

Processes and Strategies for Digital Transformation in Manufacturing Industry

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Abstract: The manufacturing supply chain has undergone an on-going transformation using revolutionary digital technologies that have profoundly changed manufacturing processes and operation ways. It is necessary to conduct digital technologies to enhance production performance. The present study analysis related digital technologies in manufacturing sector and proposes a framework under the fourth industrial revolution background, explores the benefits and challenges of digitalization. In addition, this paper establishes a manufacturing system with the applications of big data, 5G, AI in manufacturing processes. The product data can be collected and stored in the nodes of supply chain. The traceability results show the digitalization has great impacts to the manufacturing systems.

Keywords: Digital technology, Supply chains, Manufacturing.

1. Introduction

Limitations such as the shortage of capital, equipment, processing technologies, and skills prevent a manufacturing reconversion. Research related to manufacturing supply chain covers operations management [1], supply chain scheduling [2], risk management [3], industrial transformation [4] and so on. The manufacturing industry has evolved to meet Industry 4.0 requirements around the world [5]. Developing the digital supply chain is a new trend of industrial upgrading and enterprise business model innovation in China. Manufacturing is one of the industries that has been drastically impacted in the COVID-19 context. The Chinese manufacturing supply chain needs to adopt advanced technologies to cope with demand and supply uncertainties in environments in order to reduce cost, risks and waste.

Previous research explains the concepts, principles and adoptions of Industry 4.0 in manufacturing firms [6]. Digital technologies contribute new opportunities to improve supply chain performance[7], integrate the virtual digital world with the physical environment, and change the decision-making process[8]. Recent findings show that advanced digital technologies such as Artificial Intelligence, 5G, block chain, cloud computing pose a great challenge to manufacturing enterprises[9]. Compared to traditional CAD and BIM technologies, digital technologies are significantly complex and impact the core processes of manufacturing supply chains. Unfortunately, little attention has been paid to identify the crucial determinants that influence the application of digital technologies that enable the manufacturing supply chain to become more intelligent and smart. This existing gap drives us to analyze the implementation issues in the manufacturing supply chain process. Therefore, the work aims to address the following questions:

(1). What are the core processes for digital application to improve manufacturing supply chains?

(2). What are the effective strategies to improve manufacturing supply chain performance?

This paper discusses the construction of digital manufacturing supply chains and build path, puts forward the

development cultivating ideas to build digital ecological digital transformation of possible research and development design, production scheduling, inventory optimization, discusses intelligent transportation links. The possible entry point of constructing digital supply chain and the significance of promoting digital supply chain construction.

2. The Construction of Digital Manufacturing Supply Chains

(1). Build a research and development design platform based on open platform of data technology

In the process of product design and manufacturing in traditional manufacturing enterprises, R&D and design are the longest and most costly. Based on market research, R&D and design personnel can deduce consumers' preferences according to historical needs and personal subjective experience or improve the design of existing products according to the technical status of the industry. There will usually be a popular product on the market soon; the industry quickly launches similar-looking and similar-performing new products; or enterprises invest a lot of time, manpower, and resources to develop products that cannot meet the needs of consumers, resulting in unsalable products. In the digital era, data is a factor of production with the same status as land, capital, technology and an important basis for enterprises to make decisions such as new product development, business innovation, and business process optimization. On the basis of all kinds of data, enterprises sort out and analyze the product information to meet market demand, and realize the transformation of data information into commercial value. In this process, by opening the design platform of the enterprise, cooperative enterprises and consumers can participate in the R&D and design of the product, shorten the design cycle of the product, reduce the cost of R&D and design, and avoid repeated design.

(2). Establish production scheduling system based on intelligent algorithm

Production scheduling is a key task for all kinds of manufacturing enterprises because production scheduling

needs to consider the whole manufacturing process of products, simultaneous consideration of processing time, material supply, inventory, and other multiple constraints and optimization objectives such as cost and delivery time, and the need to adjust according to the actual situation and develop a real-time optimal production plan. As the complexity of the business process and production scene ascensions, through the use of digital technology and through every link of the supply chain information, the entire production of transparent management, especially for some of the constraints of traditional manufacturing production plans, "put single" situations, can guarantee the enforceability of the plan and the on-time delivery rate for the enterprise to bring significant improvements. At the monitoring end, according to the actual production situation every day, it prompts delayed product information, pushes a material shortage warning prompt, and gives replenishment suggestions. This information can be displayed to relevant employees and managers to assist their decision-making.

(3). Establish a multi-level inventory optimization system based on intelligent forecasting

The inventory optimization system mainly includes a demand forecasting module, a replenishment planning module, a promotion optimization module, a service level optimization module, and a multilevel inventory optimization module. The demand prediction module needs to classify demand management, combine traditional time series prediction methods and AI algorithms, and provide accurate demand prediction for different kinds of goods by using effective data inside and outside the enterprise. In the replenishment planning module, the products are usually divided into different categories, such as conventional products, perishable products, promotional products, and sluggish products according to their characteristics. According to the life cycle of the current products and the market supply and demand situation, targeted replenishment suggestions are formulated, and the inventory is reduced to the expected level on the premise of meeting the demand. In the promotion optimization module, according to the abnormal sales fluctuations caused by important events such as promotion events, new product releases, holidays, and so on, an emergency response mechanism will be established to ensure the stability of replenishment during promotion. The purpose of the service level optimization module is to help enterprises balance the relationship between service level improvement and inventory cost increase and guide enterprises to provide appropriate services under the established inventory demand. Multi-stage inventory optimization for enterprises that set up multi-stage distribution networks, such as pre-warehouses, they mainly adjust the allocation of goods between pre-warehouses and regional warehouses and consider reducing transportation costs through centralized transportation.

(4). Build an intelligent transportation system

Traditional transportation links mainly rely on manual operations, which have low scheduling efficiency. In the case of a substantial increase in transportation business, it is difficult to develop the optimal scheduling scheme, formulate reasonable transportation routes, and dig for potential cost-saving space. An intelligent transportation system can take a variety of transportation resources, customer needs, and transportation environment constraints into comprehensive consideration to provide multi-scene, multi-objective route planning suggestions for enterprises. Considering a variety of

constraints, the overall consideration of transport resource allocation, reducing transport costs, and improving transport efficiency. After determining a reasonable transportation network, for example, order input customers' special needs, at the same time model considering limit, time window constraints, network condition, and so on, use AI technology to greatly improve the accuracy of operation, forecast the loading and unloading time and driving cycles, realize the regional capacity, improve load factors, reduce the empty mileage, and save on transportation costs.

The digital supply chain has a certain demonstration effect. To adapt to the digital age development characteristics of the intelligent factory and intelligent workshop, the relevant departments to support enterprises shall establish a manufacturing execution system as the core, on the basis of the key equipment networking function system, through effective collection and connection module information resources in production, transportation, warehousing, and implementation of the entire manufacturing process of network monitoring and visualization management. The construction and operation of the whole digital intelligent node have a demonstration significance in the whole country.

3. The Strategies to Improve Manufacturing Supply Chain Performance

3.1. Cultivate digital organizations

Cultivate digital enterprises, that is, empower the business layer with digital technology, build the data of acquisition, collection, transmission, and execution of commands through sensors, the Internet of Things, 5G, and other technologies, and reshape the business model of enterprises. Data is the lifeline of the digital supply chain. With the application of innovative technologies, every link in the supply chain is more and more inclined to use sensors and other tools to continuously expand the scope and scale of data. The goal of the digital supply chain itself is to use digital technology to improve the original supply chain links, such as operation scheduling, transportation management, production, and processing. On the one hand, enterprises to speed up the digital technology and research and development design, manufacturing, operations, services, and other business. On the other hand, the data as a new variable, a new element in the production system, and innovation of enterprise business model can expand new business growth point, reduce the production cost of enterprises, management cost and transaction cost.

3.2. Build a digital supply chain

The key to the construction of a digital supply chain in the manufacturing industry is to build a digital supply chain and an independent, complete, and competitive supply chain based on the digital transformation of enterprises. In the traditional supply chain system, commercial value comes from products, and enterprises pay more attention to the improvement of product quality and manufacturing efficiency. In the new era of the digital economy, the concept of "product as service" is more prominent, requiring enterprises to further meet the diversified and personalized needs of customers and rethink the operation process of products from the perspective of customers, as well as the whole business model as a platform for sharing transformation. Platform through cloud computing, digital twin inner information technology

products such as the digitalization and visualization expression, get the product in different state parameter data, and through the platform, enterprise integration and design resources, supply and demand for collaborative design, promote no rights pass without physical production, reduce the enterprise cost, and promote the industrialization of new technology. In a market environment with increasingly refined product division, the complexity of products and the breadth and depth of business have also greatly increased. It is increasingly difficult to rely on a single enterprise or department to complete all business innovation and production activities in the industry. It is necessary for different enterprises to participate in or even cooperate with different supply chains to create product value.

3.3. Build a digital ecosystem

With the support of digital technology, the upstream and downstream of the industrial chain take data as the key element to release value and comprehensively transform and upgrade a series of emerging industries, such as industrial Internet, intelligent manufacturing, and the Internet of Things. The traditional manufacturing industry uses digital technology to transform and upgrade all business links of enterprise operation in an all-round and whole-chain manner and to promote the deep integration of digital technology with research and development, design, logistics, consulting, testing, etc., so as to make the digital transformation of the manufacturing industry more dynamic and competitive. In the process of digital transformation, manufacturing enterprises will inevitably encounter some different problems, such as software and information technology, and a digital ecosystem is formed on the basis of the technology in digital technology, knowledge, and information, such as physical production, circulation, consumption, and other functions of the virtual platform. It can provide loan, payment, social contact, e-commerce, and other services for participants in market transactions. In the digital ecosystem, upstream and downstream businesses, consumers, financial institutions, government departments, and platform-type enterprises of the original supply chain and industrial chain assume different functions to promote mutual symbiosis, promote information exchange flow, credit evaluation, technology application and knowledge element innovation, and promote the coordinated development of industrial chain groups.

Manufacturing industry and service industry to speed up the depth of the fusion, under the environment of digital technology to speed up the manufacturing service, can more efficiently allow businesses to define the product's whole life cycle stages, defining the product requirements, design, specification, implementation and use of financing, operation, and maintenance services, not just focus on the core manufacturing capabilities of enterprises. To realize the information transmission between enterprises and enterprises, between enterprises and users, and make it possible for users to participate in design, cloud design, non-physical design, open design, collaborative design, etc. The integrated development of the manufacturing industry and production services matching it, such as R&D, logistics, and maintenance, conforms to the evolving trend of consumer demand, speeds up the upgrading of manufacturing output, and helps manufacturing subjects pay more attention to consumer demand and provide comprehensive solutions with differentiated competitive advantages.

To accelerate the innovation-driven development strategy,

combined with the regional development demand of industrial cluster, push China manufacturing from traditional manufacturing to speed up the upgrade to new industry pattern transformation, and meet the needs of the core advanced manufacturing industry development, this study considers the existing technical conditions of the advanced manufacturing industry and promotes industrial upgrading of key technology, equipment, materials, Manufacturing is putting forward the idea of digital transformation and constructing digital supply chain paths designed to promote artificial intelligence, big data, block chain in the traditional manufacturing industry, the application of emerging technologies such as improving enterprise information, flexibility, intelligence, green production level, accelerating the transformation and upgrading of enterprises, speeding up the development of manufacturing high quality, Explore and cultivate the competitive advantage of the domestic manufacturing industry to obtain good economic and social benefits.

4. Conclusion

The digital technologies brought apparent impact on production processes and create different business mode [7]. But the negative effects of these technologies should also be notified by firms. The most obvious effect is they will increase operation cost for additional training, professional employing, and processes reconfiguring.

Regional manufacturing digital transformation should be accordance with the requirements of times development and regional economic development [8], through to the enterprise internal and external digital workflow and information flow, logistics management, effectively achieve the height of the resource sharing and collaboration, transform and upgrade traditional industry chain supply chain, speed up business to optimize upgrade, restructuring and innovation to develop new kinetic energy.

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