



A BALANCED SCORECARD MODEL TO GUIDE THE EFFECTIVE IMPLEMENTATION OF DIGITAL TRANSFORMATION OF SUPPLY CHAINS

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ABSTRACT

Today, the world is at the dawn of a new age, the age of digitization, data, and connectivity. Digitization is a much-discussed term both among practitioners and academicians. However, there is a significant difference between the hype about the digital transformation of the supply chain and its actual implementation. One of the most significant reasons behind the sluggish implementation is the need for more guidelines for the transformation. This paper aims to propose a balanced scorecard model (considering enablers and barriers of Digital Supply Chain) for the effective implementation of digital supply chain management in Indian organizations. A survey has been conducted to assess the current status of the adoption of digital transformation of supply chains in Indian organizations. Based on the findings of the survey, a model has been proposed for the implementation of DSCM in Indian organizations. The proposed model consists of four stages for successful implementation of digital supply chains based on the balanced scorecard approach, which can assist policymakers in better organizing their assets and executing endeavours toward the digital transformation of the supply chain.

Keywords: Digital supply chain (DSC), balanced scorecard model, implementation guidelines, Industry 4.0.

I. Introduction

Supply chain management is one of the most significant business processes for most organizations. The success of an organization depends on how effectively it manages its supply chain. Over the last decade, technological innovations have penetrated almost every facet of shoppers' lives [1]. This has altogether had an impact on the manner in which individuals live, consume, and interact with their surroundings. The emergence of e-commerce, the exponential growth of internet usage in day-to-day life, the rising tide of social media platforms, and the exaggerated use of smart devices have profoundly affected today's customers' buying habits and service expectations [2]. The consumers of the future want to receive the product as soon as possible, exactly as per their requirements. These drastic changes in the shopping habits and expectations of customers have put massive pressure on organizations and supply chains, forcing them to seek out new approaches, strategies, and technologies and adopt the new business model to deal with the changing behavior of consumers [3]. Relying on a conventional supply chain (SC) execution system has become less viable in the present scenario as the traditional supply chains worked on the trade-off between efficiency and responsiveness, but today, the global market requires modern supply chains to be both efficient and responsive at once, that too at even more lower cost. For a long time, the extent of supply chain productivity and responsiveness was restricted by technological capabilities, required human meticulousness, and on-time data and information availability. Recently developed novel technologies like Big data analytics (BDA), Blockchain, 3D printing (3DP), Internet of things (IoT),



Machine learning (ML), augmented reality (AR), cloud computing (CC), advanced robotics, etc. have rationalized the supply chains offering unprecedented opportunities to develop new platforms for real-time data collection, seamless interconnectedness and information exchange across all supply chain members [4,5,6]. Employing these innovations to upgrade supply chain operations, administration and products/services to accomplish a differential competitive advantage is specified as digital transformation of supply chains (DTSC).

Digitalization of supply chains is one of the essential business movements of the present time. Despite numerous benefits, both to the organizations and customers, the adoption rate is slow and limited to large-scale enterprises. The adoption of DSC in Indian organizations is not as pervasive as anticipated by peers [7,8]. However, there is absence of explicit guidelines for a successful digital transformation of supply chains. In this paper, an implementation model for the successful digital transformation of the supply chain has been proposed using a balanced scorecard approach. The remaining sections of the paper are arranged as follows. The next section presents the literature review. Section 3 presents the methodology adopted. Section 4 presents the digital supply chain implementation model. Section 5 presents a discussion of the study and conclusions of the study.

II. Literature review

The high internet penetration, multi-channel availability, rapidly growing social networks, and ubiquitous information availability have significantly changed the demand patterns and buying behaviors of customers [9]. Digitization has imported another degree of convenience to consumers, enabling them to explore all the alternatives across the globe that increases volatility in demand. Penthin and Dillman (2015) endorsed that approximately 75% of the world's total population now have access to the Internet and nearly half of them are lively users of social media [10]. In addition to it, a maximum of internet users do online purchasing. The excessive usage of internet has altered buyer's buying behavior. Now, customers hold the power, and to remain competitive in the present digital market, companies have to respond to the volatile needs of the consumers and act accordingly. Meeting the demands of the digital-age customers requires organizations to deal with multiple partners, suppliers, and contract manufacturers all over the world, which increases the supply chain complexity. Farahani, Meier and Wilke (2017) mentioned that increased supply chain complexities and volatility in demand have become the critical challenges across businesses [11]. Schrauf and Bertram (2016) addressed that traditional supply chains are incapable of dealing with these challenges as the members of traditional supply chains are connected in a linear chain that creates series of discrete steps from suppliers to customers that includes procurement, product development, manufacturing, and distribution [12]. Milovanović, Milovanović and Radisavljević (2017) advocated that seamless end-to-end visibility, transparency, and traceability across the supply chain will be needed to work with a global network of partners, which is only possible by leveraging new digital technologies in the traditional supply chain to transform it into a DSC [13]. The digitalization of the supply chain can play a crucial role in promoting sustainability by reducing overall carbon footprint, reducing waste, and adopting circular economy [14].

Digital transformation doesn't mean innovation. Rather, digital transformation requires understanding what clients truly need and their experience all through the lifecycle of the item [15]. Digital supply chain is not about having digital products and services; it is the way how to manage supply chain core operations [16]. Digitization refers to the process of adopting new technologies to redefine and reshape the present business processes to create a remarkable competitive advantage across the enterprise [17]. The terms digitization, digitalization, and digital transformation are often used interchangeably (Berger, 2015). Authors [18,16,19,20,4] have discussed relevant digital technologies enabling the transformation from traditional to digital supply chain which are IoT,



BDA, AR, AI, CC, Blockchain, 3D printing (3DP), advanced autonomous robots, and drones. The available literature has mainly explored the role of these digital technologies in meeting the requirements of today's business and their impact on supply chain functions [4,19,11,21,22,23,24,25,26,27]. Several authors [16,28,29,30] have presented literature reviews on DSC discussing the concept of DSC, its features, benefits, impact on supply chain functions and its role in encountering the necessities of current global marketplace. Several articles in the literature have discussed critical success factors [31,32], barriers [33,34,35], and enablers [36,15] of DSC. Ghadge *et al.* (2020) highlighted sixteen barriers that act as intimidating resisting forces for implementing digital transformation of the supply chain [5]. Agrawal, Narain, and Ullah (2019) proposed an ISM-MICMAC model depicting hierarchical levels of the identified barriers [37]. The available literature on DSC focussed on the impact of new emerging technologies in various supply chain processes, the role of DSC in meeting the steadily-expanding demands of consumers and requirements of the current global market, and its impact, benefits, barriers, and enablers. However, the know-how to implement a digital supply chain is incomplete. There is a scarcity of literature describing the adoption strategies and guidelines for the implementation of the digital supply chain.

III. Methodology

To examine the current status of digitization of supply chains, a survey was conducted among Indian businesses to prioritize different innovations that are empowering digitalization of supply chains, and various barriers that are hindering its implementation. A sum of 562 participants were invited to finish up the online questionnaire, out of which 144 totally filled responses were received, giving a response rate of approximately 26%, matching the response rate of past studies [38]. Experts from industry and academia were also contacted personally, with whom a detailed discussion was held in person during the course of the development of the implementation guidelines. Based on the findings of the survey, the opinion of experts, and an extensive review of literature, a model has been proposed that could be implemented in proper sequence. Figure 1 shows the evaluations given by participating members to different technological innovations. It can be observed from the figure that IoT, Cloud computing, big data analytics, and AI have gotten high appraisals (having mean 4 and above). Similarly, figure 2 depicts the ratings given by respondents to the identified barriers to the digitalization of the supply chains. It can be observed from the figure that there is no sense of urgency, lack of top management support, a lack of digital skills and talent, a lack of industry-specific guidelines, and high implementation cost. These ratings provide the current status of the digital supply chain in the organizations, which served as a lamppost in the development of guidelines for its implementation.

Insert Figure 1 About Here

Insert Figure 2 About Here

IV. Implementation model

An implementation model or roadmap is essential for the successful adoption of DSC because managers cannot take any actions in the absence of guidelines that can be both expensive and risky to the future of businesses. Figure 3, shows the proposed model for the adoption of a digital supply chain. It consists of four phases, which are explained as follows:



4.1 Phase 1

The first phase consists of a learning and growth perspective. Digital transformation of the supply chain requires the implementation of new technologies to perform various supply chain functions. As the technologies are new and emerging, organizations and their employees need to get familiar with the technologies. The initial resistance to any change/transformation is exceptionally high. Organizations will need to make certain structural changes. Moreover, digital transformation is not free from barriers (as listed in figure 2). So, in the first phase of implementation, managers and policymakers need to overcome the existing barriers and become familiar with the emerging technologies. The learning and growth perspective itself consists of transformation in three sectors.

The first one includes transformation within an organization in which organizations should adopt suitable measures to mitigate the barriers of DSC. They need to create a sense of urgency for digital transformation by organizing awareness programs. An open-to-change culture is also required within an organization, and top management should proactively participate in the digital transformation and manage strong collaboration between partners to deal with uncertainties [37]. The next one includes transformation at the technology level because digital transformation is reliant on new technologies, and new technologies will need installation of new platforms and devices. Data is the core of digital transformation [39]. The rapid generation of data from billions of intelligent and connected devices makes it imperative for organizations to improve their overall data acquisition and analytics capabilities [4]. The third transformation in the learning and growth perspective lies at the individual level. Digital transformation requires a new set of skills within the workforce. Digitalization of the supply chain depends on digital technologies, but there is a need for digital skills and talent within the current workforce of organizations. Organizations require data examiners and analysts with skills to gather, refine, and investigate information. Digital talent management strategy is crucial for the successful implementation of digital technologies. Organizations must recruit, train, and retain good staff with digital skills and expertise.

These three transformations will set the required platforms, skills, and culture within an organization that will serve as the foundation of digital transformation. Conclusively, in the learning and growth perspective, organizations should overcome initial barriers of the transformation and manage new platforms, devices, and skills for using new digital technologies in their business operations.

4.2 Phase 2

After setting up the required platforms, skills, and culture within the organization in the initial phase of the transformation, managers will need to focus on improving their internal processes. A firm's internal processes can broadly be divided into three categories namely, operational processes, transactional processes, and customer management processes. A number of new digital technologies have been identified (see figure 1) which can be employed in performing various tasks and processes with unprecedented effectiveness. Using IoT, AI, 3D printing, advanced robotics, and augmented reality will greatly enhance operational efficiency and productivity. Authors [15] have advocated that Using modern technologies such as BDA, IoT, AI, 3DP, Blockchain, etc., across the supply chain allows companies to create real-time visibility on their operations, improved communication, increased control and attain a more agile and flexible supply chain. Incorporating big data analytics and social media in customer management processes will completely change how these processes were managed earlier [40]. Big data analytics and social media have a profound impact on improving customer management processes by providing personalization, real-time feedback, valuable insights into customer behavior, preferences, and sentiment, enabling predictive maintenance, segmenting customers based on various criteria, including demographics, buying habits, and social media interactions, etc.

Insert Figure 3 About Here

The use of Blockchain technology would add another degree of transparency, traceability, and security in all transactions involved within the supply chain. Blockchain technology can significantly improve transaction management processes by reducing intermediaries, enabling smart contracts, and bringing exceptional immutability, transparency, and security [41]. Employing emerging digital technologies will greatly enhance organizations' internal business processes, but these technologies should be implemented in a sequential manner. However, organizations cannot go for executing all the enabling technologies at once as it requires a colossal speculation of cost, time, and underlying changes. Agrawal and Narain [15] have proposed a structural model that gives the sequence in which the identified technologies can be implemented in different tiers.

4.3 Phase 3

Technologies have penetrated almost every aspect of society. The use of the Internet, smartphones, and other intelligent gadgets has radically changed customers' buying habits and increased their service expectations to a higher level. In today's environment of cut-throat competition among businesses, customers hold all the power, and organizations have to respond accordingly. Organizations need to expand their concentration from diminishing expenses and managing functions to how their supply chains can drive real value from new innovative technologies to address new expectations of customers, enable new processes, and make their businesses more coordinated, straightforward, and dexterous, which can be easily accomplished through DSC. The digital supply chain is a customer-centric platform model which acquires and exaggerates the use of real-time data coming from a number of sources and enables demand sensing, matching and stimulating in order to optimize performance and alleviate risk" [42]. The digital supply chain is an agile, customer-driven, and productive way to serve these new customers and offer differentiated services [16]. Therefore, after employing suitable digital technologies in performing various internal business processes, executives will need to focus on customers. When the initial barriers to transformation have been mitigated, and the required platforms, skills, and culture are managed within the organizations, then managers will have to take all such steps that will directly or indirectly increase customers' satisfaction. It would need to offer low-cost, better-quality, innovative, and personalized products/services to customers. After-sales service, responsiveness, and delivery times also play a crucial role in improving customer satisfaction. The deployment of emerging technologies in internal operations will lead organizations to serve uncertain and variety of customers' demands and offer differentiated services to them.

4.4 Phase 4

In this phase, managers will have to make a trade—offs between the investments and reformations made in the initial three phases and the expected outcomes of those initiatives. They will need to establish key performance indicators (KPIs). The sequential implementation of the initial three phases of the model will deliver financial returns to a business in several ways. It can lead to a reduction in operating costs through inventory optimization, lower transport costs, and reduced manual labor. It will lead to improved efficiency through streamlining processes, reducing lead times, faster order fulfilment, enhanced supply chain visibility, and data monetization. It will lead to enhanced customer satisfaction through faster delivery, increased product personalization, and supply chain visibility. This will ultimately result in increased sales and profit, market share, and return on investments, and also open up new markets and revenue streams, which will serve as performance indicators of the transformation.



Overall, this model presents systematic guidelines for implementing digital supply chains, enabling companies to attain a differential competitive position and adapt to changing market conditions, resulting in significant financial returns over time.

V. Discussion and conclusions

Implementing a digital supply chain is a complex and multifaceted process that requires careful planning and execution. The implementation model started by highlighting the learning and growth perspective with respect to the digitalization of the supply chains. An implementation model should be started by assessing their existing supply chain processes, systems, and technologies. Identify pain points, bottlenecks, and areas that can benefit from digitization. After this, organizations need to define the objectives of the digital supply chain, which could be improving efficiency, reducing costs, enhancing customer service, and gaining a competitive edge. Then, appropriate devices, software, platforms, and skills should be arranged to employ new technologies. All these components are discussed in the first phase (learning and growth perspective) of the model. Then, the second phase of the model discussed the internal process perspective in which organizations must choose the right digital technologies for their supply chain, such as IoT, Blockchain, AI, and cloud computing. Consider which technologies align with their objectives and budget.

The third phase of the model highlighted the customer perspective, which emphasizes implementing mechanisms to collect customers' data throughout the entire product life cycle, along with their preferences, priorities, and wants. Collecting real-time data from multiple points in the supply chain should be ensured. This may include IoT sensors, RFID, and social media data from customers, suppliers, and partners. The last phase of the model emphasizes on establishing KPIs to measure the success of their digital supply chain. This can include metrics related to efficiency, cost reduction, customer satisfaction, and supply chain resilience. In addition to this, executives should take the following critical initiatives for the successful digitalization of the supply chains:

- Promote a culture of innovation and adaptability within their organization. Emphasize the importance of data-driven decision-making.
- Train their workforce to use digital tools and systems effectively. Ensure they understand the benefits and how to navigate the changes.
- Regularly review and optimize your digital supply chain processes. Use data analytics to identify areas for improvement and make iterative changes.
- Be prepared to adapt to changing market conditions, customer demands, and emerging technologies.
- Develop risk mitigation strategies for potential disruptions, data breaches, or technology failures.

Digitalizing your supply chain is an ongoing process that requires a strategic, holistic approach. It can bring significant benefits in terms of efficiency, cost savings, and customer satisfaction, but it requires careful planning, investment, and ongoing management to realize its full potential. This study proposed four-stage implementation guidelines using a balanced scorecard approach for the implementation of digital supply chains, considering its enablers and barriers, which can assist firms in better organizing their assets and executing endeavors toward DTSC.

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List of Figures

- Figure 1 Ratings of technologies enabling digitalization of WMS
- Figure 2 Expected outcomes of employing digital technologies in warehousing operations
- Figure 3 A balanced scorecard model to guide effective implementation of digital transformation of supply chain

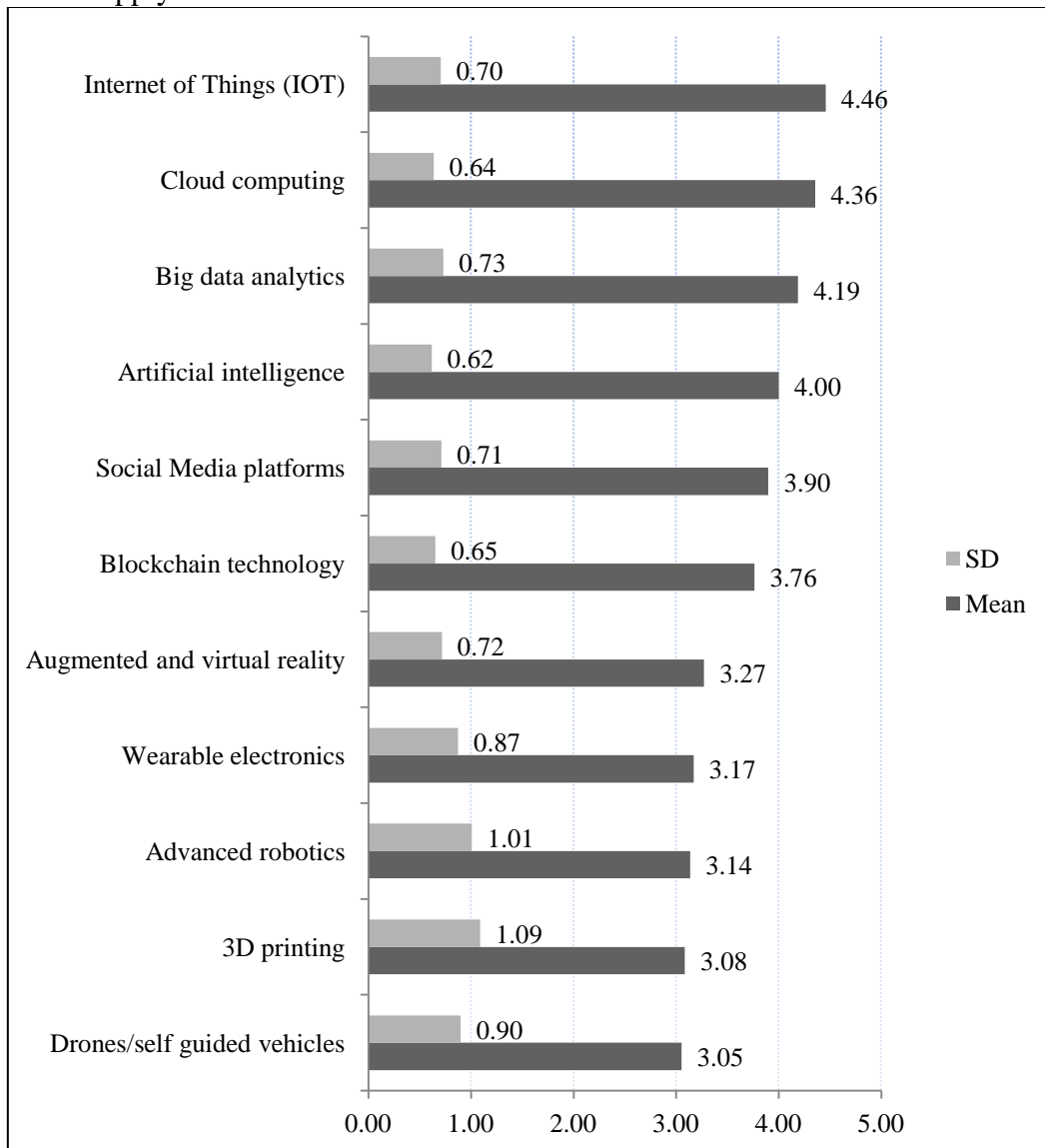


Figure 1 Ratings of technologies enabling digitalization of Supply chain

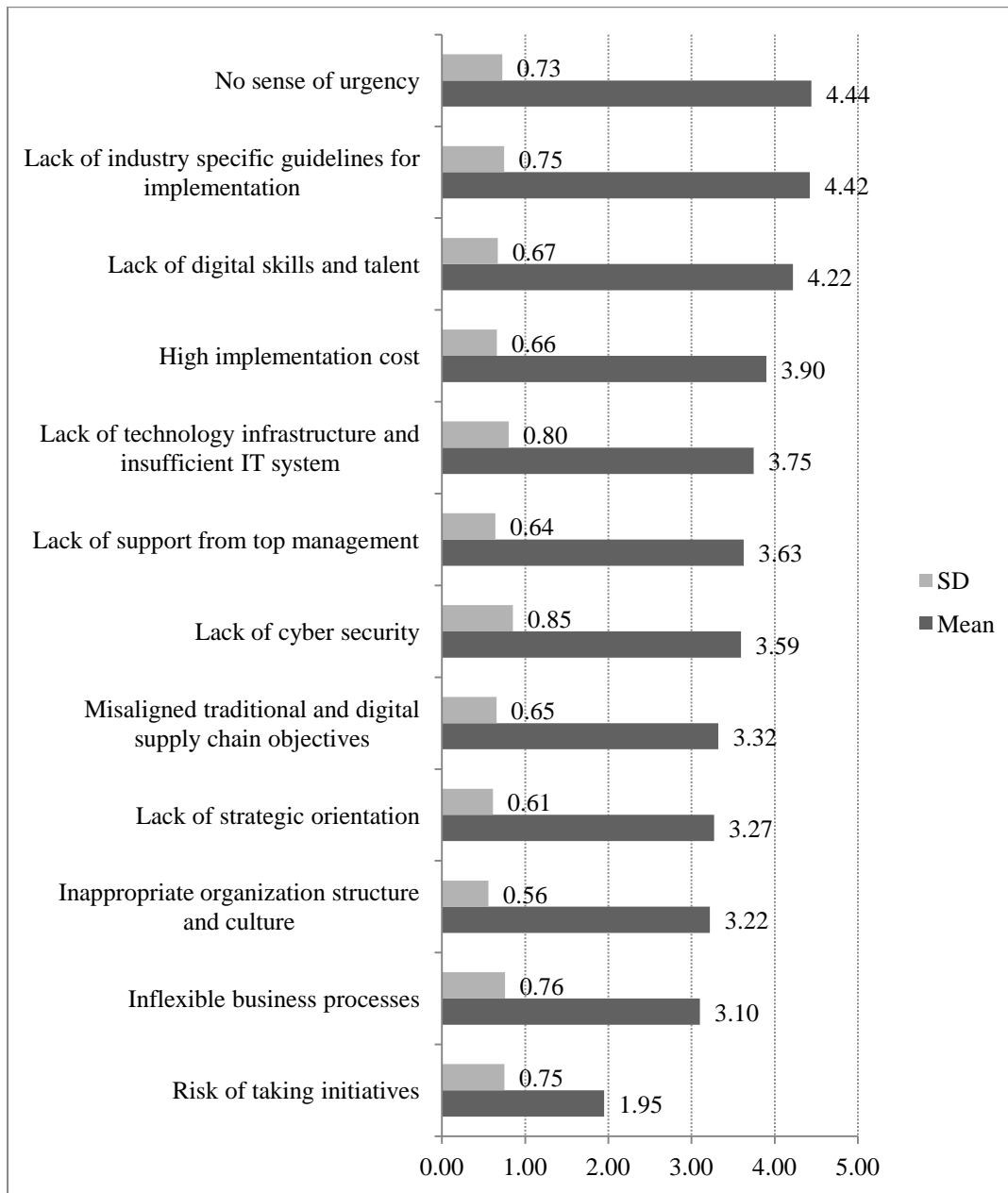


Figure 2 Barriers to Digital Transformation of Supply Chain

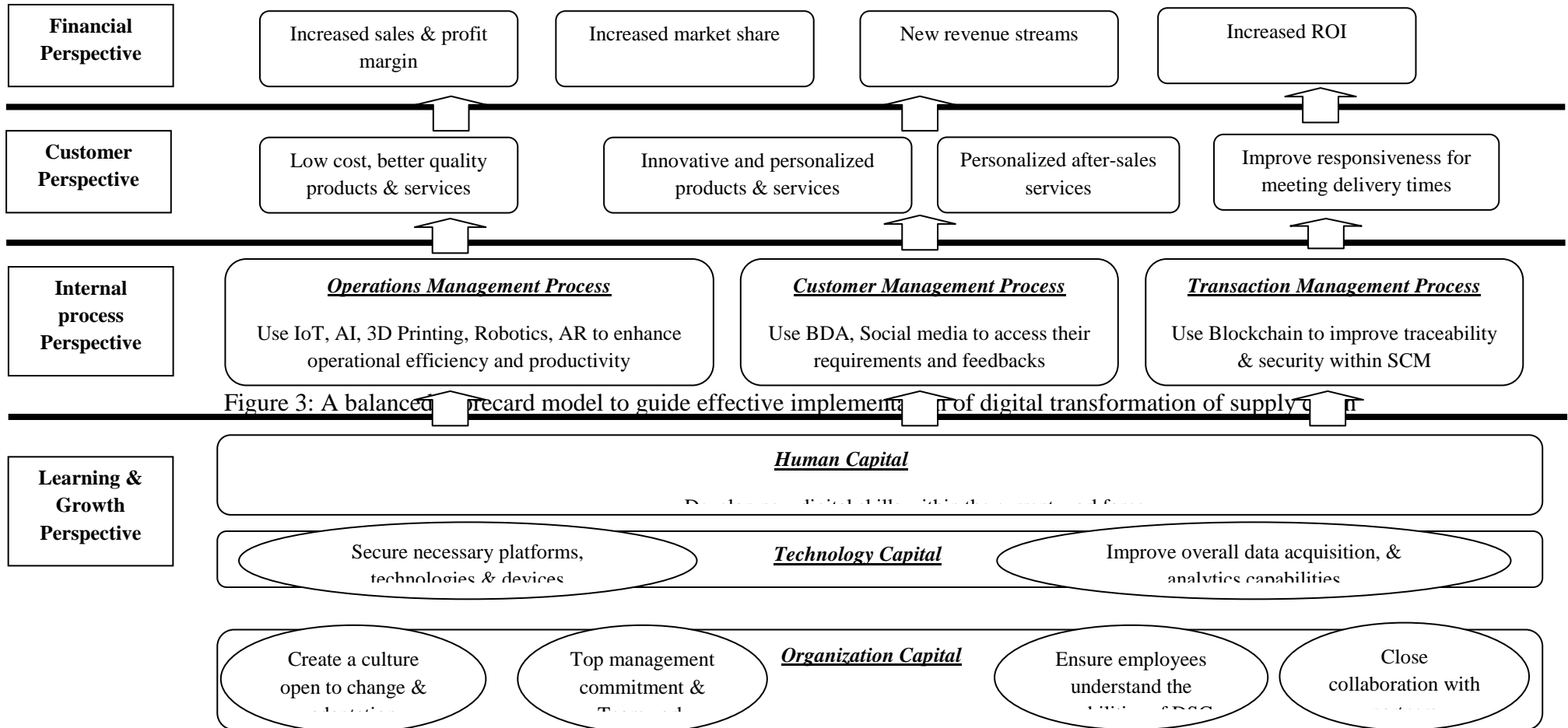


Figure 3: A balanced scorecard model to guide effective implementation of digital transformation of supply chain