Application of 5G in modern supply chain scenario

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Abstract. The supply chain is an organization form of product design, procurement, production, sales, service and so on. Continuous innovation and development of information technology and information infrastructure have promoted the continuous evolution of supply forms. With the emergence of 5G, a mobile integrated communication system that includes communication access, interconnection and things, it has developed into a modern supply chain featuring social organization coordination. This paper discusses the existence of binary space and the properties of unified digital information space, and the evolution process from the main supply chain to the platform supply chain and then to the modern supply chain. It also expounds the relationship between modern supply chain and social development, discusses the application of 5G collaborative technology in modern supply chain.

1. Introduction

In the agricultural era, human beings domesticated animals and plants through the synergy with nature, thus producing animal husbandry and agriculture [1]. After the industrial revolution, human beings have a better understanding of physical properties and mastered the laws of biological growth and energy operation. Because of the large-scale industrialization synergy, the farm came into being [2]. In the process, the original natural circulation process has not been broken, and its essence is only to accelerate the rhythm of the natural cycle [3-4]. Natural systems have the ability to self-grow and repair, while social systems do not have this self-generated function, and their development requires human-to-human collaboration [5-6]. With the spread of information and the progress of organization, the synergy has gradually been realized: the organization of collaboration in the agricultural era is an instrument, but due to the un-synchronization of time, it is impossible to achieve efficient synergy; the organization in the early days of the industrial era was people and Natural synergy, that is, the market that everyone takes the goods to the market for exchange and produces value [7-8], the supply chain was not generated at that time because the information flow was not smooth during the entire exchange process.

The booming development of digital communication technology in the 1970s and 1980s promoted a group of chain-oriented supply chain enterprises with manufacturing as the core, realizing production synergy; the Internet began to spread in the 1990s, especially the rapid growth of mobile Internet in this century, it has created a group of platform-type supply chain enterprises [9], and achieved the coordination between supply and demand. The 40 years since the reform and opening up is the process of China's active integration into the global supply chain. As the world's second largest economy, the problem of big but not strong is very prominent. With the gradual disappearance of the demographic dividend, we urgently need to build a new supply chain system. Cultivate new economic growth points.
With the development of technologies such as interconnection, mobile internet, IoT, and distributed interconnected storage in recent years, a unified digital information space has been initially formed\cite{10}, the prototype of social synergy has emerged. Under this historical trend, the 19th National Congress of the Communist Party of China put forward the important concept of modern supply chain, and gave a profound historical judgment that modern supply chain is promoting social and economic development\cite{11}. The development of supply chain is closely related to the development of information infrastructure\cite{12}. With the continuous development of information infrastructure, we believe that today's human society is moving from the industrial age to the digital age. This leap will break the interconnection of information islands, people turn to the binary space of physical space and digital information space to survive. The important purpose of developing modern supply chain is to improve efficiency\cite{13}. The emergence of 5G digital space infrastructure provides the basis for data uplink, enabling society to synchronize synergistically\cite{14}. This paper will analyze the application of 5G in modern supply chain scenarios based on objective facts.

2. Binary space survival and unified digital information space

The emergence of 5G technology has accelerated the mapping of people's daily life from physical space to digital space. From the industrial age to the digital age, human society faces the dual space of physical space and information space. The dual understanding of the binary space survival in the digital age and the unified digital information space is the key to the study of modern supply chains.

2.1. Binary space survival

The survival logic in the digital age is very different from the industrial age: human beings in the industrial age are living in the physical space of the island. The source and use of information are mostly confined to an island. The physical space and the information space are symmetrical, and the value of society as a whole. The small amount of information and the scarcity of information are the basis for the evaluation of the value of the industrial era. With the development of communication networks, the Internet, and the Internet of Things, human society has gradually moved from the industrial age to the digital age. Information islands have been gradually opened up, physical space and external information space are no longer symmetrical, and human beings are entering the binary of physics and digital information space. The objects in the physical space of the industrial age are produced one by one. Each item must occupy an independent physical space in time series in accordance with the mathematical addition, and the use value of the item will be consumed over time; in the information age, the transmission does not conform to the set addition due to the change in the amount of information, and the more valuable the information is, the more valuable it is. The survival of mankind in the industrial age is the life capital. The survival of the digital age requires the payment of intellectual capital in addition to the life capital.

2.2. Unified digital information space

With the increasing technical means such as communication and storage, a unified digital information space that can connect all information has been formed. The unified digital information space is based on information infrastructure such as communication, Internet, and Internet of Things. It uses distributed storage and unified electronic coding as information carriers, and mobile terminals, computers and other mobile terminals as access nodes for electronic and digital information ecology\cite{15-16}. The appearance of 5G technology accelerates the flow of information, and the propagation speed of external information compresses the physical space, making the information space mirrored by the physical space become a point under the physical space. People can connect all over the world through mobile phones, which embodies the integration of physical space and information space.

3. Modern supply chain Supply chain evolution process

3.1. Supply chain evolution process
Before this century, social production capacity was insufficient, and manufacturing became the core of society because of production and value. In the 1960s and 1970s, with the development of digital communication technology, the disadvantages of low efficiency and many errors in paper documents gradually emerged. Some enterprises in Europe and the United States began to use electronic communication to transmit electronic documents. EDI technology came into being. The emergence of EDI solved the problem of information exchange and process control across systems, and became a milestone in logistics informationization [17]; In the 1980s, companies reduced their costs by developing new production technologies. However, with the continuous investment of a large amount of resources, the ability to reduce production costs has reached its limit, and companies began to explore new management models to reduce costs, thereby the supply chain management came into being [18]. In the production process, the long-term dominant core enterprises integrate their upstream and downstream enterprises from design, supply, manufacturing to sales optimization, forming a logistics and information from suppliers, manufacturers, distributors to end users of network [19], we call this core manufacturing company as the leading supply chain for the chain supply chain [20]. The chain main enterprise uses the information system such as ERP to make logistics, capital flow and information flow through each node in the supply chain [21], the enterprise directly or indirectly synergistically integrates the resource allocation of most enterprises in the supply chain to reduce the cost of the enterprise; from the 1990s to the beginning of this century, with the rapid development of the Internet and mobile Internet, the ability of information exchange and sharing between enterprises has been continuously improved. The platform supply chain represented by B2B, B2C and other modes has emerged. The platform supply chain is oriented to users and the market. With the transaction as the core, it provides a trading platform for legal persons and natural persons. Users can obtain products through the network, greatly reducing time and space, and solving the general market synergy between products and people's livelihood needs; with the formation of a unified digital space, the synergy of the supply chain in the digital age has been expanding and extending to people's daily lives, and the prototype of social synergy has emerged. Under this historical trend, the 19th National Congress of the Communist Party put forward the concept of modern supply chain, which indicates that China has entered a new stage in the innovation and development of modern supply chain management.

3.2. Modern supply chain

From the evolution of the supply chain, we can see that no matter what type of supply chain, its essence is to effectively configure information. In the past, enterprises established information systems only to manage the processes and resources of themselves or the cooperative enterprises in the chain. For the first time in human history in 2015, global production exceeded supply, and human beings also gradually entered the digital age of distribution-led industrialization. The typical value standard in the industrial age is “production is value”. Enterprises do not need to pay too much attention to the demand side market; but in the digital age, their value standards are transformed into “demand is value” [22-23], products are no longer sold as a production. Since the current society does not have a mutual understanding function, the supply and demand sides are in a state of back-to-back, the market resources are not matched in time, inaccurate, and the transaction cost is too high. Enterprises collect information completely by their own time, we urgently need to establish an information system to solve the phenomenon of information asymmetry between supply and demand.

The government (public environmental provider) has a large amount of market data. Once the government as a market rule maker participates in the market activities, it will inevitably break the fairness of the market. Therefore, we need to build an information system through an intermediary. Third-party organizations (including industry associations, societies, etc.) represent the management of industry and industrial functions. There is no physical space boundary in the jurisdiction, and the business is impartial and professional. The public environment provider shall formulate laws and regulations for market operations, and provide information infrastructure such as roads and other physical infrastructure and networks for the normal operation of the market; the market can accurately obtain user requirements through the data provided by the intermediary under the rules set by the public.
environment provider. Although the scope of the physical space operated by the market side is limited, in the stable public environment provided by the public environment provider, it can operate in the digital space for the entire physical space and endorse through the credibility of the intermediary of the non-profit organization to achieve credit delivery. In summary, we can conclude that the modern supply chain consists of three elements: the public environment provider, the middle party, and the market side: the digital supply chain ecology is based on a unified digital information space, supported by modern technology, with the core of social circulation, and aim at total factor synergy. Modern supply chain is a rational tool for social governance, a collaborative tool for social circulation, and a bridge for human society to move from the industrial age to the digital age.

Table 1 summarizes the evolution process and functional comparison of the supply chain. We can see that the innovation and development of information technology and information infrastructure has promoted the evolution of supply chain form, from chain supply chain, platform supply chain to modern supply chain. The development of the supply chain is not an upgrade of technology, but a progressive evolution of relationships. It is a relationship of multiple forms of coexistence. The modern supply chain has been extended from the traditional market to the organic combination of the three parties of the public environment provider, the intermediary and the market. The three parties work in harmony and form the ternary role model of the modern supply chain. Compared with the traditional supply chain, the modern supply chain has more expanded scenes and elements, more stereo structure, more ecological elements, and features of informationization, intelligence, standardization, internationalization and greenness [24].

| Type of supply chain | Dimension | Communication and information network environment | Collaborative approach | Function |
|---------------------|-----------|---------------------------------------------------|------------------------|----------|
| Chain main          | Linear    | C⁰                                                | Production synergy     | Product production and supply |
| Platform            | flat      | C · I · Mᵇ                                       | Supply and demand synergy | Product and people's livelihood needs |
| Modern              | stereoscopic | C · I · M · I · S · Sᶜ                       | Social synergy         | Social cycle and global market |

⁰ Communication network
ᵇ Communication network & Internet & mobile Internet
ᶜ Communication network & Internet & mobile Internet &the Internet of things & super speed & super connection

4. Modern supply chain and 5G
Since information does not have direct accessibility in physical space, its transmission in physical space requires space and time; the information in digital space is diffuse, covering all physical spaces with complete accessibility, greatly reducing collaboration. Cost, for which we need a more comprehensive and faster information infrastructure to support the development of the digital age. 5G network has the characteristics of high speed ubiquity, large capacity, slicing, mobile edge computing, etc. Its appearance provides a powerful technical guarantee for the development of modern supply chain.

4.1. 5G and public environment providers
Throughout the world, due to the imbalance of information infrastructure development, people and things in many areas have not yet access the communication network. For this reason, we urgently need an ultra-high-speed, ultra-connected information infrastructure to make up for the inadequacy of previous development. The addition of the functional role of the public environment provider in the modern supply chain can provide a better information infrastructure for the market, and means that the public environment has its own belongings, forming a clear organizational boundary. But if each region has a clear collaborative tool, then an information island will be formed. The emergence of 5G, a public
network, can not only make up for the lack of development of information infrastructure in the past, but also freely and rapidly form various organizations to achieve block collaboration. For example, the narrow band, low delay and large capacity of 5G can provide strong support for the sensor network of the public environment provider. Through the real-time collection of information such as roads and vehicles, it is highly collaborative through the construction of “people, vehicles, roads and clouds”. Connected environment, optimize logistics route selection decisions, improve traffic efficiency, and ensure travel safety; At the same time, the flexibility of 5G network organization boundaries and functional boundaries supports the various needs of the public environment provider, the intermediary and the market. If the demand is large, the broadband data transmission will be used, and if the demand is small, the narrowband data transmission will be used, making the public Environmental costs, third-party service costs, and synergy costs of various elements in the market are reduced.

4.2. 5G and the middle party
With the continuous development of globalization, the market side has gone beyond the original administrative boundaries of division and division. The new models such as purchasing and Haitao are gradually getting hot. Because the buyers and sellers are beyond the physical boundary of each other, whether the purchased goods are genuine or not. A series of trust issues such as quality and customs clearance are in front of us. The emergence of 5G can solve the remote trust problem of the product. The intermediary can endorse the credit of the product. We can use 5G's flexible mobility and high speed to establish contact with the intermediary through the information system. Since 5G communication bandwidth is sufficient, even if the stranger transaction exceeds the physical boundary, we can verify the product through remote trust technology tools such as face recognition and iris recognition, and determine the uniqueness of the product, thus solving the remote trust issue.

4.3. 5G and market side
Most of the industrial era market is back-to-back production supply is random, the producer will make a rough estimate of future production based on past experience, can meet the vast majority of users' needs. However, users have their own personal preferences. Due to the limited variety of products, they can only choose the products they prefer. This is a mental state that is reduced and is not the most ideal result. The reason is the information island caused by the information asymmetry among the designer, the production process and the user. With the continuous improvement of living standards, people's demand for personalized products has greatly increased. If we count the user requirements, we can get the following user demand probability curve, as shown by curve L1 in Figure 1. The demand probabilities of different kinds of products are orthogonal and irreplaceable. \( R_0 \) represents the necessity of social production and life such as food and energy, so the demand probability is 1; The demand for bulk commodities, FMCG, chip systems, and personalized products is decreasing; Due to the different ways of organizing the above products, their demand for 5G is also different. The purchasers of bulk commodities are mainly legal persons and governments, which have high value, slow update speed and long life cycle. Their production and sales demand for 5G networks is not particularly high; Fast-moving consumer goods and chip systems are more popular for civilian use, and their consumption is fast, the update iteration speed is fast, and the circulation speed is fast. The production and sales demand for 5G networks is relatively high; Personalized goods are thin resources, and if you address thin resources in physical space, the cost will be too high. We can use 5G to cluster users to increase user density, time distribution density, and supply density to collect information and make information computational. From this we can get a 5G demand probability density curve, as shown by curve L2 in Figure 1.

The modern supply chain organization in the 5G era can be customized. The design and manufacture of products can be completed by users, designers and manufacturers, which makes the products turn from commonalization to individualization, customization, from large industrial production to multi-batch and multi-class production, to solve the problem of random supply in the market and meet the diverse needs of users; the modern supply chain organization in the 5G era can achieve mutual penetration between industries. In the digital age, the core technology of enterprises has become an
important competitive force. By addressing with high-speed information systems built by 5G, the optimal combination of upstream and downstream enterprises in the market can be achieved. Product investors, designers, technologists, processing equipment, etc. may be spread all over the world, and the combination of the best individual factors is used to make the value of each element of the market fully utilized, getting the industry and industry synergy greatly improved, established a fast track for the supply side technology promotion; the modern supply chain organization in the 5G era can realize the synergy between people and things. People can clearly use the 5G to understand the operation of the equipment and reasonably use the no-load equipment. For the production organizer, the information and resource allocation are more precise, and the available external resources are increased, which greatly improves production and capital efficiency.

5. Conclusion
This paper examines the existence of binary space and the attributes of unified digital information space. By combing the evolution process of supply chain, the historical inevitability of modern supply chain is inferred, and the conclusion that supply chain development is closely related to the development of information infrastructure is obtained, built a modern supply chain ternary role model. The passage of modern supply chain has opened up information islands for all-element resources, eliminating the asymmetry of information, and making resources continuously explored and utilized; the flexibility of 5G network makes the public environment cost in the modern supply chain, the service cost of the third party, and the synergy cost of each element in the market are the powerful hands to realize the supply-side structural reform in China.

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