

## Supply Chain Innovation – 5W1H

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### Abstract

**Introduction:** Currently in the globalized economy and amplified international trade have expanded supply chains throughout the world, which necessarily has given rise to new dependencies. Companies are striving towards new supply chain innovation opportunities to become more efficient and resilient through redundancy.

**Objectives:** Council for supply chain management awards the firms for their innovation in supply chain. Since 2005, 17 firms have been awarded till 2022. The objective of this research is: To identify what motivated firms to try innovation? To give a brief description about the case of each firm for which they innovated? To list the characteristics of innovation. To identify whether the innovation is radical innovation or an incremental innovation.

**Methods:** In this article, we explore supply chain innovation by the cases taken from supply chain innovation award winners of council of supply chain management professional and supply chain brain. The cases are then evaluated to answer the objectives.

**Results:** After categorizing the innovation under radical innovation or incremental innovation it was more the radical innovation was common amongst the companies.

**Conclusions:** The factor driving innovation is the thrust for the companies to cut down cost of supply chain to be competitive and sustainability. The companies were able to be innovative by leveraging of state-of-the-art technology available at that particular point in time, by encouraging organizational cultural changes, by Integration and collaboration for efficiency and effectiveness, by adopting design thinking approach, top down and bottom-up participation of all stake holders and kaizen approach

**Keywords:** Supply Chain Innovation, CSCMP, Supply Chain Innovation Award, Supply Chain Technology, Supply Chain Business Process Improvement, supply chain network.

### Introduction

Field of supply chain management (SCM) provides new openings for coming out with competitive advantages for any firm. To take full advantage and win the competitive horizon a new open mind set is required to explore and understand global SC, logistics and communication strategies of a business. The CSCMP (Council of Supply Chain Management Professionals) have been taking efforts towards identify and awarding the best in the class Supply Chain Innovations through their "Supply Chain Innovation Award™".

Holcim, a global leader in sustainable construction have bagged year 2022 Supply Chain Innovation Award (SCIA) for their effective and efficient use of data-driven analytics to transform their transportation operations. Out of 30 proposals received, along with Holcim, the other top five proposals included: American Eagle Outfitters who reinvented their Retail Operations powering Growth through Collaboration, Decentralization & Decision Sciences, Everstream Analytics, a Global Life Sciences Company Uncovered Risk in its Sub-Tier Supply Chain, Invent Analytics achieved Retail Omnichannel

Excellence, Kimberly-Clark's EARL for their breakthrough Innovation in Deployment Planning and Transportation Savings, and Roambee, through their Innovation brings Certainty to the Complexity of Rail Transport. Innovativeness in the supply chain influences the level of Supply chain innovation (SCI) and SCI exerts a significant impact on SCP (Supply Chain Performance) (Flint, *et al.*, 2005, Krabbe, Michael, 2007, Seo, Y. J., *et al.* 2014). Table 1 provides the list of SCI awards winner firms from 2005 to 2022.

Table 1: SCIA winner 2005 - 2022

Applicant	Year	Innovation
HP Procurement Risk Management	2005	Launched procurement risk management program to quantify impact of demand, price and availability.
Resource Optimization and Innovation/Mercy	2006	Created new supply chain business unit to standardize and consolidate systems, services and purchases.
Aidmatrix foundation	2007	Created portal-Free-clinic Link- between companies with excess medical supply to non-profit organizations needing supply
Cisco Systems	2008	Transformed reverse logistics to profit center, increasing product reuse
Intel	2009	Created a process to receive and schedule customer orders, improving customer promise to delivery service.
Pepsi Bottling	2010	New case picking automation and combined proprietary order management tools
Ahold USA, Del Monte foods, ES3	2011	Created a grocery industry distribution centre for suppliers and retailers to collaboratively streamline deliveries.
Dal-Tile, Whirlpool, Werner, Convermex, Transplace	2012	Developed an international co-load program to improve truck capacity utilization by combining shipments from companies in different industries.
Staples, Packsize Intl	2013	"Smart-Size" program to produce customized packaging for each order.
<b>Flextronics</b>	2014	Created customer idea/product incubation program and support facilities.
<b>Liquor Control Board of Ontario (LCBO)</b>	2015	innovative automated palletizing process, which uses sophisticated optimization software, three-dimensional (3-D) visualization, and simulation to build mixed-case pallets of variable dimensions.
<b>Dell</b>	2016	end-to-end sustainability initiative covering its entire product portfolio
<b>Trans Celerate</b>	2017	Transforming the supply chain for clinical comparator medicines
<b>Intel</b>	2018	artificial intelligence and cognitive computing tools that it developed to improve its sourcing decisions.
<b>Snap-on Tools/FastFetch Corporation</b>	2019	Artificial Intelligence strategy used to slash shipping costs at Snap on tools distribution center.
<b>Intel Corporation</b>	2020	Use of contract digitization and analytics to disrupt the traditional contract management paradigm
<b>Management Sciences for Health (MSH)</b>	2021	<b>Ukraine: Tapping a Private Fleet to Get Medicines to the Last Mile</b>
Holcim	2022	Use of DDA (Data-Driven Analytics) to transform its transportation operations.

Significant innovations have been developed for the past few decades viz., Material Requirement Planning (MRP), Vendor Managed Inventory (VMI), Efficient consumer response (ECR), Collaborative

Planning, Forecast, Replenishment (CPCR), various incremental improvements to business processes, Customer Relationship Management (CRM). New innovations that have ability to transform supply chain are Data Analytics (DA), Internet of Things & Artificial Intelligence (IoT & AI), Radio Frequency Identification (RFID), Geolocation- low-power, wide-area (LPWA) networks, Robotic Process Automation, Blockchain, Augmented Reality, 3D Printing, Crowd shipping, Cloud computing, Alternative Fuels, autonomous vehicles, telematics. However, the academic attention on case studies that can help firms to reorient towards the SCI has been relatively very low. This research aims to bridge this gap.

### Literature review

Since 2005, CSCMP has assigned an award to the company with the year's best SCI. CSCMP does not provide an explicit definition of what constitutes a SCI, but states instead that an innovation is:

"New processes, new technology, or new applications of old processes and technology that create quantifiable and sustainable results in terms of cost savings, revenue, customer satisfaction, etc." (CSCMP 2008)

This definition does not include innovation in network structures of a supply chain for example, a reduced supplier base, other examples of changed supply chain networks structures is the direct distribution model by Dell Computer (Magretta, J., 1998) and a responsive supply chain design by Zara (Ferdows, K., *et al.*2004).

"A supply chain innovation is defined as a change (incremental or radical) within the supply chain network, supply chain technology, or supply chain processes (or combinations of these) that can take place in a company function, within a company, in an industry or in a supply chain in order to enhance new value creation for the stakeholder." Table 2, provides the list of literature published in various journals pertaining to SCI 2014 - 2022.

Table 2: The SCI Literature from 2014 to 2022

Studies	Journals or Proceedings	Propositions
Munksgaard et al., 2014	Operations Management Research	Developed an SCI model: three interactive components: network structure, technology, and business processes.
Artsiomchyk & Zhivitskaya, 2015	IFAC-PapersOnLine	Suggests an integrated approach to help companies design sustainable supply chains and manage innovation.
Jangga, Ali, Ismail, & Sahari, 2015	Procedia Economics and Finance	Business have to improve SCM practices to become flexible and responsive to uncertainties.
Tan et al., 2015	International Journal of Production Economics	Use of big data for competitive advantage through SCI capabilities.
Nasr, Kilgour, & Noori, 2015	European Journal of Operational Research	How resolve the dilemma of innovation sharing vs protection amongst the SC partners.
Yoon et al., 2016	Technological Forecasting and Social Change	SCI is very significant in fostering operational business process for supply Chain effectiveness.
Iddris, 2016	International Journal of Innovation Science	Develops SCI capability constructs.

Rajabian Tabesh, Batt, & Butler, 2016	Journal of Food Products Marketing	Relationship amongst various theoretical constructs and how they affect SCI and performance.
Stentoft, Mikkelsen, & Jensen, 2016	Supply Chain Forum: An International Journal	Comparison of external and internal products from SCI' perspective.
Gao et al., 2017	Journal of Cleaner Production	Proposed a theoretical framework encompassing the meaning of sustainable supply chain innovation by reviewing 107 studies published between 1996 and 2014.
Shah & Naghi Ganji, 2017	British Food Journal	Lean production and SCI to increase the performance in food based industry.
Stentoft & Rajkumar, 2018	Innovation and Supply Chain Management	Link between SCI, Organizational performance, and market performance.
Sabri et al., 2018	Journal of Engineering and Technology Management	Process and product innovation in SC framework – an implementation.
Shou, Che, Dai, & Jia, 2018	International Journal of Operations & Production Management	Examining complementarity and similarity in SC
Kwak, Seo, & Mason, 2018	International Journal of Operations & Production Management	The link amongst SCI, risk management capabilities, and competitive advantage in global supply chains.
Ted et al., 2018	The International Journal of Logistics Management	Use of Supply chain innovation to sustainable logistics and transport.
Wu & Tsai, 2018	Transportation Research	Proposed new business models in purview of new Supply chain and logistics methods.
Abdelkafi & Pero, 2018	Business Process Management Journal	Exploratory analysis business models driven by SCI models.
Seidiaghilabadi, F., Seidiaghilabadi, Z., & Miralmasi, A. (2019)	Proceedings of the Hamburg International Conference of Logistics (HICL)	Exploring the application of Artificial Intelligence and Digital Transformation in Supply Chain Management: Supply Chain innovation initiatives.
Chen, Dimitrov, & Pun (2019)	Omega	Explored influence of drivers such as government subsidy and collaboration on SCI.
Wong & Ngai (2019)	Industrial Marketing Management	Deducing of construct of SCI.

Reimann, Xiong, & Zhou (2019)	European Journal of Operational Research	Examining to lowering the variable remanufacturing cost via innovation process.
Lv & Qi(2019)	Computers & Industrial Engineering	Choosing the collaborative partner of SC based on innovation resources.
Hsin Chang, Hong Wong, & Sheng Chiu, (2019)	Information & Management	Effects of Process innovation and uncertainty factors of business systems leveraging on supply chain performance.
Russell & Swanson (2019)	The International Journal of Logistics Management	Examining for gaps between information processing and SC dexterity.
Beltagui, A., Kunz, N., & Gold, S. (2020).	<i>International Journal of Production Economics</i>	The role of 3D printing and open design on adoption of socially sustainable supply chain innovation.
Arabshahi, H., &Fazlollahabbar, H. (2020).	<i>International Journal of Logistics Systems and Management,</i>	Evaluation of efficiency of SCI considering innovation risk and performance improvement.
Brunet, A., César, F., Brunet, A., & César, F. (2021).	<i>Contract Management</i>	How SCI Can Support Contract Management.
Belhadi, A., Mani, V., Kamble, S. S., Khan, S. A. R., & Verma, S. (2021).	<i>Annals of Operations Research</i>	AIDI (Artificial-Intelligence-Driven Innovation) for improving supply chain resilience and performance considering effect of supply chain dynamism.
Wang, M., Lee, P. T. W., & Chan, R. Y. (2021).	<i>International Journal of Logistics Research and Applications.</i>	investigate the relationships between <i>guanxi</i> , supply chain innovation, and stakeholder's value in a value-added supply chain innovation model.
Zhang, X., Shi, X., & Pan, W. (2022).	<i>Mobile Information Systems, 2022.</i>	Big data logistics service supply chain innovation prototype based upon artificial intelligence and blockchain.
Afshan, N. (2022).	<i>IUP Journal of Supply Chain Management.</i>	Supply Chain Transformation at Dell.

Heinbach, C., Beinke, J., Kammler, F., & Thomas, O. (2022).	<i>Electronic Markets</i>	Exploration of data-driven service capabilities of Digital Platforms in supporting road freight transport management.
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The resolution to implementing SCI is firm specific. Firms may focus enhancing service to customers with the help of SCI, efficiency increase through cost reduction, standardization, better flexibility to adopt to market changes, increasing revenue, enhancing customer satisfaction, reducing defect rate, better strategic planning (Hahn, G. J.,2020).

### 3. Discussion of Case studies related to SCI

So, What is Supply chain innovation: An incremental or radical change supply chain processes, supply chain network, supply chain technology, or combinations of all these three that can take place within the purview of organizational functions, within a company, in an industry or in a supply chain in order to add/enhance new value for the stakeholder. (Arlbjørn, J. S., *et al.*, 2011).

Successful supply chain innovation will only happen when firms stop thinking of innovation only as adopting emerging technology but by taking actions such as break silos across organization, collaborate with peers; move beyond fixation on cost, without risk there is no return; we realize that even Amazon has limitation. 85 percent of supply chain leaders define innovation as process improvements or business model innovation (Croxtton, K. L., *et al.*, 2001). The three components of supply chain innovation (Stentoft, J., & Rajkumar, C., 2018): Supply Chain business process (SCBP), Supply chain technology (SCT), Supply chain network structure (SCNS).

The Global Supply Chain Forum, identified eight SCBP with sub-processes which are listed as along with their academic clarification: Customer Relationship Management (Fawcett, S. E., *et al.*, 2012). Customer Service Management (Bolumole, Y. A., *et al.*, 2003). Demand Management (Croxtton, K. L., *et al.*, 2002). Order Fulfillment (Croxtton, K. L., 2003), Manufacturing Flow Management (Goldsby, T. J., & García-Dastugue, S. J.,2003), Supplier Relationship Management (Croxtton, K. L., *et al.*, 2001), Product Development and Commercialization (Rogers, D. S., *et e.*, 2004), Return Management (Rogers, D. S., *et al.*, 2002).

The elements of SCT: Global Positioning Systems (He, W.,*et al.*, 2009), Bar coding (Manthou, V., & Vlachopoulou, M., 2001), Radio Frequency Identification (He, W.,*et al.*, 2009), Pick by voice technology (Dujmešić, N., *et al.*, 2018), Electronic Data Interchange (Hill, C. A., & Scudder, G. D.,2002), Advanced Planning Systems (Jonsson, P., *et al.*,2007), Warehouse Management Systems (Ramaa, A., *et al.*,2012), Enterprise Resource Planning (Akkermans, H. A., *et al.*, 2003), Manufacturing Execution System (Almada-Lobo, F. 2015), Product Life-cycle Management (Chaudhary, K., & Chandhiok, T.,2011), Business Intelligence (Jalil, N. A., *et al.*,2019), Internet enabled e-auctions (Nair, A., 2005).

The factors of Supply Chain Network Structure (SCNS): Inhouse and outsourcing, Partnership, Collaboration, Distribution channels, trust amongst supply chain participants, Third party logistics providers, Fourth party logistics providers, Joint ventures, Complexity in supply.

The analysis of case studies of firms excelled in supply chain innovation (based on CSCMP) will outline a blue print for companies to refer to as they look towards what drives meaningful supply chain innovation. The following is the case analysis of winners of supply chain innovation award 2005 to 2022.

#### 3.1 HP Procurement Risk Management

Motivation for Innovation. During year 2000, the increase in demand for electronic component influenced for increase in their market prices. To manage this demand the company initiated a Procurement Risk Management (PRM) project to implement new tools and processes to handle the risks of increasing prices and shortage in materials.

Description of the case. Through this program initiative, the innovation is the effective use of tools and processes from the financial risk management processes on Wall Street. HP established a framework to quantify impact of product demand, component pricing, and availability uncertainty of materials on revenue, costs, and profits. It is a software developed to support the risk management process and to

take action to manage procurement uncertainties and risks. The PRM business operations process is cross-functional that connects and defines the roles and responsibilities of planning, supply chain operations, procurement, finance, and marketing functions.

SCI Characteristics. The SCI of HP i.e. PRM can be characterized by: (1) Plan, development and implementation of new processes (2) One time change; (3) Comparatively a long period for plan, develop and implementation (4) Both top-down and bottom-up participation during the entire process and (5) The horizon for change was cross-functional and intra-organizational.

Observation. The SCI of HP i.e. PRM was a radical innovations in their SCBP and SCT.

### 3.2 Mercy Health Systems Resource Optimization and Innovation (Roi)

Motivation for Innovation. Health-care supply chains should support clinical operations, however, the supply chain can rarely be directly correlated to improved clinical performance. Sister of Mercy Health System's new supply chain division called Resource Optimization and Innovation (ROI) was to launch the supply chain as a strategic imperative for the business.

Description of the case. ROI did drastically simplified the supply chain of Health Care Systems by reducing its dependence on third-party intermediaries. This enabled a new way of working closely with makers and users of health care products, which in-turn provided an increased value for all the players in the supply chain.

SCI Characteristics. The SCI ROI of Mercy Health System can be characterized by: (1) Plan, development and implementation of new processes (2) One time change; (3) Comparatively a long period for plan, develop and implementation (4) Both top-down and bottom-up participation during the entire process and (5) The horizon for change was cross functional involving more organizations. The implementation of this program was driven by working in a new team structure with competences from inside the hospital and from outside resources that were hired from the logistics and supply chain industry.

Observations. This company has made radical innovations in their SCBP and SCT, which showed the Health-care supply chains importance in optimizing the total business.

### 3.3 Aidmatrix foundation

Motivation for Innovation. It was observed that many small service health care organizations do not have the necessary resources to be able to meet the needs of their continuously increasing client base. This could be solved by strong coordination across all the stakeholders in the supply chain.

Description of the case. The internet-based tool "FreeClinic Link" connected each member of the free health care clinics. The value proposition of each of the stake holders is maximized by full capture of all benefits and minimization of transaction costs. This tool allowed all participating free clinics to connect virtually. This system enabled all stakeholders to behave in a manner that maximizes the value for all other stakeholders. "FreeClinic Link", collaborative supply chain innovation by leveraging supply chain solutions from industry supporters such as Accenture, i2 Technologies and Sun Microsystems.

SCI Characteristics. Aidmatrix SCI "FreeClinic Link" can be characterized by: (1) Plan develop and implementation of new processes and technology (2) A one-time change with scope for kaizen (3) Relatively long period for development and implementation (4) Top-down and bottom-up participation; and (5) The horizon for change is cross-functional, inter organizational involving number of organizations.

Observations. Aidmatrix SCI "FreeClinic Link" was a radical-innovations in SCBP and SCT through the development of a internet based portal by effectively using different state-of-the-art technologies. The standard supply chain business processes were integrated using IT, it was possible to automate the collaboration between all stakeholders in the supply chain and thereby enjoying the gain across the chain.

### 3.4 Cisco Systems

Motivation for Innovation. In the logistics operation handling product returns at Cisco, was looking for ways to increase the efficiency in the handling processes and hence optimize the cost of the return process operation. A shift in management in 2005, they focused on finding new ways to maximize the value proposition from the returned products.

Description of the case. With the new focus from changes in leadership on value recovery, the logistics organization handling product returns had to change their way of working and of understanding the processes, so reverse logistics team created a reuse program. Through this program they started increase recovery rates and define and implement a profit-based business model to gain highest value for the company from the returned products. The returned and excess equipment were given a second—or even a third—life, before disposing off responsibly to recycling. Early on the recycling process was outsourced, however CISCO found this led to management and compliance gaps, increased expenses, and created risk. Hence, they brought in these core processes back in-house while outsourcing non-core activities. This resulted in tighter control of operations and so increased productivity, which enabled rapid growth. They implemented automated data sharing processes, which reduced losses from stocks and excess and obsolete parts. They decided to custom-build the IT architecture to manage its stock, evolving from exchanging spreadsheets to utilizing a central database to track stocks and take requests from internal customers.

SCI Characteristics. SCI “Transform Returns into a Profit Maker” of Cisco can be characterized by: (1) Plan, develop and implementation of new processes and technology (2) A one-time change with scope for kaizen (3) Relatively long period for development and implementation (4) Top-down and bottom-up participation; and (5) The horizon for change was cross-functional and inter-organizational changes involving suppliers in terms of in house and outsourcing of processes.

Observations. This Cisco’s SCI “Transform Returns into a Profit Maker”, the company made radical innovations in SCBP and SCT. Looking at SCT, as Cisco could not find standard IT solutions to support their new business model they developed a new IT architecture to support SCBP.

### 3.5 Intel

Motivation for Innovation. Due to exponentially increased demand for microprocessors during 1990’s exceeded the available supply. During the same period, the design and technological complexity of microprocessors increased, which resulted in production cycle times up to 90 days or more. After the “Internet bubble” burst Intel’s product manufacturing and process complexity, as well as cycle times, improved significantly. However, still Intel required seven to 9 days to respond to a customer request for supply. It was rated “Worst in Class” benchmarking with IBM Global Services.

Description of the case. The SCI “Just Say Yes” campaign was launched in 2005 to reverse their perception issues such as need for significant cultural changes in addition to various tool and process enhancement. The first step was to improve the ability to respond quickly and positively in order to respond to order requests. Secondly, steps were taken towards increasing the Committed Dock Date (CDD) performance to competitive levels. Thirdly. Initiation was towards reduction in inventory levels, and, finally, a program was instituted to reduce demand forecast errors.

SCI Characteristics. The Intel SCI “Just Say Yes” can be characterized by: (1) Plan, Develop and implementation SCBP by aligning a new mindset and setting new business rules and develop efficient IT applications to support coordination and collaboration (2) Multiple changes with scope for a kaizen approach towards change process; (3) It is a long-period implementation process; (4) The overall change process was initiated as a top-down approach. However, during the multiple stages of changes there have been both top-down and bottom-up participation and (5) The horizon of SCI is cross-functional and inter-organizational, for example, implementation of VMI supply models involved both suppliers and customers and also sharing forecast information.

Observations. Intel’s SCI “Just Say Yes”, radical innovations made in their supply chain in terms of SCBP, SCT and SCNS. In a highly complex business environment, Intel was able to manage new standards for customer response time and delivery service by implementing innovation of cross-functional business processes. Intel implemented technology to manage the new supply chain setup and changed the patterns of cooperation by implementing VMI solutions and collaborative solutions with their customers and suppliers.

### 3.6 Pepsi Bottling

Motivation for Innovation. In 2002 the company decided to expand manufacturing capabilities to enable growth. It needed to transform its warehouse effectiveness and a so-called “go-to-market” strategy to optimize service and costs. At the same time it was faced with a rapidly shifting product line and



customer expectations. The challenge was to Supply Chain Logistics Group was tasked with "transforming warehouse effectiveness." Daily sales orders needed to be picked and loaded within an 8- to 12-hour window, order profiles and SKU proliferation continued to challenge productivity efforts, building pallets was highly complex, and employee turnover was too high for various reasons, not least of which was because morale was low. Moreover, many remote satellite warehouses in the company's network were at or above their designed space / inventory index. Some were totally landlocked; increasing their footprint was not an option under any circumstances.

Description of the case. With focused combined approach to automation and distribution, a program called Direct Store Delivery Transformation Initiative developed its "Top Off" concept, the crux of its innovation. "Top Off" is an order pallet building process that enables up to 85 percent of the cases to be built at the upstream automation facility, then transported to the satellite warehouse where the remaining 15 percent of the cases are placed on top of the pallet. The pallet is now complete and ready for loading onto the delivery vehicle.

SCI Characteristics. This Direct-to-Store-Model innovation can be characterized by: (1) The development and implementation of new processes, Technology and network structure (2) A one-time change, however, that created a basis for continuous improvements; (3) Relatively a long period for development and implementation (4) Top-down and bottom-up participation; and (5) A cross-functional scope characterized by an inter-organizational solution spanning a number of organizations.

Observations. Their SCI "Direct to Store Model" was an incremental innovations in SCBP and radical innovations in SCT and SCNS. By implementing combined approach of automation and distribution through their highly innovative - and successful - Direct-to-Store Delivery Transformation Initiative, results observed were very significant.

### 3.7 Ahold USA, Del Monte foods, ES3

Motivation for Innovation. They figured that the traditional method of distributing manufacturer's product to grocery stores was a tried-and-failed process. Wasteful of time, money and resources, there had to be a better way, and indeed there is, Ahold USA, Del Monte Foods and ES3 did just that.

Description of the case. Their direct-to-store vision was to create a streamlined supply solution for the grocery industry that eliminated a distribution center and leg of transportation. By using the ES3's capacity, manufacturers like Del Monte Foods (and others) and Ahold USA - whose supermarket portfolio includes Giant Food Stores - combined their mixing centers and distribution centers into one large facility. This restructuring of the supply chain requires scale, automation, information technology, and collaboration. It has resulted in a synchronized, efficient, end-to-end supply chain solution that is faster, cheaper and greener than the current supply chain models.

SCI Characteristics. Ahold USA, Del Monte foods, ES3 SCI "Direct-to-Store" can be characterized by: (1) Plan, develop and implementation of new processes, technology and change to network structure (2) A one-time change, however, that created a basis for continuous improvements; (3) A relatively long development and implementation period; (4) Top-down and bottom-up participation; and (5) The horizon for change is cross-functional collaborative operations to restructure the supply chain.

Observations. This case demonstrated incremental innovations in SCBP, radical innovation in technology & network structure. Restructuring the supply chain through combining multiple manufacturers' mixing centers and a retail distribution center into a single facility. Additionally, retailers are seeing savings in store labor as selected pallets are better organized to align with store layouts and more accurately picked due to automation.

### 3.8 Dal-Tile, Whirlpool, Werner, Convermex, Transplace

Motivation for Innovation. In logistics business shippers with dense consignment reach legal weight bounds but a significant amount of cubic capacity could be unused in a trailer, container or boxcar. Shippers with lower density freight can fill cubic capacity but leave weight capacity under-utilized.

Description of the case. However, such companies can be the good match for each other. Improving weight or cubic capacity utilization is a challenge many shippers face. As the firm quotes "Opposites Attract – Shippers Consolidate Truckloads to Improve Capacity Utilization and Sustainability" Partnering with like-minded businesses has allowed firm to bring its shipments much closer to absolute capacity

optimization, and realize financial and environmental benefits without sacrificing service. (1) Collaborative consolidation of Dal-Tile's high density freight with other shipper's low density freight onto the same vehicle has reduced the demand for transportation resources by 60 percent on applicable lanes, netting cost reductions of 10-25 percent while reducing our carbon footprint." collaborative efforts to consolidate low- and high-density freight onto the same vehicle to reduce demand for transportation resources, thereby reducing costs. (2) Developed an international co-load program to improve truck capacity utilization by combining shipments from companies in different industries. Dal-Tile's intermodal and over-the-road shipments might cover 2,000 miles at 20-percent cubic capacity utilization. Whirlpool's boxcar shipments used 20 percent of their weight capacity. Combined, the boxcar shipment now yields 70 percent to 80 percent of the capacity each shipper received in private service, as well as an environmentally friendly mode shift.

SCI Characteristics. The case is characterized by (1) The development and implementation of new processes, Technology and network structure (2) Change undertaken with kaizen approach (3) A relatively long development and implementation period; (4) Top-down and bottom-up participation; and (5) A cross-functional and inter-organizational change: Dal-Tile, Whirlpool, Werner, Convermex, Transplace solution must be characterized as collaborative approach to solution spanning a number of firms.

Observations. This case was incremental innovation in SCBP and radical innovation in SCT and SCNS through collaborative efforts to reorganize the business process and network structure by identifying an opportunity for co-load with other shippers.

### 3.9 Staples, Packsize Intl

Motivation for Innovation. Corrugated cardboard is the most commonly used packaging material. And rightly so—it's the cheapest, cleanest, and most versatile option available to businesses. Huge solid waste comes from containers and packaging, with over half of that packaging waste being cardboard. This kind of trash generation is not sustainable. Staples ships a lot of boxes every day. However, they only carried a handful of box types. This resulted in a lot of empty space and a huge number of customer complaints for "excessive packaging."

Description of the case. Sustainability has been labelled an "inescapable megatrend" by many experts and it is one of the top concerns for companies and individuals today. Waste reduction is a key pillar of sustainability improvement efforts, with packaging a substantial component under consideration. As the second largest e-commerce fulfillment business in the world after Amazon, Staples ships millions of packages each year to customers through their U.S. "E-Commerce Fulfillment Centres". Looking for solutions to reduce packaging waste, Staples, in collaboration with Packsize International, implemented a "Smart-size Packaging Program" in 2012 that produces customized packaging tailored to each order. The result—a better customer experience and improved supply chain sustainability and efficiency with every delivery order.

SCI Characteristics. Their SCI "Smart-size Packaging Program" can be characterized by: (1) Plan, Develop and implementation of new processes; (2) A one-time change; (3) Relatively short period for development and implementation (4) Participation was both top-down and bottom-up; and (5) The scope cross-functional and intra-organizational and collaborative.

Observations. This innovation is an incremental in their SCBP and radical innovation SCT by effectively using state of the art technologies.

### 3.10 Flextronics

Motivation for Innovation. The emergence of wearable technology products such as augmented reality eyeglasses, sensor guided canes for blind, headband for monitoring brain activity, concussion sensors nestled in helmet, smart T-shirts for soldiers are promising to be critical game changers in the technology landscape. Their rapid pace of development and shortened time to market expectations clearly states the need for advanced level of synchronization from product design to fast material acquisition to prototype manufacturing, and from volume production ramp to end-customer Fulfillment.

Description of the case. At this stage they realised just quick is not enough, rather they needed a soup-to-nuts supply chain cluster. Initially, the ideas to address this problem came from people with little or no business experience through brainstorming. They came out with their own innovation to transform

their manufacturing facility at Milpitas, California into state-of-the-art COE (Center of Excellence) to support the SC needs of these new products. Their “Silicon Valley Product Innovation Center” integrated every element (concept, design support, knowledge of materials etc) of its supply chain to give end to end SC solution.

SCI Characteristics. Flextronics SCI, “Silicon Valley Innovation Center” can be characterized by: (1) Plan, Develop and implementation of new processes and state of the art technology (2) one time change with scope for continuous improvement (3) Comparatively long period for plan, development and implementation (4) Though it was initiated from top down, however both top down and bottom up participation is required during entire process (5) Multiple cross functional and interorganizational coordination for all transformational changes.

Observations. Product Innovation Center was a radical innovation in SCBP and SCT to transform their manufacturing facility.

### 3.11 Liquor Control Board of Ontario (LCBO) -

Motivation for Innovation. LCBO has 650 plus retail stores and 210 plus agency stores, catalogues and special order services. Their warehouse manages sorting and distribution of 50 million plus cases of product each year, which is a labour-intensive work. The problems faced by the company are atrocious product breakages, on the job musculoskeletal injuries, inefficiencies due to not dense or stable pallet loads leading to below optimal cube utilization in the outbound truckloads. When an order arrived at a store with missing case, there was no way to track it, as there was no traceability of what was in each pallet. Their challenge was getting the product palletized and out of the door.

Description of the case. SCI award they received was for innovative automated palletizing process developed inhouse by using a sophisticated optimization software, 3-D visualization and simulation to build mixed case pallet of variable dimensions. It's an algorithm that allows automatic palletization of outbound orders having varied case sizes and products. The algorithm is complex, but to put it in simple framework: Firstly, It creates theoretical tier patterns based on the case sizes presented to it, secondly, it adjusts the pattern so it can be created on a standard pallet loader and finally, it evaluates the pattern for stability.

SCI Characteristics. This inhouse built SCI “Automated Palletizer” can be characterized by: (1) Plan, develop and implementation of new technology (2) One time change (3) Comparatively a long period for development and implementation (4) The top down participation during the entire process (5) The horizon for changes is limited to only one function i.e. WMS

Observations. This SCI of LCBO is a radical innovation in SCT which they applied for patent.

### 3.12 Dell

Motivation for Innovation. Dell Inc supply chain is optimized for efficiency, speed and reliability. However, the management was unhappy with their pace in moving towards their series of aggressive sustainable goals to achieve their mission “Legacy of Good”.

Description of the case. They had to accelerate the pace of innovation to drive sustainability faster into every facet of Dell's operations, from procurement to manufacturing to logistics. Three key transformations were considered: 1. Creating and sustaining innovation culture through significant employee communication around the program, extensive training on “Design Thinking”, competitions and recognitions for employee efforts. 2. Identifying and deploying tools to support the program such as “crowdsourcing” application to submit and track innovative ideas, evaluating them through development of repeatable process and promoting innovative ideas. 3. Define progress clearly, using innovation metrics developed by them that measured pace and success of innovations in sustainability. By this SCI they were able to reduce supply chain costs.

SCI Characteristics. This SCI of Dell Inc can be characterized by (1) Plan, develop and implementation of new process and technology (2) It was not an one time change rather it is characterized by multiple phases of change with an approach to kaizen (3) It was a top down participation which also need bottom

up support during the entire process (4) (5) The horizon for change: A cross functional and intra organizational to implement cultural changes and smooth communication during the entire process. Observations. This innovation of Dell Inc is an incremental innovation in their SCBP and radical innovation in SCT.

### 3.13 Trans Celerate

Motivation for Innovation. The procurement of comparator medicines required for use in clinical trials for the development of innovative medicines poses a SC challenge within biopharma R&D. This supply chain challenge is because of absence of direct relationship between the innovator (i.e. buyer) and the manufacturer (i.e. seller), which may lead to introduce counterfeit produce into supply chain, compromising patient safety and jeopardizing the clinical trials.

Description of the case. TransCelerate's SCI "Comparator Network" marks a transformative shift in the manner in which biopharmaceutical companies have historically procured comparator medicines to conduct clinical trials. It created a forum that provides participating member companies access to comparator medicines and information that supports their ability to conduct clinical trials efficiently with integrated approach. It is a game changer in that it has led to the creation of a platform that provides participating member companies access to clinical medicines and related documentation which facilitates their ability to conduct clinical trials more efficiently and mitigates risk to the continuity of clinical trials. Additionally this network has fostered an environment where member companies can collaborate and develop community based knowledge and learn from the experiences of others.

SCI Characteristics. This SCI "Comparator Network" can be characterized by: (1) Plan, develop and implementation of new processes and technology (2) one time change (3) Comparatively a long period for development and implementation of entire process (4) both top down and bottom up participation (5) Cross functional and intra organizational involving multiple stakeholders from biopharmaceutical industry supporting to do clinical trials more efficiently with integrity.

Observations. This is a radical innovation in SCBP and SCT through their digitization of pharma R & D "Comparator Network Exchange System".

### 3.14 Intel

Motivation for Innovation. Intel satisfies more than 1 million orders every year from multiple manufacturing plants and 30 plus distribution centers, while generating humongous amount of data. For organizations of as big as Intel, supply chain proficiency and readiness by ceaselessly enhancing are very basic along with dependably concentrating on lowering of supply chain costs. This is when Intel jumps to cognitive computing.

Description of the case. Intel's SCI "Artificial Intelligence/Cognitive Computing Based Sourcing Intelligence Platform" paved way for digital supply chain transformation. Intel employed this tool to aid in making sense of the infinite amount of unstructured data to its transition from product centric business to data centric business. This innovation helps them to deal with their military of worldwide suppliers, by making better decisions which suppliers are their best partners irrespective of any given material and any area of the world.

SCI Characteristics. Intel's SCI can be characterized by: (1) Plan, develop and implementation of new processes, technology and network (2) one time change (3) Comparatively a long period for development and implementation of entire process (4) both top down and bottom up participation (5) Cross functional and intra organizational involving multiple stakeholders

Observations. This is a radical innovation in SCBP and SCT, SCNS

### 3.15 Snap-on Tools and FastFetch Corporation

Motivation for Innovation. Sanp-on Tools, a leading supplier of hand and power tools, looked for ways to slash shipping costs, packing labour, dunnage and also to use corrugated materials for packing.

Description of the case. This need of Snap-on Tools was addressed by FastFetch, a technology development company developed artificial intelligence strategy to slash shipping costs of their distribution center. The solution Intellipack shipping cost optimization system employs three key innovations to reduce cost and enhance worker productivity. 1. A highly effective AI strategy for minimization of wasted space in shipping cartons. The strategy computes the dimension of an ideal carton for shipping a collection of items of known size in less than a second. 2. A search strategy that

analyses historical order records in order to identify an inventory of carton sizes for shipping orders with minimal waste. 3. Carton management strategy that makes right sized cartons available to packers as soon as they are needed and guides human workers as they replenish consumed cartons using combination of voice, barcode scanning and light directed technologies.

SCI Characteristics. FastFetch's "IntelliPack" can be characterized by: (1) Plan develop and implementation of processes and technology (2) One time change with focus on kaizen (3) Required comparatively long period for implementation of the process (4) Top down and bottom up participation (5) The horizon for change is cross function and inter organizational with collaborative approach.

Observations. FastFetch's Artificial Intelligence strategy used to slash shipping costs at Snap on tools distribution centre is radical innovation in SCBP and SCT

### 3.16 Intel Corporation

Motivation for Innovation. Organizations as big as Intel Corporation with exponential growth in markets and applications, coupled with increasing customer demands, has brought their procurement, manufacturing, and order fulfilment network to an unprecedented level of complexity. Intel was finding it really difficult to assess the terms and conditions of contracts with 650 plus suppliers. Manual assessment was no longer sufficient. Auditing contract documents and scoring key contractual provisions was overwhelmingly difficult manually.

Description of the case. – They received the innovation award for their "Use of contract digitization and analytics to disrupt the traditional contract management paradigm". It was developed inhouse in four steps 1. Data extraction – download thousands of contracts from the central repository in minutes with the help of Robotics Process Automation (RPA) and digitizing them through optical character recognition (OCR) in order to standardize the information and make it searchable 2. Data Integration – raw data is merged with meta data 3. Use machine learning and natural language processing – suss out risks associated with labelling data based on input from commercial and legal experts. 4. Creation of colour coded dashboard to display results in a meaningful way. This is how they leveraged the power of data and artificial intelligence (AI) to modernize their supply chain processes and architecture in the face of an ever-changing business and technology landscape.

SCI Characteristics. can be characterized by: (1) Plan develop and implementation of processes and technology (2) One time change with focus on kaizen (3) Required comparatively long period for implementation of the process (4) Top down and bottom up participation (5) The horizon for change is cross functional.

Observations. This Intel's SCI is a radical innovation in SCBP and SCT

### 3.17 Management Sciences for Health (MSH)

Motivation for Innovation. Russia's invasion of Ukraine has had devastating consequences for its citizens as well as core institutions in the health care sector, with hundreds of facilities decimated from bombing and other attacks. Ukraine's vibrant domestic pharmaceutical sector, a \$2 billion market before the war, initially broke down. Trucks couldn't make deliveries. Manufacturing sites were bombed and destroyed. More than half of all pharmacies were unable to dispense medicines at one time or another.

Description of the case. Before the invasion, Safe, Affordable, and Effective Medicines for Ukrainians (SAFEMed) Activity was helping strengthen the country's pharmaceutical sector through activities such as boosting transparency and efficiency while lowering the cost of state purchase of medical goods with the creation of a Central Medical Procurement Agency. The end goal is ensuring that patients can access lifesaving medicines for HIV, TB, COVID-19, and more. As the war began, the Ukrainian Ministry of Health asked MSH to assist in setting up and managing the delivery of humanitarian medical supplies, from essential medicines to emergency first aid kits and hospital stretchers. MSH is providing technical support to design, coordinate, and monitor the supply chain system necessary to deliver a substantial proportion of the humanitarian medical assistance arriving in the country from governments and private donors in Europe and North America. MSH engaged a Private pharmaceutical logistics company for last-mile distribution of HIV and TB medicines. The approach aimed to streamline

fragmented public-sector logistics services while following supply chain best practices and improving patient outcomes.

SCI Characteristics. (1) Plan develop and implementation of processes and technology and network (2) One time change (3) Required comparatively short period for implementation of the process (4) Top down and bottom up participation (5) The horizon for change is cross functional and inter organizational Observations. Management Sciences for Health (MSH) - **Ukraine: Tapping a Private Fleet to Get**

#### **Medicines to the Last Mile is a radical innovation in SCBP and SCNS.**

##### 3.18 Holcim

Motivation for Innovation. Holcim, a global leader in innovative and sustainable building solutions. COVID 19 pandemic, it is by human nature, strive to make the best of a bad situation, and such efforts often yield positive results that might otherwise have never been realized. COVID 19 pandemic increased uncertainty in supply chain & demand. In Pre-Covid times, experience driven decision was preferred over data driven decisions.

Description of the case. It's no surprise that misfortune serves as a catalyst for innovation. Holcim's case of "Crisis as Innovation Catalyst", firm adopted quickly by leveraging the technology. Transport Analytic Center (TAC) optimizes logistics in a data-driven way, powered by advanced analytics and artificial intelligence. With its tracking devices, TAC uses data for optimal route mapping, increasing the predictability and safety of deliveries. This proprietary digital tool enables Holcim to transparently track its transportation emissions, including those of its third-party suppliers, to continuously reduce its environmental footprint in line with its scope 3 emissions target. By using data to optimize supply chain logistics through its TAC by leveraging on MAD (Machine Learning, Analytics and Data). Data driven analytics can help an organization to increase road safety, boost efficiency, reduce carbon emissions and leverage new opportunities.

SCI Characteristics. (1) Plan develop and implementation of processes and technology and network (2) One time change (3) Required comparatively short period for implementation of the process (4) Top down and bottom up participation (5) The horizon for change is cross functional and inter organizational Observations. Holcim - Use of data-driven analytics to transform its transportation operations, SCI is a radical innovation in SCBP, SCT and SCNS

#### **4. Concluding Remarks**

Supply Chain Management approach involves integration and coordination across organizations and throughout the supply chain. It means that supply chain management requires internal and external integration. Organizations excel in their supply chain through internal integration, external integration, collaborating outside and across the company in designing the supply chain process by using supply chain technology to create the appropriate network design. The considered companies receiving supply chain innovation award, highlight different approaches to supply chain innovation, demonstrating the importance of leveraging technology, data, and customer-centric strategies to achieve operational excellence and competitive advantage.

As we progress from the first SCIA winner to the 2022 SCIA winner we observe

1. The factor driving innovation is the thrust for the companies to cut down cost of supply chain to be competitive and sustainability.
2. Leveraging of state-of-the-art technology available at that particular point in time. Either design and development inhouse or by making decision to outsource.
3. Encouraging organizational cultural changes.
4. Integration and collaboration for efficiency and effectiveness.
5. Design Thinking Approach
6. Both top down and bottom-up participation of all stake holders.
7. Kaizen approach

Definitely the awards encourage the companies to establish their global presence. These studies will benefit other companies to analyze why and how they have seen success from their innovations and impart those learnings into how one can develop their next innovative solution or process.

Table 3: Radical and Incremental Innovation categorization

1\* Incremental 2\* Radical

Case No.	Company	Title	Radical Innovation	Incremental innovation
1	HP Procurement Risk Management	Launched procurement risk management program to quantify impact of demand, price and availability.	Y	
2	Resource Optimization and Innovation/Mercy	Created new supply chain business unit to standardize and consolidate systems, services and purchases.	Y	
3	Aidmatrix foundation	Created portal-Free-clinic Link- between companies with excess medical supply to non-profit organizations needing supply	Y	
4	Cisco Systems	Transformed reverse logistics to profit center, increasing product reuse		Y
5	Intel	Created a process to receive and schedule customer orders, improving customer promise to delivery service.	Y	
6	Pepsi Bottling	New case picking automation and combined proprietary order management tools	Y	Y
7	Ahold USA, Del Monte foods, ES3	Created a grocery industry distribution centre for suppliers and retailers to collaboratively streamline deliveries.	Y	
8	Dal-Tile, Whirlpool, Werner, Convermex, Transplace	Developed an international co-load program to improve truck capacity utilization by combining shipments from companies in different industries.	Y	Y
9	Staples, Packsize Intl	"Smart-Size" program to produce customized packaging for each order.	Y	
10	Flextronics	Created customer idea/product incubation program and support facilities.	Y	Y
11	Liquor Control Board of Ontario (LCBO)	innovative automated palletizing process, which uses sophisticated optimization software, three-dimensional (3-D) visualization, and simulation to build mixed-case pallets of variable dimensions.	Y	
12	Dell	end-to-end sustainability initiative covering its entire product portfolio	Y	Y
13	Trans Celerate	Transforming the supply chain for clinical comparator medicines	Y	Y
14	Intel	artificial intelligence and cognitive computing tools that it developed to improve its sourcing decisions.		Y
15	Snap-on Tools/FastFetch Corporation	Artificial Intelligence strategy used to slash shipping costs at Snap on tools distribution center.		Y

16	Intel Corporation	Use of contract digitization and analytics to disrupt the traditional contract management paradigm	Y	
17	Management Sciences for Health (MSH)	Ukraine: Tapping a Private Fleet to Get Medicines to the Last Mile	Y	
18	Holcim	Use of data-driven analytics to transform its transportation operations.	Y	
		<b>Total</b>	15	8

### 5. Future Scope:

The study has several limitations of using only CSCMP SCIA winners. If the studies can further be expanded by comparing the supply chain performance of SCI leaders across the globe would enhance the body of literature. Most companies see a need to reduce supply chain risk, but few invest to solve by innovating. Further research can define hypothesis for the associated risk and assess risk associated with supply chain innovation.

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