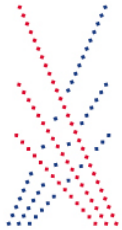

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Back to the future: Who drives the DeLorean in your supply chain?

Introduction

Supply chain management (SCM) is a concept that has gained much popularity and importance since the new millennium (Pounder et al., 2013). Ellram and Cooper (2014) found the term “supply chain management” is well over 30 years old, first appearing in the practitioner literature in 1982 (Oliver and Weber,1982). Meanwhile in 1985 Marty McFly and Doc Brown in the first movie “Back to the Future” was released in which the pair ventured time travel into past and the future in their DeLorean. Subsequently, the pair travelled to 1885, 1955 and 2015 starting from 1985 where the DeLorean could either fly or be powered with plutonium or using a steam engine according to the era. In this research the author will also venture into the past and the future of SCM to point out who are some of the different types of managers who have been in the driving seat of the “DeLorean of a supply chain”. SCM has been through many phases over time (Ellram and Cooper, 2014). There are many definitions for SCM (Pounder et al., 2013). According to Pounder et al.,(2013) the definitions for SCM have been revised over time due to the external changes in the SC such as globalisation, e-commerce, technology, recession and competition. Ellram and Cooper (2014) found that the definitions for SCM are still fluid, where according to Mentzer et al.,(2001) and Chicksand et al., (2012) pointed out that there is not an agreed upon definition for SCM. Moreover, Mahadevan (2017) found that there is an apparent lack of a single theory that explains SCM: it needs a number of theories such as RBV (Resource Based View), TCA (Transaction Cost Analysis) and NT (Network Theory) to explain the concept. Sandberg and Abrahamsson (2010) pointed out that SCM as described in theory is a rare occurrence in today’s business environment (Fawcett and Magnan, 2002; Sandberg, 2007; Marien, 2007). This suggests inadequate evidence that SCM concept is an art and not a science. SCM is a relatively young discipline (Flothmann and Hoberg, 2017).

Ellram and Cooper (2014) have pointed out that are around 1.7 million articles and books written about supply chain management (SCM) since its inception in 1982. Fundamentally, it refers to the movement of products and services from one point to the customer along a pipeline. Interest in SCM has steadily increased since the 1980s when firms saw the benefits of collaborative relationships within and beyond their own

organization (Lummus et al.,1999). This suggests that researchers believe that there is room for growth in research in SCM and that the best is yet to come (Gonzalez, 2015).

Along with these external changes the different types of management mindsets managing the SC operations have also evolved. Supply chain leadership styles and competencies have metamorphasised over time (Sohal, 2013, Jordan and Bak, 2016). Gunasekaran et al., (2017) found that talent is an important element in a SC. The SC depends on smart SC managers and how they deal with people, relationships and contemporary issues. Contemporary supply chain issues include issues such as globalisation, increasing in logistics cost, greater product variety, shorter product life cycles, increase levels of risk, increased labour costs in developing countries, rapid development in information technology, sustainability and volatility of commodity prices (Gunasekaran et al., 2017).

The purpose of this paper is to review the current literature in relation to the management aspects of SC operations during the last four decades. Using the findings from the literature, the author will establish the mindsets or skills of managers that have managed SC over that time. Thus, the rhetorical question is "who owns the supply chain?"

Firstly, the author will review the existing literature. Secondly, the author uses the findings of this literature to establish the different mindsets and skills of managers and or teams who have been in charge of the SC during different eras. Next, the future of SCM is discussed. This is followed by the conclusion.

Literature Review

The analysis of this research is based on secondary data, including online databases, digital libraries, books, journals, conference papers, theses and so on. SCM research papers authored by academicians and practitioners are used from international journals. Moreover websites, namely PROQUEST, EMERALD, EBSCO, JSTOR, and Science Direct, provided the author with access to the use of the journals.

In order to establish the skills set of managers over time, it was necessary to review the literature based on the events that impacted on SCM over time. Thus a time frame is applied in the review. The author leverages the work of Pounder et al., (2013) who has

classified their research into various time frames: 1980 -1989, 1990 - 1999, 2000 – to the present. In addition they include definitions of SCM over time, key world events, technology etc. In addition, it is also necessary to consider the frameworks under which various researchers have examined literature. The approach used by Ellram and Cooper (2014) in their paper “supply chain management: it’s all about the journey, not the destination” reviews SCM based on processes, discipline philosophy, governance structure and functional area. In addition the author applies a numerical analysis from a research paper to understand the skills sets of those managing the SC over time.

The author did an initial scan of 3000 research papers under the term such as leadership in supply chain, SCM definitions, SC collaboration, challenges in SC, SC and globalisation, SC education and future trends.

The research material was narrowed down to around 100 journal papers. Next breaking down the findings into the three time frames as prescribed by Poulder et al.,(2013). Before, proceeding on to the different eras of SCM, the author will first review the SC definitions over different time period.

The next section discusses the definitions of SCM over various eras.

Definitions of Supply Chain Management

According to Deangelis (2018) SCM has been in existence since people started trading, although it was probably known under a different name. The author found the term “Supply chain management” was coined in 1982 (Oliver and Weber,1982), however organisations such as Mitsui and Dupont are some of the oldest companies have existed since the 1600s. These companies have been manufacturing and selling products and therefore managed some kind of operations, thus a series of definitions would have existed. The term first was coined in 1982 by, Keith Oliver a consultant at Booz Allen Hamilton (now known as Booz & Company). Keith Oliver’s first definition of SCM is “The management of upstream and downstream value-added flows of materials, final goods, and related information among suppliers, company, resellers, and final consumers”. The definition has metamorphasised over the years.

Gligor and Esmark (2015) found the SCM is important for senior managers as SC costs typically account for 60 to 80 % of a company's total costs. At the same time Mahadevan (2013) research pointed out that there is a relationship between the level of managers in organisation and the effectiveness of the SC. Meanwhile Ly (2014) found that in 1997 Marshall L Fisher, then professor of operations and information management at the University of Pennsylvania's Wharton School, asked a simple question in an article in the Harvard Business Review entitled 'What is the right SC for your product?' The author argues that the definition of SC could vary not only by industry or product type but also by different era since the industrial revolution.

In the periods before 1980s, whilst there was no formalised term for SCM, however, the author found that the term "operations management" was applied in organisation. Organisations started to plan for materials as early as the 1950s when the concept of materials planning was developed (Orlick, 1975), furthermore, researchers tend to define and refine "definitions" over time as when the business environment changes.

Bayraktar et al.,(2007) noted in their research that the functions of OM first came into being during the period of 1890-1920 with the works of Frederick W. Taylor, Frank and Lillian Gilbreth and Henry L. Gantt (Skinner, 1985). This era was later defined as ''scientific management''. However, notwithstanding the great depression in 1930s, in many ways the period from 1920 to 1960 can be considered as the golden age for the development of industry in the USA (Hopp and Spearman, 2001).

During this era, the main focus of OM was on the labor productivity improvements where time and motion studies, layout, production control, queuing theory were among the popular techniques to improve labor productivity. Operations Research and Management Science applications dominated the OM field starting from the post World War II until the 1960s (Bayraktar et al.,2007).

In earlier decades (the 1920's, 1930s and 1940s), the term ''Operations Management'' referred primarily to manufacturing production. However, over the period of time the field has expanded to include service systems as well, since operations permeate every functional area of the organization ranging from marketing, accounting, purchasing, logistics, and information management to engineering and human resources (Bayraktar's et al., 2007).

In the very recent times Castillo et al., (2018) adapted established concepts from the business ethics literature to the SC context, a synthesized definition of SCI is presented as *the dedication to maintaining integrity in SC activities and the recognition of the systemic and strategic implications of maintaining integrity in supply chain processes and flows*. Thus, SCI is characterized by both structural and moral dimensions that underlie SC activities.

In synthesising the findings of the different authors, there is an apparent lack of a stabilised definition for SCM. The definitions have been found to be changing over time and possibly impacted by world events and changes in the business world. This could mean that SCM is continuously evolving over time, which indirectly means that the types of managers running the operations are also continuously evolving.

The next three sections will review the events and the factors helped to shape what is SCM over different period.

The period before the 1980s

The world moved into the industrial revolution with a labour intensive workforce. This led to the application of scientific management often referred to as Taylorism was advocated as an approach to organising work by Frederick Winslow Taylor who lived from (1856-1915) according to Urick et al.,(2015). As result of its perception of being micro-managing and treating employees like machines, this approach has received much criticism by modern management (Fry, 1976). However, the principles of scientific management informed future organisation behaviour studies focusing on how individuals work in organisations (Urick et al., 2015). The principles of Fredrick Taylor's (1914) on work study was practiced in the 1920s where manufacturing operations was labour intensive. The author argues that the role of an "operations manager" equivalent of the 1920s was a task manager or a "strict man manager".

Leavitt and Whisler (1958) found that the 1910s and 1920s were about scientific management. However, after the 1945 (World War 2), it was participative management that was applied in organisations. The author argues the shift from scientific to participative management indicates that operations managers now were delegating various tasks to the employees.

Moreover, the story of operations management is a fascinating one that extends far beyond the boundaries of the organization (Piercy, 2012): a story of great pioneers and engineers, innovators and inventors. Piercy (2012) further added that it is a story of revolution: industrial, economic, social and libertarian. Perhaps more than any other business discipline, operations management has shaped the world in which we work and live (Piercy, 2012). However, the terms such as “logistics” and “transportation” according to Robinson (2015) in the 1940’s and 1950s noted the focus of logistics research was mainly in transportation. At the same time after the second world war (Goestch 2015) in his book pointed out that the Americans were producing and selling to whole world. Meanwhile the Japanese after being destroyed by the war had to manufacture products and sell them to Japan to feed its population (Goestch, 2015). The number of layers of management also grew across industries and more new operations management techniques were incorporated in business.

The 1960s had developed a clear trend had developed in shifting more time – dependant freight transportation to truck rather than rail which led to the need for joint consideration of warehousing, materials handling and freight transportation (Robinson, 2015). Transactions were all done manually as the era of the PC was 10 years away. This suggests that managers had strong mathematical ability with less focus on management, which means another layer of supervision was created. By the late 1960s with the formation of the National Council of Physical distribution Management, academic research and education in this area gained recognition (Robinson, 2015). The computers were gradually introduced into the broader operations, which opened the door for huge opportunities in innovations in logistics planning from randomised storage in warehouses to optimisation of inventory and truck routing (Robinson, 2015). In addition, in the late 1970s, the computer technology led to the creation of research centres such as Georgia Tech. The MRP as a concept was becoming popular but it was not supported by technology until the 1970s (Slack et al.,2002). The MRP concept developed by Orlick (1975) around the 1960s broke the paradigm of models based on the Order Point Policies (Slack et al.,2002). Simultaneously, the world economy grew and consumerism kicked in and society was changing (Hecl, 2006): the magic economy. It was the counterculture era, which questioned the world order where Europe and the USA were transformed through the American ideals of free speech, equality, world peace, and the pursuit and music and the 1960s was known as the “Beatles decade” (Hecl, 2006). These changes in society

subsequently affected the management style in industry. The strict man management approach was out and with the growth of MRP 11 concepts, management was playing a different theme according to the author. According to Chase and Prentis (1987), the 1960s was an era where specific textbooks on OM were written and the term ‘‘operations’’ was introduced to extend the scope of OM into service settings. The author argues that the development of people was becoming important in an organisation and adding another dimension to the role of the operations management.

Although there are many research issues to be resolved in the transition from theory to practice, the transition of managers was taking place. Gradually managers moved away from Taylorism to Modernism. However, managing the manufacturing operations was still an art and less of a science as managers used their “gut feeling” about forecasting and scheduling as MRP was used as a guide.

Furthermore, in the 1980s era most manufacturers owned their owned factories and controlled their own production (Pounder et al., 2013). Thus, MRP suited well for the managers to have visibility of their operations, as globalization was not born then. According to Gupta and Synder (2009) the MRP included information on the Bills of Material of products and the information on the scheduling and planning. The author argues that the MRP is a System or tool without a computer. Vollman and Whybark (1988) found that the MRP 11 (manufacturing resources planning) was concept that needs IT to support the operations. Furthermore, the MRP was divided into three sections, the system is made up of a ‘front end’ for production planning and master production schedule generation, the ‘engine’ for the little MRP and capacity requirement plans (CRP) assuming infinite capacity, and the ‘back end” for purchasing, order release, and shop floor control (Vollman and Whybark, 1988).

Thus, the role of the operations manager had evolved as result of changes in society, changes in new tools and concepts introduced to the manufacturing environment. The operations manager needed to understand some level of computer programming, forecasting and procurement to apply the MRP 11 was the control mechanism (Vollman and Whybark, 1988).

The author argues that the MRP concepts applied in operations management required more than just strict man management type of managers. Thus, the new breed of managers was slowly coming into the picture. These managers usually had an engineering degree and mathematically inclined arriving into the operations management roles. Thus, it was the beginning of the tertiary qualified managers in managing operations on the shop floor.

In synthesising the findings for the era up to the end of the 1970s, the author noted that the managers in the driving seat of the supply chain were mainly technical and operational focussed. They needed to come from an engineering background that could relate to shopfloor personnel which helped to gain productivity.

The next section will review SCM in the 1980s

The 1980s: Logistics comes of age

The term “Supply Chain Management” was born in the 1980s, which marked the beginning of a sea change in logistics in the history of SCM (Robinson, 2015).

The author found that in the period before the start of the 1980s, the debt level of the USA was skyrocketing. In the 1960s, the US householders owed banks and others about $220 billion (Robinson, 1989). By 1984, those debts had grown to $2 trillion, and by the end of 1988, they hit a whopping $3.1 trillion. The high level of debts of the 1970s caused a recession, which led to the massive corporate restructure in the 1980s. Thus, management focus was shifting from productivity to costs. Thus, the author argues that accountants, and operations managers were now in the driving seat of the SC.

Simultaneously, the emergence of personal computers (PCs) in the early 1980s provided tremendously better computer access to planners and a new graphical environment for planning (Robinson 2015). According to Pounder et al., (2013) there were three key components that impacted SCM: innovation of the personal computer, bilateral trade agreements, and increasing global competition. Moreover in 1989, the Berlin wall came down or the reunification of Germany took place, which led to many changes in the economy that impacted Europe. Furthermore in the 1980s most manufacturers owned their owned factories and controlled their own production (Pounder et al., 2013). Leavitt

and Whisler (1958) in the HBR issue projected that “A radical reorganization of middle-management levels could occur, with certain classes of middle-management jobs moving downward in status and compensation (because they will require less autonomy and skill), while other classes move upward into the top-management group”: this caused a lot of shift in management levels. At the same time, Schou and Storm (1980) found that as a result of technology and organization structure changes forced a major change on middle level managers. Leavitt and Whisler (1958) argued that information technology would alter dramatically the shape of organizations and the nature of managerial jobs: further organizations would recentralize, levels of middle management would disappear, and a top management elite would emerge. Moreover, Leavitt and Whisler (1958) urged managers to prepare for these inevitable impacts by developing their internal technological capabilities and their liaisons to external technological resources in the 1980s. The operations in a factory of the 1950s and 1960s were a different place: there was a purchasing manager, production manager, planning manager, operations manager, warehouse manager and a transport manager. These managers had supervisors reporting to them. Many of these roles have now been compressed into a supply chain manager role as the organisations were heading towards lean operations in the 1980s.

Next, Thome et al., (2012) found that Sales and Operations planning (S&OP) is a tool that unites different business plans into one integrated set of plans. Its main purpose is twofold: (1) to balance supply and demand and (2) to build bridges between the business or strategic plan and the operational plans of the firm. The author argues that marketing, sales, finance and operations now have importance and input into the SCM, which means that there were more managers in the meeting room to action that SOP. Sales and marketing will say, “Increase production, but the accountant says we cannot afford it”. The Manufacturing manager says, “We don’t have the capacity to meet the demand”. Now, the indifferences in planning shifts to the next level in the organization where the Operations Director, Financial Controller and the Marketing director were at the wheel of the Delorean revving up the SC.

In the context of organizational changes, the relationship between information technology and organizational change was a central concern in the field of Information Systems (IS) as pointed out in Leavitt and Whisler's (1958) seminal article, "Management in the 1980's," speculations on the role of information technology in organizations and its implications for organizational design have flourished. Furthermore, Leavitt and Whisler's (1958) pointed

out that some managers resist these ripple-effects upward in the hierarchy, thus as a consequence they may try to put pressure upon the first-line supervisor to minimize the practical impact of formal changes in organizational structures and tasks. These developments indicate that first-line supervisors have become entangled in a multitude of mutually conflicting forces. The author argues that it is perhaps naive to think that it would suffice for the supervisor of the 1980s to give up his old style of leadership and adopt a new style (Leavitt and Whisler, 1958). Instead, it seems necessary that supervisors show more flexibility in the sense that they use different styles to cope with different forces in different situations.

On the other hand, Simon (1977) was less pessimistic than Leavitt and Whisler (1958) in his predictions about the impact of computers, but no less deterministic. Simon (1977) contended that computers would not change the basic hierarchical nature of organizations but would recentralize decision-making. Furthermore organization as structures would shrink in size, and the number of levels would decrease whilst staff departments would increase in number and size, making structures more complex and requiring more lateral interaction (Leavitt and Whisler, 1958).

At this point, the Operations Director predominantly responsible for the quality and distribution of the company products from third party manufacturers, still the driver of the SC but being heavily distracted by sales and marketing and the accountant. It would seem that the accountants would have had more power over the supply chain managing it with activity-based costings. The accountants were in the driving seat for a period to control costs when recessions crept in, but to fully understand the costs implications. Furthermore, the author argues that type of industry commanded the type of supply chain manager with different skills sets. Further Mahadevan (2013) has found that there is a relationship between SC managers and industry type, although this happened much later.

In synthesising the above-mentioned findings, the author notes, the 1980s were a major period of change and uncertainty. With advent of technology, focus on costs due to the debts from the previous decade and organisational restructures with the reduction in management levels, the overall management focus in the decade was on optimisation.

Moreover, the 1980s had higher expectations for managers as they had to embrace many aspects of the SC that changed many things. Furthermore, SCM was not established discipline and it did not have regimented skills set requirement to fulfil the needs of the role. The author argues that unlike the accounting or engineering roles, which required registration from the relevant bodies, the role of a SC manager did not have professional guidelines. Therefore, there was a shift in the type of the expectations along the different periods.

The 1990s: The technology revolution

The 1990s saw the formation of the European Union, which included 28 states in Europe, which had a significant impact on the economy. The author argues that with the reunification of the German economy and the formation of the European Union, there were significant changes to the economy impacting on the supply chain. In the 1990s the concept of SCM was still being developed and defined, thus the literature did not reflect any significant changes, even with the five-year delay in consideration (Pounder et al., 2013).

At the same time Robinson (2015) regarded the period of 1991 to 1999, the technology revolution in the broader business operations and SCM was taking place. The MRP 11 focussed within the boundaries of the organisation, had limited technology to link activities outside the organisation. Lancioni (2000) found that Electronic data interchange (EDI) firms were actually linking up their companies with computer-to-computer ordering and data exchange. The linking was the beginning of e-commerce where online transactions were taking place. This was based on linking MRP11 system of one organisation to another. Pounder et al (2013) found that three main factors that contributed to the development affected. These include the emergence of globalisation; e-commerce; and research development. The emergence of e-commerce was becoming prominent as it was becoming business as usual where technology is part of business (Gonzalez, 2015).

“Globalisation” has become the buzzword of the last two decades (Economist, 2013). The sudden increase in the exchange of knowledge, trade and capital around the world, driven by technological innovation, from the Internet to shipping containers, thrust the term into the limelight (Economist, 2013). Globalisation was a defining term of the 1990s (O’Rourke and Williamson, 2002). Some world historians attach globalisation ‘big bang’ significance

to 1492 and 1498 (O'Rourke and Williamson, 2002). On the other hand, optimists argued that trade with the Third World would keep American inflation low, despite ten years of high US growth rates, a belief that helped underpin the great bull market of the Clinton Presidency. Pessimists argued that globalisation was boxing the world into a 'global trap', increasing inequality and undermining the ability of the state to deal with pressing social problems: however, world historians have gone much further. They argue that globalisation is a phenomenon, which stretches back several centuries, or even several millennia. For the supply chain manager it meant that working across different cultures, different economic strengths and different continents. Fortunately the ERP system provided information throughout the supply chain from one country to another. However, the connectivity was slow as the Internet arrived in 1995 (Lancioni, 2000). The Internet has grown rapidly over the last 5 years. It is predicted that more than 100 million households will be connected to the World Wide Web by 2002 (Lancioni, 2000). But what about the use of the Internet in business-to-business SC applications? The greatest potential of the Internet is being realized by speeding up communication between customers and their suppliers, improving service levels, and reducing logistics costs. In this article, the author discuss for the first time how the Internet is being used in managing the major components of supply chains including transportation, purchasing, inventory management, customer service, production scheduling, warehousing, and vendor relations. The study breaks down each area and describes to what extent and how the Internet is being applied.

Thus, the use of the Internet in supply chain management (SCM) is a relatively recent phenomenon. Its principal applications have been in the areas of procurement, transportation scheduling, vehicle tracking, and customer service in the early 2000s (Lancioni, 2000). However, throughout the 1960s, 1970s, and 1980s the ability of firms to achieve these goals was limited, since the communication and knowledge links in the existing supply chains did not bring together all of the key databases. There was the reluctance on the part of firms in the SC to share data with each other (Lancioni, 2000).

The concept of EDI or data sharing lead to the development of ERP (Enterprises Resources Planning). In the 1990s ERP systems had taken over the MRP 11 systems (Rashid et al.,2002). At the same time Globalisation was becoming more prominent and with the demise of MRP11 in the late 90s and the birth of ERP or Enterprise Resources

Planning, where strategists, analysts and IT professionals were part of the SC in addition to the Operations Managers and the Accountants.

The ERP had a lot more to offer to the “passengers” in the supply chain. ERP was the first step towards inter-enterprise integration. The ERP has scalability where the CRM (customer relationship management) in the downstream gathers information from the end customers. CRM (customer relationship management) has connected customers to the organization. On the upstream of the supply chain ERP allowed material suppliers to be connected electronically to manufacturing operations across the SC. Thus, information in the SC gained significant prominence as the result of ERP application. With the advent of the Internet in the early 2000s consumers have become more demanding as they become more educated making the customer a part of the SC.

Pounder et al.,(2013) found that between 1990 and 1998 the spending in research and development in the field of SC rose by 35%: in real terms more than USD 350 million were spent in this area. Thus confirming that SCM is growing in magnitude by means of network development although the definitions have not been fully defined.

The author found that the 1990s was also an era of Business Process Reengineering (BPR) that became one of the most popular change management approaches which has attracted great attention from practitioners, academicians and has also become commonplace among companies (Goskoy, et al.,2012) and (Hammer and Champy 1993). The main reason is an organization creates value through its processes, as BPR is purported to produce positive results for firms including improvements in critical, contemporary measures of performance, such as cost, productivity, service, customer satisfaction, and speed (Fliedner and Vokurka, 1997; Raymond et al., 1998) and can be used to bring about major internal and external quality increases, thus increasing value for both the employee and the customer (Dean, 1996). Thus, reengineering of a supply chain required managers with change management and project management skills.

In addition towards the end of the 1990s issuing arising from sustainability was beginning to emerge in the supply chain. The world was beginning to see a lot of discarded electronic goods such as PCs, printers, MFDs and scanners due to its product lifecycle. The author noted product stewardship and end of life product management were gaining importance. Thus, the need for reverse logistics leading to new challenges for the SC manager.

Mahadevan (2019)'s research noted that the topic of RL has been researched since the late 1960s, however, in only the last ten years it has gained prominence (Jayant et al., 2012a, b; Chan et al., 2010; Chan and Chan, 2008).

Thus, in synthesising the thoughts of the various researchers, the author argues that the SC manager in the 1990s had far more challenges than their predecessors from the previous decades. These managers needed to have a number of skills to understand and manage a range of issues in managing the supply chain. The author found that researchers in the field of supply chain education found that SC managers required skills in sustainability, process management and costs. According to Sohal (2013) over the past two decades academics have the examined the skills that supply chain managers require to function effectively in a SC network (Harland, 1996; Lamming et al., 2000). Harland (1996) found that managers needed skills in working across internal organisation networks. However, the author also found the lack of a clear definition also affects SCM education: Universities have established programs for SCM only recently (Korn 2013), and the university programs that do exist differ significantly in various ways. While SCM programs are under the umbrella of the business schools or business administration programs of some universities, they are part of the engineering schools at others (Cottrill and Rice 2012). Thus, confirming the need for SC managers to be constantly upgrading and renewing their skills set.

The new millennium and beyond: Globalisation, sustainability and Supply chain Integration

Since the arrival of the new millennium organisations began to face many challenges around the globe.

According to Mahadevan (2013)'s research in synthesising the visions and thoughts of SCM researchers (Bowersox *et al.* 2007; Cattani and Marbet 2009; Fickle 2006; Handfield and Nichols 1999; Simchi-Levi and Fine 2010; Storey *et al.* 2006; Wisner *et al.* 2005), point out that the key challenges faced by organisations converging towards to globalisation are collaborative supply chain practices (SCI,IS and SCV), postponement and greening of SC (reverse logistics). On the other hand, Martin (2015) identified the three key elements that changed SCM include: globalization of supply chains, continued outsourcing, and widespread adoption of 'lean' practices. Further, Martin (2015) then

analyses the impact of these three key elements on the need to manage across boundaries, the need for both left-brained and right-brained skills, and most importantly the understanding and creation of a broad skills-profile for successfully managing the complexity in the SC.

Thus, the author argues that developing the breed of SC managers beyond the 2000 is going to be a challenge. It is necessary to look at some of the key world events that have taken place the beginning of the new millennium.

Simultaneously, the recession in 2001 according to Pounder et al.,(2013) was the major cause for supply chains to be streamlined also affected the way we did business (Pounder et al., 2013). This world event impacted the cost of SC, which suggests SC managers need to become cost conscious and productivity focussed at the same time. However, the recessions in 2001 (Pounder et al., 2013) pointed out SCM definitions were refocussed to streamline business operations. On the contrary the “supply chain” discipline has grown in importance with each recession since the function changed the focus of business, SC managers needed to be more cost conscious. Mahadevan (2007) found that the world was rocked by September 11 incidents in 2001 that significant impact on the SC for Toyota in the US. Likewise the SARS bird flu, London bombings, the GFC, Tsunami in Indonesia and Thailand had a significant impact on global SC. For example, the SARS bird forced the electronics manufacturers to quickly relocate their factories from China to South America. Mahadevan (2007) found that supply chain managers at this point in time needed to be aware of risk management in their jobs. Risk Management and identifying risks in SCM have become important. Accountants tend to be more focused on risks rather engineers. Juttner et al., (2003) found that terrorist attacks on the USA have underlined the vulnerability of modern supply chains. Despite increasing awareness among practitioners, the concepts of SC vulnerability and its managerial counterpart SC risk management are still in their infancy in the 2000s. The author argues that the accountants were becoming more prominent in managing the supply chain.

The outsourcing of business operations started in 1970s and 1980s, however, Lieb (2005) and Mahadevan (2017) found that in the context of broader SCM, the growth of 3PL (Third Party Logistics) services exploded in the new millennium. Further Mahadevan (2017) found that the logistics industry plays an important in the end-to-end SC, which has boomed worldwide, and competition in the 3PL market is currently very intense (Wang et

al.,2015). Moreover, the performance of 3PLs is crucial in today's competitive business world (Wang et al., 2015) suggesting growth in SCI. Thus, this impacts the role of the SC manager adding greater expectations to the role.

The new millennium also saw the birth of the BRICs (Brazil, Russia, India and China) in 2001. These nations experienced advanced economic development, which caused the shift of production from the West to the upcoming nations. At the same Mahadevan (2013) found that SC collaboration and Integrated supply chains supported by supply chain integration, supply visibility and information sharing helped linkage of the globalized world. Furthermore, the customer had become more educated through the Internet by means of e-commerce. However, technology used in SCM grew in leaps and bounds in the 10 years since 2009. Thus, the author argues that the Technology applied in SCM has now frown from MRP 11 to ERP to integrated planning systems now connected to social media based on Gonzalez (2013)'s thoughts. According to Gonzalez (2013), social media can and should play a central role in SCM. Gonzalez (2013) further added after all, social networking is not about only socialising but about facilitating people to people communication and collaboration, which can be mirrored in a SC. With the advent of the Internet in the early 2000s consumers have become more demanding as they become more educated.

The SCM landscape also saw another leap forward in 2009 with the formation of the CIVETS countries like the BRICs. The CIVETS is made up of Colombia, Indonesia, Vietnam, Turkey and South Africa. The author argues that BRICs and CIVETS changed the way organisations manage their supply chains. Together with e-commerce applications, customers are now able tap into the SC 247.

With the emerging technological advancements and fundamental shifts in SC activities, it is safe to say that the supply chain landscape is not the same as it was a decade ago with the advent of Industry 4.0. New evolutions in technology such as 3-D printing, autonomous vehicles, the Internet of Things (IoT), big data analytics and omni-channel retailing have brought about tremendous change in SCM. For example the e-commerce giant Amazon for example, which has been working on a drone-based delivery system. Mahadevan (2019) pointed out that reverse logistics industry has grown as a result of online businesses. Moreover, the retail corporation Walmart has also developed a global satellite system that collects and shares its real-time store data. While these companies have

taken that early step towards redefining their SC for optimal success in the future, most industries are finding it difficult to prepare themselves for today's ever-evolving, exponentially more complex supply chain industry.

The question is why? According to industry analysts and experts, so much progress so quickly calls for new skills in SCM and leadership (Robinson, 2015). Unfortunately, most supply chain organizations are unable to meet this demand currently. Hence, the need of the hour is an advanced workforce who can integrate innovation and technology with their working knowledge of SC tools, activities and goals to carry out strategic, higher-level SC activities in the very near future.

Subsequently, Lyall et al.,(2018) pointed out that new technology will replace management in the SC operations with the next 5 years with disruptive technology triggered by Industry 4.0. This means senior management in SC will be focussing on other aspects of the SC such as the Big Data. In addition new technology will take over SCM entirely that will disrupt traditional ways of working. Furthermore, within 5-10 years the SCM may be obsolete, replaced by a smoothly running, self-regulating utility that optimally manages end to end work flows and requires very little human intervention. At the same time Zhong et al.,(2016) pointed that the service and manufacturing sectors are facing a data tsunami: it was reported from International Data Corporation that over 1600 Exabytes data were created in 2015 from both sectors. Moreover, data volume continues to grow tremendously in part because service and manufacturing sectors have much more workforce are progressively being gathered by advanced information technologies such as ubiquitous-sensing mobile devices, aerial sensory techniques, cameras, microphones, Internet of Things (IoT) technologies (e.g. RFID, Barcode), and wireless sensor networks. The author agrees with Lyall et al., (2018)'s thoughts in which SC Managers need to be information focussed. On the contrary, Mahadevan (2013) has found that despite availability of technology supporting supply chain integration, there is still an apparent lack of supply chain visibility and information sharing across the SC.

In synthesising the thoughts and findings of the above mentioned researchers, the author believes that SC managers need to have a multitude of skills to take on the challenges of the end to end SC. The author also found that in the new millennium, SCM has been taken to a new level based on the findings of a number of SC researchers.

Therefore, managers now needed education and training to manage the handle these challenges in the new millennium. Jordan and Bak (2016) found that SC education research in the past 15 years has focussed on the gap between industry needs and the existing talent pool, focussing mainly on the interaction between education and employers and tools used to bring industry and education closer.

The author uses some of Robinson (2015)'s findings material from his practitioner article to prescribe those skills that are required for a new-age SC manager:

1. Understanding of Information Systems

In the words of Satya Nadella, CEO, Microsoft, "Information Technology is at the core of how you do your business and how your business model evolves itself." This stands true for supply chain industry as well. Thus, it is important for SC managers of tomorrow to gain expertise and adeptness in packaged software systems like WMS, ERP, TMS, for better decision support.

2. Technological Expertise

In the wake of technological revolution, it has become imperative for SC managers to gain knowledge in areas like Artificial Intelligence, the Internet of Things, Robotics and Automation, and know how to effectively utilise them to advance their SC. For example Alibaba for instance, which was able to reduce the human workforce at one its facilities by 70% by increasing robotic labour.

3. Strategic Planning and Big Thinking

Another capability quickly becoming indispensable in SC leaders is data analytics mentality or Big Thinking. The knowledge of advanced analytics provides them the ability to draw on the data sets and information created by SC activities to anticipate market trends and make better, faster, holistic decisions while say, optimising their production runs and distribution plans.

4. End-to-End Supply Chain Management

Unlike a few years ago, a SC manager today needs to understand the complete end-to-end SC – from sourcing to production, planning to delivery and service – through collaboration and networking. This real-time experience can enable future managers to

align all key SC partners, identify potential risks and address issues as they arise for effective operations.

5. Risk Management Expertise

As new and improved products, processes and services are entering the market, risk management is fast becoming an important asset for SC managers. While different businesses will have an array of different potential risks, the knowledge of risk management can help SC managers ask the right questions relating to business, quantify risks, and build contingencies effectively. Mahadevan (2007) has highlighted some of the key world events that significantly raised the need for supply chain risk.

6. Global Leadership

As the SC is becoming global owing to the technological developments and changes in the market, it has become vital for SC managers of tomorrow to develop a holistic leadership style. The ability to control the entire SC process as a single point of command, and work seamlessly on a multi-channel, multi-partner basis will enable them to drive change and action.

In addition, Flothmann and Hoberg (2017) noted that there is mounting evidence that indicates a shortage of qualified SC personnel on a global scale (Cottrill 2010). Given the fact that the complexity of global supply chains is increasing, it is not surprising that the demands on SC managers have changed (Harvey and Richey 2001).

Currently, SCM positions are growing at nearly 270,000 opportunities per year, and there is only one skilled candidate for every six job openings. Further by 2030, the volume of jobs in the SC industry would have grown exponentially and the ratio of qualified candidates to job openings could be as high as 1:9.
The question is will you qualify to run the supply chains of 2030? How would you thrive, and not just survive in the rapidly changing and rather complex SC environment?

Synthesis of research findings

In synthesising the literature review findings of the three eras, the author found that the definitions of SCM varied according to the progress of time, technology and new concepts introduced through research and development. From moving of the material across the plant for production stock in the 1960s and 1970s, the SCM today involves in the event management of supply chain activities and the use of social media to monitor supply chain disruptions.

The skills set of managers differed over time or over the three time periods (1980s, 1990s and 2000 and beyond). The definitions for SCM varied over the different eras (Pounder et al., 2012). Thus, SCM has a different meaning over time means SC function of managers was something that varied across different era. It suggests that the skills set of SC managers differed and different types managers were in the driving seat.

Therefore in order to understand the different levels of management in the SC function the author used some analysis from Mahadevan (2013) work on collaborative practices. Researchers (Pounder et al., 2013; Sohal, 2012) have broadly examined the impact of SC managers over time in industry. In order to get further understanding of the state of play among of SC managers, the author leveraged the research work of Mahadevan (2013) to get a better understanding of the approaches applied by managers.

Review of a numerical research

In order to understand the current state of SC managers in the context of end to end SC collaboration, the author has leveraged the work of Mahadevan (2013), and Sandberg and Abrahamsson (2010). According to Sandberg and Abrahamsson (2010) top management is the enabler of SCM in an organisation. Furthermore, these researchers also pointed out that top management does not include the Board of Directors. Sandberg and Abrahamsson (2010) pointed out that typically top management can include the Chief Executive office (CEO); Chief Operating Officer (COO), purchasing manager, production manager, Chief Financial officer (CFO), and marketing manager. However, in recent times,

the “Chief Supply Chain Officer” and the “Vice President of Supply Chain” are gaining popularity according to Gartner and SCM World.

Mahadevan (2013) in his research using 223 survey responses described the level of management as five major areas that included: executive team (1); senior management team (2); middle level management (3); consultant (4); and others (5). The executive team can include: Chief Executive Officer; Chief Operating Officer; Chief Information officer; and Chief Supply Chain Officer. The senior management team comprises of General Managers, Vice Presidents and Supply Chain Director. The middle level management include: Supply Chain Managers; and Logistics Managers. Those referred to as others include: business analysts; project managers and SC specialists who are indirectly contributing to the SC. The breakdowns of the survey responses are shown in Figure 1.0.

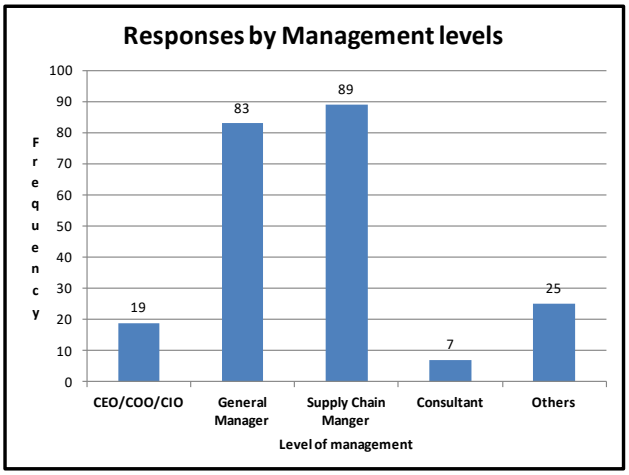

Figure: 1.0: Levels of management

Source: K.Mahadevan 2013

Mahadevan (2013)’s research examined the different levels of management with a number of collaborative SC variables and those variables related to costs by means of cross tabulation. Table 1.0 showed the different levels of collaborative variables as designed by Mahadevan (2013), whilst Table 1.0 presented the data collected from a survey on those variables.

Table 1.0: Collaborative supply chain variables

Source: K. Mahadevan (2013)

			Supply Chain Variables				
Level	Perceived level of Usefulness*	Categories	Level of SCI	Level of SCV	Level of IS	Level of under-standing	Ability to influence
Lowest	Strongly disagree (1)	1	No integration	No visibility	None	None	No influence
	2	2	Minimal Integration	Medium visibility	Limited Information	Limited	Limited
	3	3	Limited integration	Moderate Visibility	Selected information	Some extent	Partial influence
	4	4	Moderate integration	Medium	Moderate level of info	Moderate	Moderate
Highest	Strongly agree (5)	5	Highly integrated	Highly Visible	All relevant information	In depth	Fully influence

Table 2.0: Responses for core variables from survey

Source: K.Mahadevan (2013)

Perceived Current Level / **Core Variables**	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Total**
SCI	30	64	79	43	7	223
SCV	41	59	61	49	13	223
IS	44	46	76	39	18	223
Level of understanding	51	79	46	37	10	223
Level of influence	27	79	63	41	13	223

Figure 1.0 shows the cross tabulation of the different levels of management with the collaborative variables described in Tables 1.0 and 2.0.

Further, Mahadevan (2013)'s research included correlation analysis of the level of management and the level of influence and level of understanding. The analysis indicated weak correlation of around 3.6%. The Chi square analysis was also conducted which concluded non-significance between the variables levels of collaborative SC. However, the analysis is meaningful as it provides the reader and future researchers an understanding of those relationships.

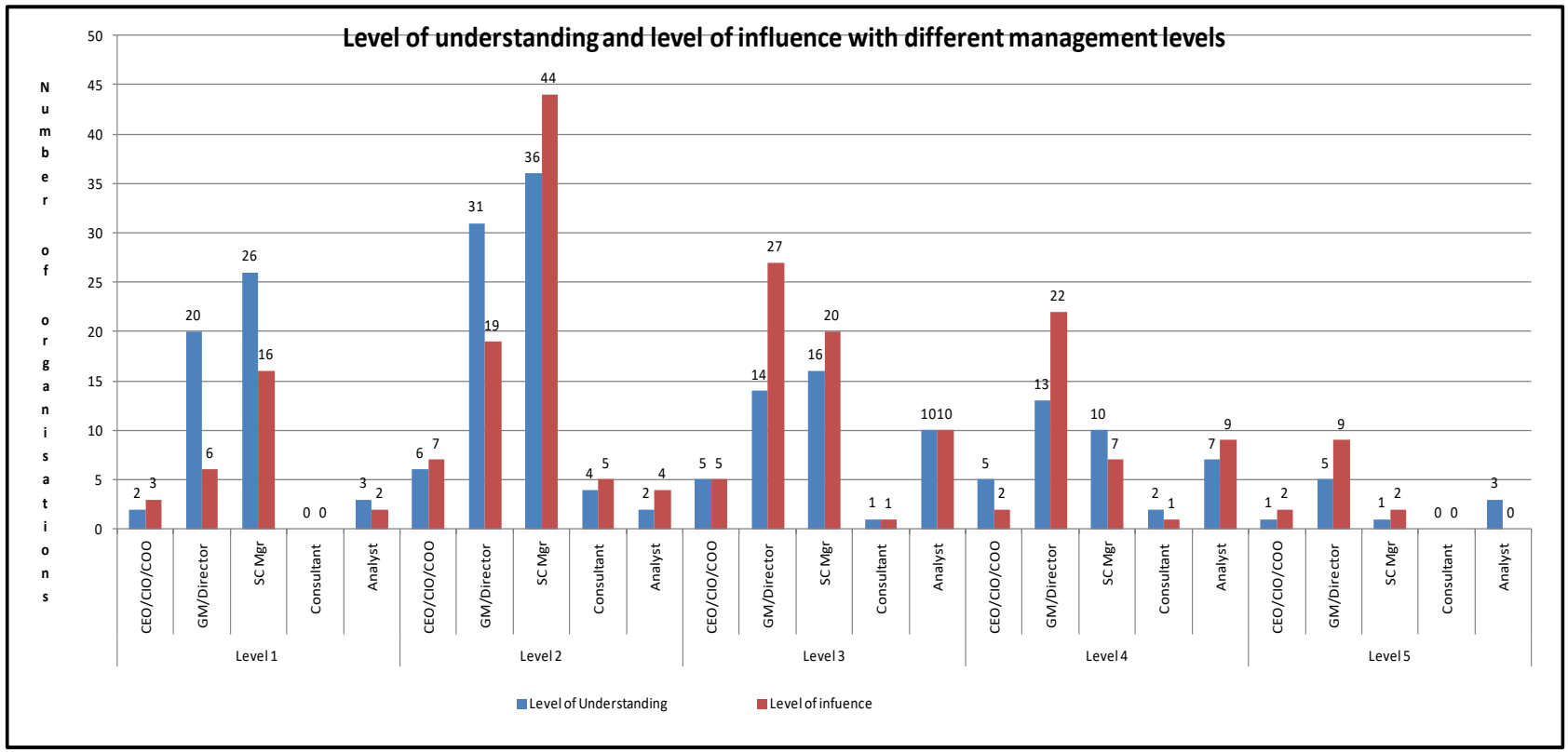

Figure 1.0:Management levels with level of influence and level of understanding

The following is noted about different categories of managers in a SC, level of influence and level of understanding from Figure 1.0.

- 62% (26/42) of SC managers have no understanding of SC partners' operating information and at the same time 38% (16/42) of SC managers have no influence over their SC partners' planning, control and execution of activities.
- At level 2, 45% (36/80) of SC managers have limited understanding of SC partners' information however, 55% (44/80) of SC managers' organisations have limited influence in planning, control and execution of activities and resources of SC partners.
- At levels 3, 4 and 5, general managers or operations directors are prominent than SC managers in understanding and influencing SC partners. Further, these senior managers are more focussed on influencing their SC partners' activities and planning functions.
- SC managers in general, have only a limited level of understanding of SC partners' information and even less ability to influence the activities of SC partners (levels 2-3). General Managers and Operations Directors have a higher level of understanding of SC partners' information and along with this, a greater ability to influence SC partners (levels 4-5).

In addition Mahadevan (2013)'s research indicated a number of key findings about the behaviour of CEOs, General Managers, SC Managers in an end-to-end SC environment:

- CEOs have a greater interest in re-engineering business processes to gain the expected levels of SCI, IS and SCV, compared with SC managers and General Managers.
- Moreover managers across different industries also support the need for the re-engineering of business processes to gain the expected level of SCI, IS, and SCV.

- CEO, General Managers and SC managers have different perspectives on costs relating to increasing SCI, IS and SCV. The views held by different management levels in organisations about incremental costs differ among the organisation dimensions of volume of sales, number of employees and number of distribution points.
- Management at different levels across different organisation size (number of employees) understood the need for the re-engineering of business processes to attain the required levels of SCI, IS and SCV in a different light. In parallel, management at different levels across different organisation size, both agreed and disagreed that increasing SCI, IS and SCV increases SC costs. These observations indicate that currently organisations are unclear about re-engineering of business processes and cost implications in attaining the required levels of SCI, IS and IS.

In synthesising the research findings from Mahadevan (2013) work, it can be argued SC managers tend to have are lower levels of understanding, and the ability to influence SC partners. Based on Castillo et al., (2018) definition of SCM, which focuses on ethics, it appears that SC managers at an operational level want to ensure credibility at the shopfloor level. However, General Managers are prominent at higher levels of influencing their SC partners based on Fig 1.0. Also noted at level 1, there are a greater number of both SC managers and general managers who do not understand their SC partners' information. However, at levels 2-5 those managers appear to be more focused on influencing than understanding (as shown in Fig 1.0).

Furthermore, CEOs and Managers have different approaches to SC transformation when it comes to influencing SC partners and understanding other SC partner's operations.

Conclusions

This research confirms that the definitions of SCM are continuously being redefined although it has not been ascertained as a discipline or fully supported by one single theory. Key world events, globalisation and changes in different industries across three eras have determined who is in the driving seat of the SC.

In the very recent times the birth of the Chief Supply Chain Officer (CSO) is becoming common to lead the SC function in an organization. The CSO is a new breed of operations manager with core competencies in engineering, operations management, risk management, security, sustainability and finance. The CSO will be also be required to execute integrated business planning (IBP) beyond the boundaries of the organization. It is also expected that the CSO will share information with the SC partners. The question, is will the CSO take orders from the CFO? The struggle to drive the Delorean in the SC continues.

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