Study of Supply Chain Management and Buyer Supplier Relationship and Industry 4.0 Implementation in the Supply Chain

Dr. Deepak B. Magar[1] Dr. D. M. Khandare[2] Dr. Ramkisan S. Pawar[3] Dr. Munjadas S. Kadam[4] Prof. Nilesh V. Sawdekar[5]

[1,5]Assistant Professor [2]Professor and Finance Officer [3]Principal and Professor [4]HOD and Professor
[1,2]Department of Civil Engineering
[1,5]MSPM'S, DIEMS, Aurangabad, India [2]S.R.T.M.U., Nanded, India [3]TSSMS PVPIT, Bavdhan, Pune, India [4]MGM University, Chh. Sambhajinagar, India

Abstract — Supply chain performance represents a swiftly evolving area of research. Many companies are actively seeking tools to enhance performance metrics, particularly in response to the volatile nature of business markets and the need for efficient control of business operations. The prevailing perspective on competitiveness and strategy emphasizes that customer value is created through collaborative efforts among firms with shared objectives, rather than through isolated endeavors. Consequently, there is a growing realization that firms engaging in cooperative, long-term partnerships can enhance the overall operation of the supply chain, benefiting all parties involved. Our findings indicate positive correlations between a) trust and financial performance, and b) supplier involvement and financial performance. However, the relationship between face-to-face site visits and financial performance did not yield significant results. Notably, Industry 4.0 has a discernible impact on Social Capital within Buyer-Supplier Relationships. We have conducted a systematic literature review analyzing 36 academic articles to explore the strategic shifts that Industry 4.0 entails for Social Capital within these relationships. These transformations encompass cognitive, structural, and relational aspects, such as shared vision, social interaction, and trust. This underscores the importance of Social Capital within Buyer-Supplier Relationships and highlights its cultivation, particularly in areas like collaborative decision-making, information sharing, and cross-company integration in Industry 4.0 contexts. Our proposition posits that Industry 4.0 implementation not only necessitates but also fosters Social Capital within Buyer-Supplier Relationships, delineating the coexistence of two diametrically opposed fundamental forms of such relationships within an Industry 4.0 context. This systematic literature review is the first of its kind, offering a comprehensive analysis of the existing body of literature on Buyer-Supplier Relationships in the context of Industry 4.0, shedding light on intricate transformations within the purview of Social Capital. Additionally, it provides a comprehensive overview of the current research landscape and offers several recommendations for future research and managerial practices, notably concerning the involvement of human expertise in strategic tasks within Industry 4.0.

Keywords: Supply Chain Management, Industry 4.0, Buyer-Supplier Relationship

I. Introduction to Supply Chain 4.0

Supply Chain 4.0 involves the application of the Internet of Things (IoT), advanced robotics, and sophisticated big data analytics in supply chain management. It entails the placement of sensors in various elements, the establishment of extensive networks, automation of processes, and comprehensive data analysis to markedly enhance performance and customer satisfaction.

Over the past three decades, logistics has undergone a profound transformation. It has evolved from being primarily an operational function reporting to sales or manufacturing, focused on ensuring the supply of production lines and timely customer deliveries. In some organizations, it has even reached a point where it is led by a Chief Supply Chain Officer (CSO), signaling its strategic significance. The shift in the focus of supply chain management has been towards advanced planning processes, such as analytical demand planning and integrated Sales and Operations Planning (S&OP), which have become integral business processes in numerous companies. Consequently, operational logistics has often been outsourced to third-party Logistics Service Providers (LSPs). The supply chain function now strives for integrated operations spanning from customers to suppliers.

II. Trends in Supply Chain Management

Industry 4.0 is a disruptive force, compelling companies to reevaluate their supply chain design. It introduces a multitude of technologies that are reshaping traditional modes of operation. Additionally, macroeconomic trends and evolving customer expectations are driving this transformation. Factors like the continued growth of rural areas globally, along with wealth distribution shifts, present new challenges for logistics. Pressures to reduce carbon emissions and socioeconomic regulations further compound the challenges that logistics face. Changing demographics have led to labor shortages and increased ergonomic requirements as the workforce ages. Simultaneously, customers have raised their expectations, fueled by the online shopping trend of recent years. This has resulted in greater service demands and more finely-grained orders, coupled with a strong trend toward personalization and customization, contributing to the proliferation of Stock Keeping Units (SKUs). Increased online transparency and accessibility to multiple shopping options have intensified competition among supply chains. These trends collectively demand that supply chains become faster, more granular, and exceedingly precise in their operations.

III. Digital Waste Preventing Supply Chain 4.0 Unleashing its Potential

In contemporary supply chains, digital waste, in addition to conventional waste, presents significant obstacles to realizing the full potential of Supply Chain 4.0. Recognizing the sources of this waste and developing solutions to reduce or

eliminate it in future states is crucial. Digital waste can be categorized into three types:

A. Data capturing and management:

Frequently, available data is manually processed, such as data collection in a system or paper-based data handling. Moreover, this data is often not regularly updated, resulting in outdated information, like static supplier lead time data. Another example pertains to advanced shipping notifications, which are often received but not leveraged for optimizing inbound processes. Often, it remains unclear which additional data could be leveraged to enhance processes, like sensing supply disruptions. The inability to recognize and act upon signals in current systems can lead to lower supplier service levels and operational issues.

B. Integrated process optimization:

Many companies have initiated integrated planning processes, but they are frequently executed in silos, where not all information is utilized to attain the optimal planning outcomes. Additionally, automatic planning or statistical forecasts are often manually overwritten by planners, adversely affecting forecasting accuracy, especially for fast-moving parts. Achieving advanced levels of integrated process optimization necessitates alignment of organizational structure, governance, processes, and incentives within and among supply chain partners.

C. Physical process execution by humans and machines:

Currently, activities like warehousing, assembly line replenishment, and transport management are often based on instinct rather than leveraging available data for process improvement. Warehousing operations are managed in time intervals that hinder real-time allocation of new orders and dynamic routing. Opportunities offered by emerging devices like wearables (e.g., Google Glass) or exoskeletons are underutilized.

IV. Increasing Operational Efficiency Through Supply Chain 4.0

Supply Chain 4.0 stands to impact all facets of supply chain management. To structure the key levers for improving Supply Chain 4.0 and map them to six principal value drivers, we have developed the McKinsey Digital Supply Chain Compass (refer to the following figure). Ultimately, these enhancements pave the way for substantial improvements in service, cost efficiency, capital management, and agility.

A. Planning

The future of supply chain planning will significantly benefit from big data, advanced analytics, and the automation of knowledge work. Two prime examples with substantial impacts are "predictive analytics in demand planning" and "closed-loop planning."

Predictive analytics in demand planning involves analyzing hundreds to thousands of both internal and external demand-influencing variables (e.g., weather, social network trends, sensor data) using Bayesian network and machine learning approaches. These technologies uncover and model complex relationships, resulting in precise and granular demand plans. This approach often reduces forecasting errors by 30 to 50 percent. Moreover, it no longer relies on a single forecast number but provides probability distributions of expected demand volumes, enabling more targeted discussions, including upsides and downsides, in Sales and Operations Planning (S&OP) and advanced inventory management.

Comprehensively automated and seamlessly integrated closed-loop demand and supply planning dismantle the traditional divisions between Sales & Operations Planning (S&OP), Advanced Planning & Scheduling (APS), and execution. Real-time alerts indicate potential issues, while automated rules can trigger decision-support actions or directly alter execution parameters.

V. Operational Excellence

The realm of operational excellence in Supply Chain 4.0 encompasses both end-to-end processes and functions. Enhanced operations benefit from the advancements in technology and automation, ultimately yielding superior efficiency and flexibility.

End-to-end process efficiency gains are particularly prevalent in logistics. Sensor technology allows continuous shipment tracking with geolocation and condition monitoring. Predictive maintenance of vehicles and warehousing equipment maximizes uptime and utilization. Drones are employed for last-mile delivery. Blockchain technology enhances the transparency and traceability of goods in transit, providing documented proof of product authenticity and compliance. Robotic process automation (RPA) is a game-changer for labor-intensive manual processes such as order-to-cash, procure-to-pay, and hire-to-retire. These technologies culminate in significant operational cost savings and enhanced customer service.

On the functional side, cognitive procurement is one of the key levers. Machine learning enables an automated analysis of spend data, supports automatic purchase order generation, identifies supplier performance issues early on, and analyzes potential savings. Ultimately, this leads to more effective supplier collaboration, cost savings, and better supplier risk management.

VI. Asset Productivity

The lever for increasing asset productivity is characterized by improved resource utilization, predictive maintenance, and the creation of new business models.

In manufacturing, predictive maintenance of machines, based on data analytics and sensor technology, has evolved. Machine utilization is further optimized by condition-based maintenance, which schedules maintenance activities not at fixed intervals, but when the condition of the machine indicates it's necessary. This approach dramatically reduces downtime and maintenance costs. The integration of collaborative robots (cobots) with humans can increase assembly line productivity. Cobots are equipped with sensors and cameras that allow them to work alongside humans safely. This enables flexible and efficient resource allocation.

In addition, advanced asset tracking and management using IoT technology allows businesses to monitor and optimize the utilization of equipment and vehicles. For instance, GPS data combined with predictive

analytics can determine the optimal routes for delivery trucks, reducing fuel consumption and improving delivery times.

VII. Performance Management

Performance management is centered around enhancing decision-making processes through data-driven insights and performance monitoring. It plays a pivotal role in enabling supply chain leaders to make informed and proactive decisions.

Real-time performance monitoring provides executives with a comprehensive view of the entire supply chain. Advanced analytics tools offer predictive and prescriptive insights, helping organizations proactively identify potential issues and take corrective actions. For instance, predictive maintenance analytics can alert maintenance teams to equipment issues before they cause unplanned downtime.

Supply chain leaders are increasingly adopting digital dashboards that offer real-time visibility into key performance metrics. These dashboards enable executives to monitor KPIs, track progress toward strategic goals, and quickly respond to deviations from the plan.

VIII. Customer Experience

Customer experience encompasses all aspects of interactions between a company and its customers. In a Supply Chain 4.0 environment, customer-centricity is paramount, and technology enables companies to deliver exceptional experiences.

Personalization is a key driver of customer experience improvement. Machine learning algorithms analyze customer data to understand preferences and behavior. This enables companies to tailor product recommendations and marketing messages to individual customers, increasing the likelihood of conversion and loyalty.

Supply Chain 4.0 also enhances transparency and visibility for customers. Customers can track the status of their orders in real-time, receive accurate delivery estimates, and even see the journey of their products from manufacturing to delivery. Blockchain technology can provide immutable records of product authenticity and origin, increasing trust and reducing the risk of counterfeit products.

IX. Business Model Innovation

The final lever, business model innovation, involves the creation of new revenue streams and value propositions enabled by Supply Chain 4.0 technologies.

One example of business model innovation is the shift from selling products to offering product-as-a-service or subscription-based models. IoT-enabled products can be monitored remotely, allowing companies to offer predictive maintenance services. For example, an industrial equipment manufacturer can offer equipment uptime guarantees as part of a service agreement, charging customers based on machine usage.

Another example is the sharing economy within logistics. Companies can leverage digital platforms to share excess capacity with other businesses. For instance, a logistics company with spare warehouse space can rent it to other companies in need of storage, generating additional revenue.

X. Conclusion

Supply Chain 4.0 represents a transformative shift in supply chain management. It leverages cutting-edge technologies, data-driven insights, and automation to drive improvements in planning, operations, asset productivity, performance management, customer experience, and business models. Companies that embrace Supply Chain 4.0 can achieve significant competitive advantages, including increased efficiency, agility, and customer satisfaction.

The key to success in this new era of supply chain management is a holistic approach that encompasses technology adoption, organizational alignment, and a focus on delivering value to customers. By leveraging the six levers of the McKinsey Digital Supply Chain Compass, companies can navigate the complexities of Supply Chain 4.0 and unlock its full potential.

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