

Research on the Supply Chain Integration Mode of Dangerous Chemicals in Colleges and Universities

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With the industrial upgrading, research efforts on dangerous chemicals increase continuously as well, especially universities and other research institutions. This makes the circulation of dangerous chemicals in colleges and universities and in the supply chain more frequent, and the requirements for safety are getting higher and higher. Integrated research on supply chain of dangerous chemicals and establishing an efficient and healthy supply chain system have become an urgent problem to be solved. This paper conducts economic analysis of dangerous chemicals in colleges and universities through the value transfer theory and finds that the industrial value of dangerous chemicals in colleges and universities has gradually shifted from manufacturers to distributors and logistics companies, current manufacturers, retailers, and logistics companies cannot effectively integrate the dangerous chemicals supply chain. Therefore, this paper puts forward the concept of the fourth party logistics platform, by supply chain integrated management to realize the organic combination of government, enterprises, universities, and related personnel, and establishes a supply chain solution that can share information efficiently and openly, integrate service provider, and achieve comprehensive control, so as to provide guarantees for the management of dangerous chemicals in colleges and universities.

1. Introduction

Dangerous chemicals are the general term for toxic, hazardous, flammable and explosive chemicals. Under the trend of global economic integration and industrial upgrading, the research, use and circulation of dangerous chemicals have become more frequent, as a result, the generated potential hazards are also rising linearly, such as chemical accidents, occupational health problems, environmental issues, etc. (Fine and Kobrick, 1985; Young, 1982; Lee and Billington, 1995). For university R&D personnel engaged in research on dangerous chemicals, due to the lack of awareness and insufficient training of some personnel, it is more likely to generate potential threats. How to effectively manage the use of dangerous chemicals has become an urgent problem that need to be solved by the dangerous chemicals management department in colleges and universities.

In the aspect of safety management of chemicals, foreign countries have developed earlier, and they had established a safety legislation mechanism and formed a scientific regulatory system and management mode. In contrast, the safety management of dangerous chemicals in China started late. Although the Safety Regulations on the Management of Chemical Dangerous Substances has been established, it still lacks in specific measures, universal education, personnel quality, and degree of marketization. In response to the safety management of dangerous chemicals in China, some scholars have proposed concepts such as Responsible Care and Apell Plan (Sarmiento and Nagi, 1999; Lewis and Naim, 1995; Singh, 1996), which had promoted the development of chemical safety management in China, especially the organization of universities. In terms of theory, researchers have studied the legislative basis and guidelines; in terms of infrastructure, experts have called for the construction of emergency response centers, safe transportation centers and other intermediary agencies.

The research on the safety management of dangerous chemicals in universities is not limited to the use and transportation of chemicals, but is based on the idea of an overall supply chain. Insufficient systematic research on safety management of chemicals and unsmooth capital flow, logistics and information flow have

all together hampered the development of the safety management of dangerous chemicals. This paper analyzed the phenomenon of value transfer existing in the dangerous chemicals industry and proposed a mode for the fourth party logistics to integrate the chemical supply chains. Through the integration of supply chain, the government, enterprises, universities and related personnel can be organically linked to form a scientific, rigorous, and highly efficient management system to protect and escort dangerous chemicals.

2. Supply chain value transfer of chemical industry

Economic development is the basis for all business activities. For the chaos of current dangerous chemical management, reducing safety costs is a practical solution. Here, a safety economics analysis of the dangerous chemicals industry is conducted through the value transfer theory.

There are three stages in the value transfer cycle, including value inflow, value stable and value outflow (Stabler, 1996; Mortazavi et al., 2015; Shen and Lewis, 2010), as shown in Figure 1. In the value inflow stage, by mimicking or innovating the business strategies, companies can fully adapt to customer needs and satisfy their customers, the competitiveness between companies is not fierce, which would result in value inflows; in the stage of value stable, customer needs are better satisfied, and competition among companies is in a stable state, the frequency of business strategy innovation decreases, so that the value tends to be stable; in the value outflow stage, the traditional business strategy is becoming increasingly outdated and unable to meet the needs of customers, leading to accelerated outflow of value.

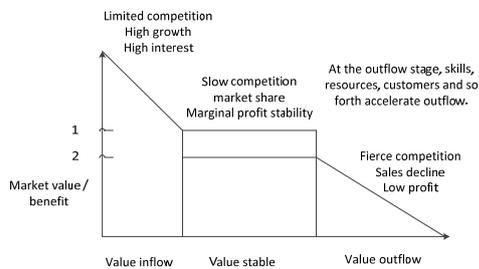


Figure 1: Life cycle of value transfer

The modes of value transfer mainly include multi-directional transfer, transfer towards an otherwise unprofitable industry, innovative value transfer, multinomial transfer, transfer from integration to specialization, changes in core firms caused by distribution costs, etc. (Zhou, 2013; Reiskin et al., 2010; Stock et al., 1998). For example, the U.S. steel industry transfers from integrated manufacturers to suppliers with innovative business ideas and manufacturers with alternative materials, as shown in Figure 2; innovative business strategies: service/exogenous, point-to-point within the region, which are caused by the white-hot competition of the American aviation industry, and the growth of value profits brought by the world's largest airlines to external services are shown as Figure 3; the rapid development of computers has caused the transformation of customer groups from government, enterprises to the individuals, creating new demand groups, which brings about the value transfer, as shown in Figure 4; when the customer's preference shifts from focusing on products and services to focusing on product prices and convenience, a change in demand results in the transfer in value, as shown in Figure 5.

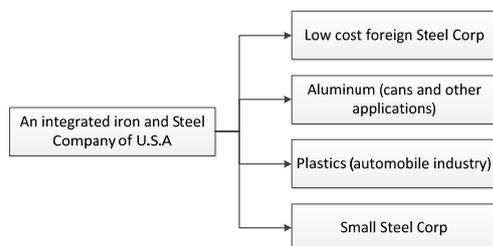


Figure 2: Multinomial transfer

For dangerous chemicals, scientific and technological innovation has been the main force driving its value growth. However, the process of chemical technology innovation has slowed down, and the factors that

colleges and universities are more concerned about transferred from the technical factors to safety, environmental protection, health and other non-technical factors. As shown in Figure 6. This change in traditional forces and needs has caused the value of chemicals to transfer, as shown in Figure 7.

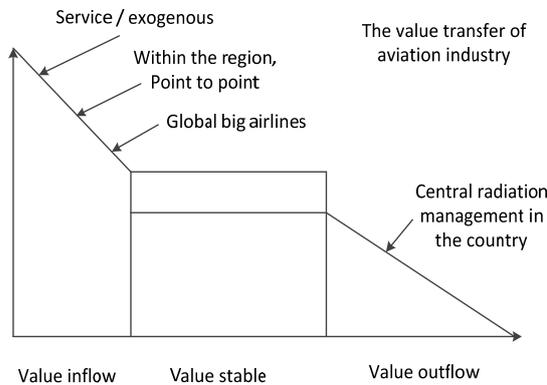


Figure 3: Moving towards an otherwise unprofitable industry

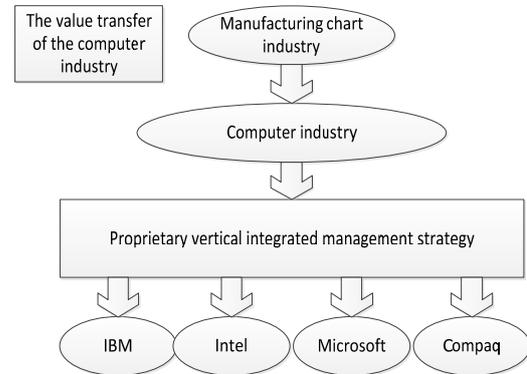


Figure 4: From integration to specialization

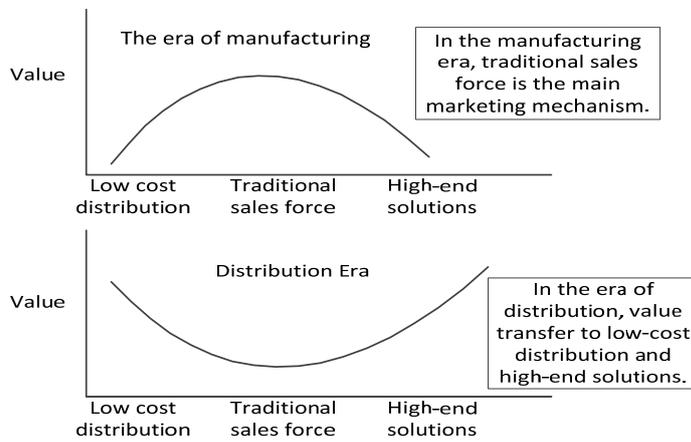


Figure 5: Change of core enterprise caused by distribution cost

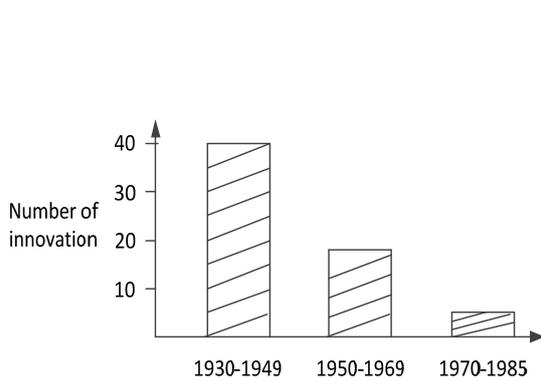


Figure 6: Major technological innovation changes in chemical industry

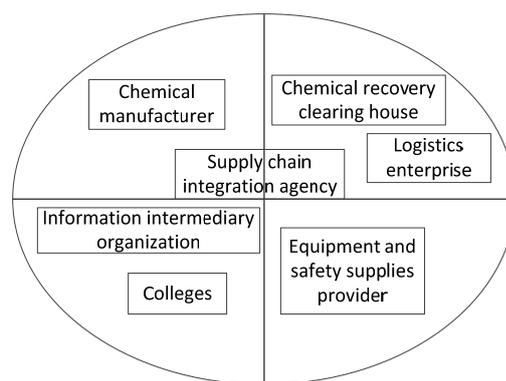


Figure 7: The trend of value transfer in chemical industry

From the course of development of the chemicals, it can be seen that the transfer situations in the chemical industry are mainly by three means: transfer from integration to specialization, transfer towards an otherwise unprofitable industry, and value transfer due to distribution costs (Kauremaa et al., 2009; Elzarka, 2013; Hokey, 2010). The rapid development of the division of labor in the chemical industry has made it impossible for traditional chemical manufacturers to independently undertake all business operations, and it gradually began to transfer to professional organizations such as intermediary organizations, research, equipment, safety product production, logistics, and chemical recycling professional organizations. As the chemical industry puts more focus on safety, environmental protection, health and other factors, the value of chemicals has gradually transferred to safety management and other fields. Moreover, in the fierce competition environment, customers of the chemicals, such as universities, have begun to pay attention to the price of the products and the convenience of obtaining them. As a result, the value of chemicals has changed and the core companies in the supply chain have turned to distributors and logistics companies.

Through the above analysis, the development trend of the entire link in the supply chain of dangerous chemicals in colleges and universities is specialized, safe, and convenient. Because the logistics, capital flow, and information flow in the supply chain of dangerous chemicals are not smooth, the safety costs are often high; because of the complexity of chemical supply chain system, the overall safety management is difficult. Therefore, in the safety management of dangerous chemicals in colleges and universities, an efficient and safe supply chain system needs to be established, and a unified operation management platform should be formed to coordinate relevant agencies such as manufacturers, sellers, and transportation companies so that all links can cooperate closely, ensuring the full safety of chemicals.

3. Supply chain integration of the fourth party logistics

In the existing supply chain system, the manufacturer's core advantage is manufacturing, not the supply chain integration management; the core of the distributor is the creation and maintenance of sales network, not the technical support or monitoring; the logistics company runs through the entire supply chain and ensures the flow and storage of the chemicals, but current logistics companies are small in scale, with few service functions, low talent qualities, weak competitiveness, scattered network structure, informal business orders, etc., which cannot undertake the integration platform. The role of chemical supply chain integration and chemical safety management is missing.

The concept of the fourth logistics has well solved the above problems, and it has the ability to mobilize and manage resources, capabilities, and technologies of various service providers, and provides a comprehensive supply chain solution, namely, a supply chain integrator, who can effectively adapt to the diversity and complexity of various parties. The advantages and characteristics of the fourth party logistics are shown in Table 1.

In order to make all relevant parties in the supply chain system work together to establish an efficient and healthy supply system of dangerous chemicals, the fourth party logistics needs to increase the interests of all parties involved in order to achieve the overall optimality of the integrated supply chain. In the supply chain system of dangerous chemicals in colleges and universities, the main stakeholders are the government, public, manufacturers, sellers, consumers and waste disposal companies, as shown in Table 2.

From Table 2, we can see that the fourth party logistics has used its strong information integration and processing capabilities to provide accurate and satisfactory services to relevant stakeholders in the supply chain of dangerous chemicals. This has ensured the orderly operation of the entire supply chain and guaranteed the safety management of dangerous chemicals in colleges and universities.

Table 1: Advantages and characteristics of the fourth party logistics

Advantage	Characteristic
Re-construction of supply chain	Linking business strategy and supply chain strategy into one
Functional transformation	Sales and operational planning, distribution management, material procurement, customer response, supply chain technology, etc.
Business Process Reengineering	Through strategic adjustment, process reengineering, integrated change management and technology, supply chain operation integration among customers is achieved.
Multifunction and multi process supply chain business	By influencing the whole supply chain to get value, it can bring benefits to the customers of the entire supply chain.

Table 2: Stakeholders of dangerous chemical supplies

Stakeholder	The function of the fourth party logistics	Solved Problem
Government	Monitoring and emergency response	More convenient and systematic understanding of the whole process of hazardous chemicals.
Public	Information integration	Meeting the information needs of the public
Manufacturer	Responsibility care	Solve the technical problems of manufacturers, provide supply chain design, supply and sales relationship management and other services.
Seller	Technical support and resource allocation	Get comprehensive and detailed instructions and technical support for the products.
Consumer and waste disposal	Centralized processing capability	Provide technical support and waste disposal

Taking the fourth party logistics platform as the core to integrate the management of all parties in the supply chain of dangerous chemicals in colleges and universities, a complete supply chain solution is designed as shown in Figure 8. The solution integrates functions such as management, consulting, and third-party logistics to reduce costs and promote the orderly operation of the supply chain.

From Figure 8, we can see that the fourth party logistics can give full play to the capabilities of the third-party logistics provider, IT service provider, emergency rescue party, and government, forming a supply chain solution which can share the information effectively and openly, integrate the service providers, and achieve comprehensive control. The solution can provide integrated management services for all parties in the supply chain of dangerous chemicals in colleges and universities, such as providing MSDS logistics integration design and implementation for manufacturers, providing warehousing and transportation for retailers, providing consumers with instant knowledge services, providing adequate and stable customer resources for logistics providers, and providing the government with detailed and timely supply chain operation information.

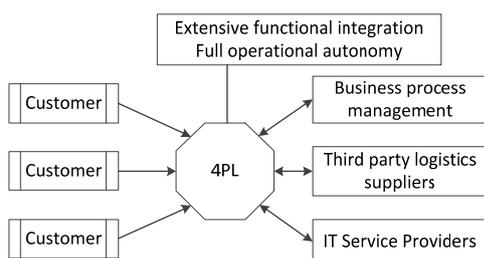


Figure 8: A supply chain solution based on the fourth party logistics

4. Conclusion

The properties of dangerous chemicals make it particularly complex in its production, transportation, storage, use, and disposal. Especially in the environment of colleges and universities, the level of personnel is uneven, the environment is complex, and it is more likely to cause security problems. Therefore, the management of dangerous goods in colleges and universities has become the focus of research. In the course of the development of dangerous chemicals, the core companies in the supply chain have gradually changed from the original manufacturers to distributors and logistics providers, resulting in value transfer. Therefore, it is of great practical significance to study the integration of dangerous chemical supply chains, and the construction of an efficient and healthy supply chain system for the safety management of dangerous chemicals in colleges and universities is of great practical significance.

Based on the value transfer theory, this paper analyzed the dangerous chemicals industry, and proposed to use the fourth party logistics platform as the core to integrate and manage the relevant parties in the supply chain and establish a scientific and efficient mode for the integration of dangerous chemical supply chain.

1) The industrial value of dangerous chemicals in colleges and universities gradually transferred to distributors and logistics companies through three means: transfer from integration to specialization, transfer from integration to specialization, transfer towards an otherwise unprofitable industry, and value transfer due to distribution costs.

2) This paper analyzed various stakeholders involved in the supply of dangerous chemicals, it's found that current manufacturers, retailers, and logistics companies cannot effectively integrate the dangerous chemical supply chain.

3) This paper put forward the concept of the fourth party logistics platform, integrated all relevant parties, and established a supply chain solution for sharing information efficiently and openly, integration of service provider and comprehensive control.

Acknowledgments

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