-interest short-term financing to the company's suppliers that scored high in the sustainability scorecard (Bové and Swartz 2016). As such, it is clear that the scope and boundary of supply chain partnering will likely expand as never before.

Future research questions

In this paper, we argued that the following elements of supply chain management are still relevant:

1 The strategic nature of SCM
2 Customer value creation as the whole purpose of SCM
3 SCO as an essential facilitator of SCM
4 Interorganizational collaboration at the center of SCM

Although practitioners seem to agree on the unchanged core of SCM, the specifics of each element of SCM may have changed as the currently available technologies as well as customer demographics and attributes are different now from when our paper was published. Therefore, it will be meaningful to empirically test our theory of SCM and confirm/disconfirm the argument that the very principles of SCM have not changed. In addition, investigating how supply chain strategies are being transformed by technological innovations to better support the principles of SCM will help managers retain the core value of implementing SCM.

At the same time, we proposed that there will be important transformations in ways of managing supply chains in upcoming Industry 4.0 yet to be tested, for example:

1 Coexistence of various supply chain configurations
   a Need to manage multiple supply chains for different degrees of customization
   b Importance of direct supply chain that consists of a focal company and its immediate supplier and customer linked by supply chain flows
   c Participation of small- and micro-size multinationals in supply chains
   d Coexistence of lean and resilient supply chain designs
2 New ways of supply chain partnering
   a Supply chain partnering through business platforms
   b Partnering with a larger number of micro-multinationals
   c Supply chain partnering with members in various tiers beyond immediate customer and supplier

The customer-centric supply chain strategy requires companies to understand and incorporate a customer perspective (Stolze et al. 2016). As a result, anecdotal evidence about new forms of supply chain configuration and new ways of supply chain partnering is abundant in the field. Nevertheless, we still do not know if they are isolated changes or large-scale evolution. Zinn and Goldsby (2017b) suggested that impending phenomena (e.g., the evolution in SCM as proposed in this paper) are often hard to observe directly and thus exploratory research is needed to understand, describe, and explain in depth.

CONCLUSION

We hope this article will again provide practically relevant and academically timely insights that will serve as a useful basis to rethink the way SCM is framed, implemented, and controlled. We believe research is much needed with a focus on theorizing the very nature, of market and technological changes that will transform SCM in areas such as intra- and interorganizational designs, processes, and systems that will dramatically boost customer values in the age of Industry 4.0. For example, recent articles both in practice and in academia about the roles of technological changes in managing supply chains are fragmented but very promising. What is needed now is not what those technologies can or cannot do in the course of SCM, but why these technologies are worth adapting from the perspective of customer value creation, which triggered the supply chain revolution in the beginning of this SCM journey. Supply chains are evolving as technologies, companies, end-customers, and markets all change. However, with all these changes it is clear that understanding SCM is still relevant and important going forward. We look forward to continual research on developing new frameworks to

better describe, explain, predict, and shed light on the evolving nature of supply chain management.

In closing, on behalf of all the authors who contributed to "Defining Supply Chain Management," we the current authors would again like to thank all managers and scholars who read and cited our paper. We are also grateful to anonymous reviewers and the Editors Walter Zinn and Thomas Goldsby and the editorial team for their support. We have witnessed exciting changes both in supply chain practices and SCM research in the past 17 years and we look forward to even more changes in the next 17 years.

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