

Research Article

Research on the Application of Information Technology in Food and Agriculture Related Industry

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Abstract: With the application of information technology, more and more practice shows that food and agricultural related industry must rely on information technology. This study listed a few of problems which seriously restricted our domestic food industry to upgrade competitiveness and analyzed about functions of information technology apply to the food industry value chain system in industrial business process reengineering, outsourcing and industrial value chain alliance system and established related model, which manifested the important role of information technology in the upgrading of food industry competitiveness prominently.

Keywords: Agriculture-oriented, application, food and agriculture related industry, information technology, modeling

INTRODUCTION

Since the 1990s, with the rise of the IT revolution, knowledge has become an important engine for promoting social, economic and cultural development. Therefore, creation of knowledge as well as the ability and efficiency of its application has become an important factor in evaluating national and regional competitiveness, marking the era of knowledge-based economy (Caroli, 2001). In a knowledge-based economy environment, knowledge has become the most important economic and strategic resource. As the carrier of intellectual capital, data and information also performs the function of allocating economic resources (Brynjolfsson and Hitt, 2000). Also it is in a most important position of a company's core competitiveness. With the support of modern information technology, the organizational structure of modern enterprises is becoming more flat. Because of it, a company's effectiveness of allocating economic resources improves, which directly depends on data and information management system who has mastered the modern information technology. IT has changed management models and concepts and promoted innovation and efficiency. In this context, data and information is the key to enhance the core competitiveness of the food and agriculture industry (Kalaitzidakis, 2001).

Food industry has the characteristics of long industry chain and covering a wide range. It is the pillar industry of national economic development and has the strongest correlation with agriculture, which can absorb the most urban and rural employed population in all of the industries (David and Scott, 2002). The weakness or

strength of food industry international competitiveness will greatly influence a country's development. With the continuous integration of international economy, food industry in China has developed rapidly (Edson *et al.*, 2007). However, facing an intensive competition from the international market, food industry affords the great development opportunity and challenge together. There are obviously deficiencies in the development of food industry in China, which restricted the improvement of its international competitive (Bresnahan *et al.*, 2002). It displayed mainly as following:

- There is lack of organic connection between food industry and agriculture. The products, which are provided by agriculture, cannot adapt to the demand of food industry in the aspects of variety, quality, quantity, specification and etc. Conversely, the low benefit of food industry makes the poor income of agriculture.
- There is not according to the order. The food processing enterprises know little about the market information, especially the demand from consumers. Only depending on their own operation situation to determine the order of products' variety and quantity and then process it, it usually makes the raw material overstock or shortage.
- There is lack of realistic selection for offers and suppliers. Traditional food processing firms didn't realize the importance of offers and suppliers in company's developing, so they didn't establish partnerships with offers and suppliers.
- Technology information management is out of date. The food industry internal system of information is defected and digital management technology is

behindhand, even the information transferred tool between two companies is the outdated one. They do not make full use the EDI, Internet and such advanced technologies well, which cause that they couldn't deal the information in time and correctly. As the result, the data from different areas are not integrated together, so that they couldn't fulfill the function of shopping and selling online.

- The food industry's service level is low and added value is limited. Food industries in international market pay attention on the product's service. They divided the product's value into 30% material and 70% service, so the added value created by good service is pretty high. While in our domestic food processing companies, they concern on food producing. It means that they pay more attention on products than on service, so the ratio of service value is quite low.

Such problems we mentioned above which seriously restricted our domestic food industry to upgrade competitiveness. This article analyzed the food processing firms from the value chain system and price channel system. We have concluded that information technology applying to food industry' value chain system would improve the food industry competition ability (Johnson, 2000).

MATERIALS AND METHODS

The logical topology structure: The food information application logic topology structure is shown in Fig. 1. In the food information application logic topology structure, the food information data server group is used for managing variety of data involved in management system, including management materials, software and so on. The whole system can provide 2 different types of service to users by the subsystem server (WBPI/WBL Business Server, WBQB Business Server, WBST business server and WBPIM/WBTM/WBSM Business Server, etc.). One is based on C/S structure only for the manage staff which require higher safety, reliability and efficiency in business conditions; the other is based on B/S-oriented business services for all users, this service

requires the appropriate Web server and the users (including all staff) on Internet/Intranet can access the system through the Web browser. There also is a user authentication identity mechanism on the business server for a variety of users to access. The muter in figure connects the campus network to the Internet and the firewall protects the campus network from external malicious attacking, so it can operate safely (Brynjolfsson and Hitt, 2000).

The food information is mainly constituted by five databases.

PTMDB: It is the core database of food information, which is mainly used to save the data handled by food information, including physical programming, the setting, the venues and timing, information resources and so on. These data are also useful in the management of WBPIM and the WBSM.

PIMDB: It mainly used to store the data processed by WBPIM systems for instructors, involving their personal information and relevant information. These data also are partly used for management of food information.

SMDB: It mainly uses for saving the data managed by the staff handled by WBSM involving personal information, process, data selection and relevant information. These data also are partly used for management of food information.

SCWDB: It mainly uses for saving for the staff, these modules can play on the computer through WBPI or WBL business service in the form of browser page (Web-Pages) to staff. The CWDB can also be used for storage some test questions associated with the process of management.

QBDB: It mainly uses for storing several questions generated by the WBQB for the test. The WBST is a computer testing system based on Web, which can be generated Tests according to the actual needs.

The overall structure is determined by the requirements of food industry information system,

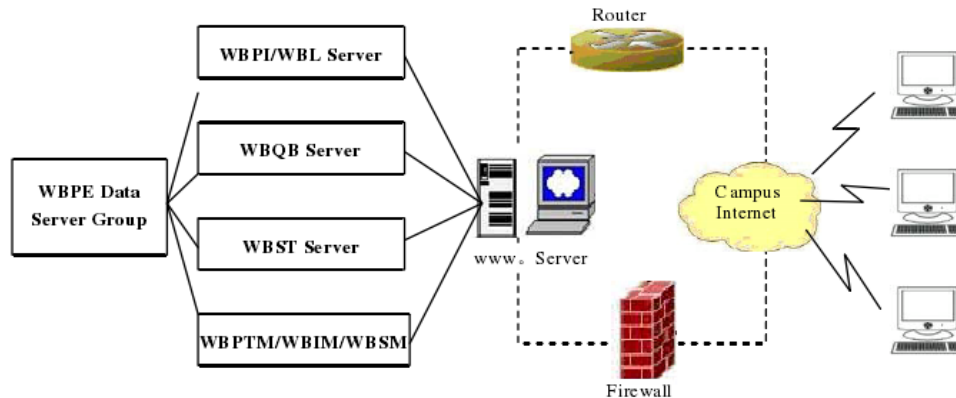


Fig. 1: The logical topology structure

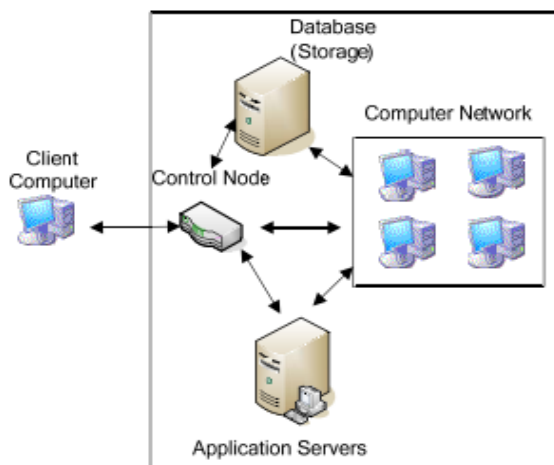


Fig. 2: Cloud computing network

which is established on the basis of the content structure. The food industry information system is essentially the organizational structure of multimedia information, which reflects the main framework functions of multimedia network courseware. The overall structure of the system is divided into two parts: food industry content and interaction online. The food industry content is composed of industry curriculum and scalability knowledge. Because of the introduction of methods online, it makes a lot of scalability knowledge connect with the data content, which forms a specific industry resources and environment (Simmons *et al.*, 2007).

The cloud computing technology in food information industry: It has no need to worry about the data transformation in the food information system or the memories cannot be stored so many data. Because these data will be stored in one or more data centers which cloud computing providers offer. This depends on the cloud storage systems. Cloud storage systems generally rely on hundreds of data servers. Because computers occasionally require maintenance or repair, it's important to store the same information on multiple machines. This is called redundancy. Without redundancy, a cloud storage system could not ensure clients that they could access their information at any given time. Most systems store the same data on servers that use different power supplies. Clients can access their data even if one power supply fails. Not all cloud storage clients are worried about running out of storage space. They use cloud storage as a way to create backups of data. If something happens to the client's computer system, the data survives off-site. The resources of one area could be shared and other multiple areas can also be shared (Ichniowski *et al.*, 1997).

Cloud service providers should complete the first and second steps, the third and fourth steps (such as web design, pay standards) should be completed together by users. Cloud infrastructure's the on-demand capabilities

are first designed to do two things: make efficient use of resources and ensure scalability. Some method of load balancing/application delivery will be necessary to accomplish the former.

To abstract the applications, this layer of the architecture will helpful and will provide a consistent means of access to users, shielding them from the high rate of change which occurs in the infrastructure. This study introduces the critical first step in detail. Hardware: network, storage. The network must be configured to deal with such change without requiring human intervention and must be able to handle applications which migrate from hardware to hardware. For this, the network will require constant optimization to adapt to changing traffic patterns. As illustrated in Fig. 2.

When the website runs officially, cloud service providers maintain the safety of data and managers of various university network centers to update the public information. It will strengthen the communication between user and user.

RESULTS AND DISCUSSION

The construction of industry system is integrated by 'upriver', 'mid-river' and 'backward' sections in the internal industry chain. Every corporation's value chain is linked up by connect points. Before the industry chain is linked, each corporation's value chain is independently, incompact and even unrelated. Through the industry integrated, the corporations are binding together as a value chain system and forming the industry value chain. Industry chain creates the new value by applying to renovation link through the connection between corporations

Based on adjusting the 'upriver' primary products industry's price channel path, mid-river food industry price channel path and 'downriver' food marketing section, it is working through the whole industry value chain's path and making it free to achieve the industry chain's value conveniently. From the picture the 'upriver' ('mid-river' and 'downriver') sections, industry' enterprises value chain can be understood as the abstract description of value chain after the 'upriver' ('mid-river' and 'downriver') sections' industry value chains integrated.

In food industry chain, every enterprise of upper, middle and lower enterprises has their own value creation and delivery channels and the enterprises achieve profits via value channels. After the food industry value chain formed, every company should adjust its own value chain, get through the value barriers between enterprises, link the value chain up by attaching point and build industry value chain to form a new value channel. Food industry value chain overpasses a unified layout and disposal to straighten out the relationship between the value chains, coordinate the activities of the value of the enterprises, so that the whole integrated industrial chain creates far more value than created by

the separate enterprises together, more open access to transmission channel and more convenience to fulfill the value of the industrial chain (Goodman, 2005).

Enterprise informationization will normally link to terms such as Management Information System (MIS), Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Business Process Reengineering (BPR), E-Commerce (EC) and so on. In fact, Informationization includes those ideas or tools, but not only ideas and tools. Enterprise Informationization means using modern information processing technology and device, network technology and equipment, automatic control technology and equipment and communications technology and equipment to transform the enterprises efficiently and safely.

In order to use information flow to control the logistics and energy flow, through information resources exploitation and information technology effective utilization to improve the enterprises' productive capacity and management level, they will enhance enterprises competitiveness in the domestic and foreign markets.

It is obvious that, whether informationization is regarded as an ideological or a tool, its purpose is to enhance competitiveness, gain the sustainable competitive advantage and continue to increase enterprises' value. Following will be the analyses about functions of information technology applied to the food industrial value chain, such as industrial business operation reorganization. Outsourcing and industrial value chain alliance and so on.

Business process reengineering is one of the important manifestations of value chain recombined. Being different from the enterprise and its business processes, the industrial business operation processes can be completed by several different enterprises together. It means that the behavioral subjects are industrial member enterprises, who are in charge of their own tasks.

The processes of different member enterprises can also have certain time sequence, or the happen concurrent. The only reason is that member enterprises are independent, so there are supply-demand relationships between the upstream and downstream enterprises of the processes and the whole processes can form an integrated industry chain (Dormer, 2005).

Generally speaking, industrial business processes recombination goes on from the breadth and depth two aspects:

- To reform the business processes, which means to improve some invalid or time-wasting business activities in the industry chain and make the enterprise work better.
- To redesign business processes, which means on this level it is not only to optimize certain links, but also to ingrate them into business processes and to be admitted by the link of industrial value chain (e.g., customers, suppliers). Business processes redesigning involves a wide range of action and changes a larger scale. Reduced redundant activities, redeploying storage and sharing information with the other member,

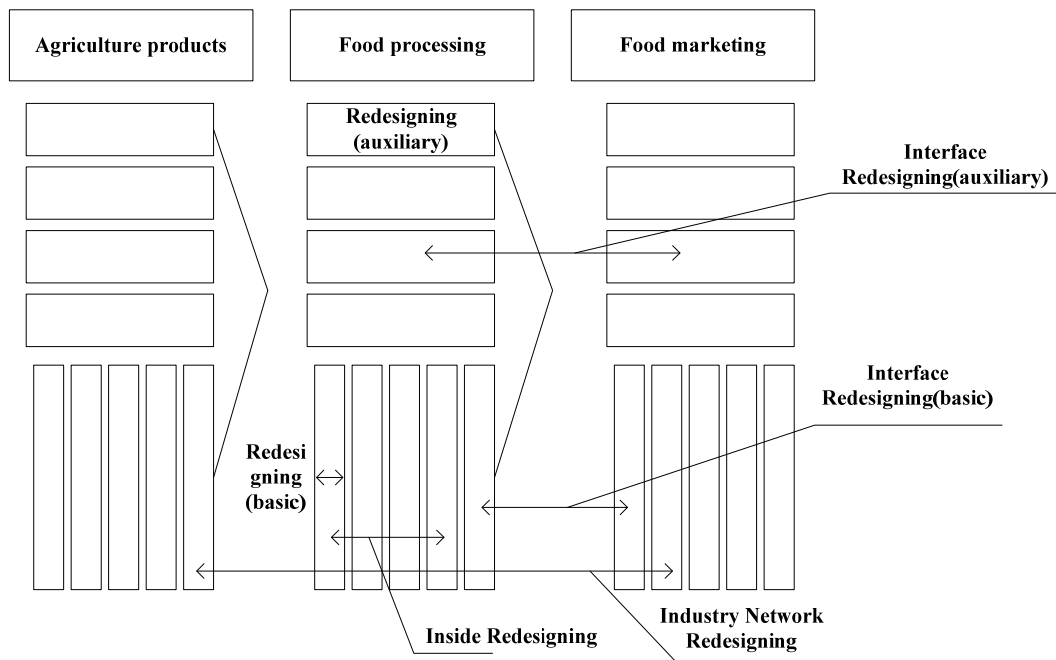


Fig. 3: Enterprise resource plan of food industry

the value chain will not only change the update the working model, but also will influence other links.

- To recreate business processes, which means overturn the original operating mode and build a completely new process. This is adopted by many enterprises facing business regroup in our country.

In depth aspect, industrial business operation reengineering in an industry chain could be partial redesigning, inside redesigning, interface redesigning or industrial network redesigning which is shown in Fig. 3.

To fully get the information of the food industrial upstream and downstream enterprises by IT and to build a new business process from the breadth and width two aspects. This kind of recombination based on IT brings the effects of:

- On the basis of integrated the upstream and downstream enterprises in value path of food industrial, it will get through the whole food industry value chain path and make it smooth, which is good for the value realization of food industrial chain.
- To flat the organization structure of food industrial upstream and downstream enterprises, reduce the

cost of management and decrease the information transfer distortion, it will release the of employees' activeness, motivation and creativity.

- To broaden the interface between the food processing enterprises, suppliers and customers, it will direct the business operation from customers' requirement. Due to social economy development and technological progress, the social division is deepening unceasingly and many enterprises value added sectors are divided into longer and thinner value added links. Outsourcing is an effective strategy, which stacks all the advantages links and shares the advantages resources. So that the enterprises can get the professional production effect of industrial chain, improve the advantages of specialized production of industrial value chain, reduce the costs and failure risk in independent technology research, shorten the life cycle of developing new products and concentrate resources on their core business to raise the ability to establish the competitive advantages.

In food industry, the enterprises on the middle and lower positions could research the information by information technology and exchange the data with

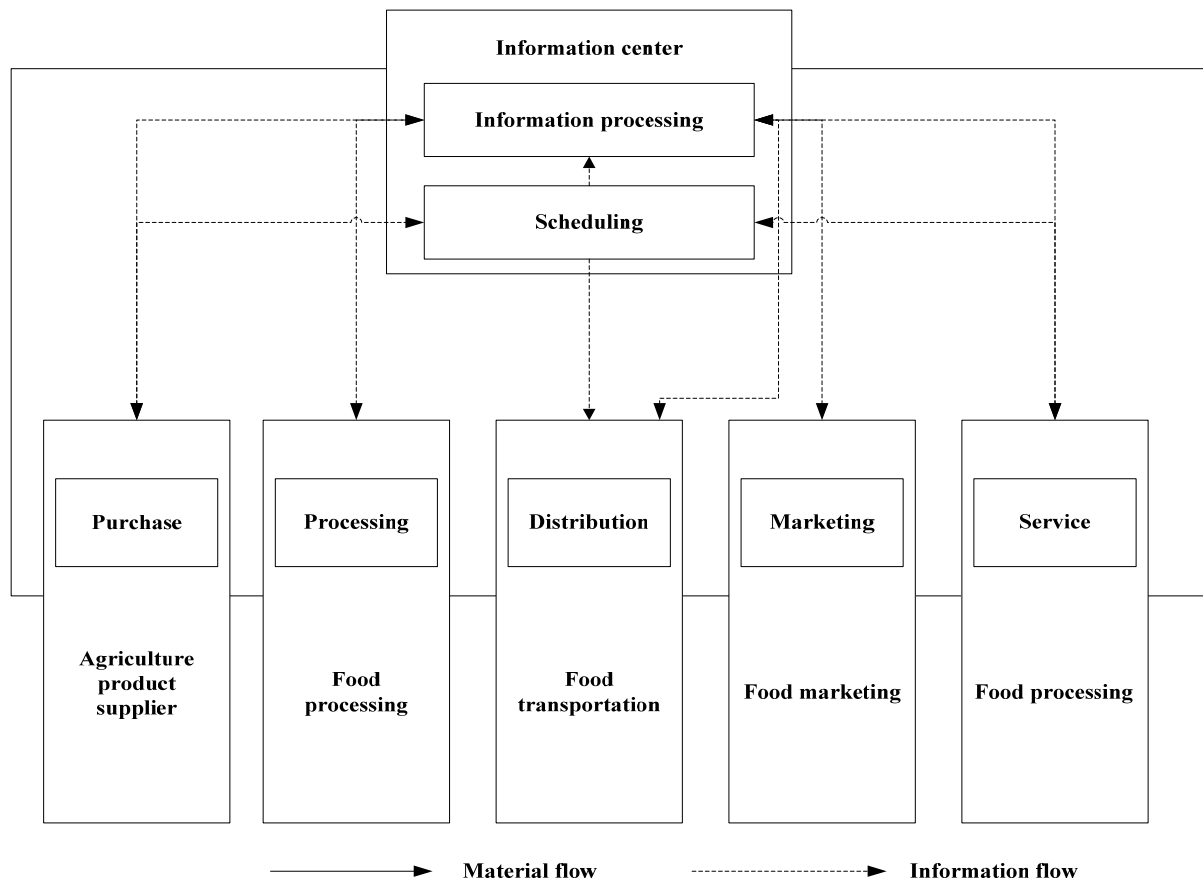


Fig. 4: Virtual enterprise value chain of food industry

other enterprises, which could realize the information sharing and form cooperated competitive relationship between them. Based on information sharing, the enterprises, which are on the middle and lower reach of the food industry, can deliver the sectors of value chain that they are not good at to other companies to complete.

However, they can concentrate on running their own good at session to gain a competitive advantage. With the support of the information technology, most parts of business can be outsourced in the higher and lower reaches of the enterprise in the food industry value chain, but this may adversely affected the normal operation of the enterprise. Because too much outsourcing business will cause a lot of business coordination work, which will result in more consumption than the benefits. Therefore, based on the actual situation, the company should control the basic link and outsource a suitable number of businesses.

Industry value chain alliance establishes a contractual relationship with the chain-related industries enterprises to make use of its resources and related disposable.

The alliance strategy is an effective way to realize the "win-win" synergies. It can support the sharing of resources in enterprises and create greater value in the industry value chain link and supportive activities. Establishing strategic alliances with the industrial value chain on the higher and lower reaches, not only improve the barriers to entry the industry, but also share knowledge with the parties.

So that, resources will be concentrated the core strategic in its major industry value chain links and carry cooperative research and production, enhance production efficiency, shorten the time to develop new product and market, reduce costs and rise the ratio of the success of the research.

However, establishing strategic alliances with alternative is also an effective way to defense the potential competitors. It will optimize the product structure, meet the diversified needs of consumers and enhance consumer satisfaction. Through modern information technology, it can enhance the close cooperation between enterprises, promote the strategic cooperation between enterprises of the food industry on the middle and lower reaches, put into full play to resource efficiency of the industrial chain and tonally achieve "win-win" or "multi win" situation.

Information technology can promote the formation of virtual enterprise value chain of food industry which is shown in Fig. 4. With the support of information technology, the agricultural product supplier in the food industry chain, food processing enterprises, distribution, sales and other related enterprises are constitutive of a virtual enterprise Union, which provides good quality and lower price products for customers, thus forming a strong competitive advantage.

CONCLUSION

In a knowledge-based economy environment, knowledge has become the most important economic and strategic resource. As the carrier of intellectual capital, data and information also performs the function of allocating economic resources. Also it is in a most important position of a company's core competitiveness. With the support of modern information technology, the organizational structure of modern enterprises is becoming more flat. The competitiveness of food industry has a large effect on a country's economic. One reason is that the original industry is the agriculture, which supplies the basic means of subsistence for human's life. On the other hand, its development improves the downstream industry, such as food transportation, sales, catering and a group of related industry as electromechanical, light industry and chemical industry. This study starts from the food industry value chain and value channel system, analyzes from the information technologies apply to the food industry value chain system in the industrial business process reengineering, business outsourcing, the industry value chain alliance and so on, which indicates that information technology play an important role in upgrading the food industry's competitiveness.

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