THE CURRENT STATE AND DEVELOPMENT OF E-BUSINESS FOR THE MACHINERY INDUSTRY IN TAIWAN

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ABSTRACT

With the change and globalization of the internal and external environments and the application of the information network technology, the internal and B2B business models of the domestic machinery industry have been completely changed, and such key factors as 'Innovation', 'Speed' and 'Flexibility' have become the key values of the future competition in the machinery industry with e-Business as one of the most important solutions. The e-Business in the machinery industry will enable lower operational cost, shorter reaction time and stronger elasticity. Moreover, the B2B interactivity will promote the supplier relationship management and improve customer service and satisfaction at the same time. This paper exercises the machinery industry as an example to discuss such ideas as the e-Business implementation strategy, promotion mode, standard setup and global logistics.

***Keywords*:** Machinery Industry, e-Business, Global Logistics

1. INTRODUCTION

In the advancement of information and Internet, as well as the competitive market of global industries, how should traditional industries utilize the latest and most appropriate approaches to enhance the competitive advantages, to increase the market share, and create goals for sustainable operation become an urgent issue for industries and nations. Incorporation and reengineering of e-Business has provided a new trend of thoughts for those entrepreneurs, managers, investors, and industry observers in utilizing e-Business to create values and improve competitive advantages. Therefore, a number of researches have been conducted on e-Business for different industries and nations to expound the strategic goals, conceptual framework, success factors, and experiences of implementing e-Business for future guidelines [1,13,15,17].

The machinery industry in Taiwan has played an important role in economic development of the nation. It is now facing problems of labor shortage, high land cost, high structural cost, high quantity and few variant products, lack of competitiveness, and pressure from competitors of uprising countries. Since the economic development is oriented with planned economy, the policing making and execution, as well as the utilization and allocation of industrial resources, have serious effects on the development of the machinery industry [1,12]. Therefore, to improve the competitiveness of the machinery industry in Taiwan, the government formulated plans to provide subsidy and counseling methods to assist the implementation of e-Business in machinery industry, and established e-Business standard and platform to construct an e-Business environment for the machinery industry [2,15]. This study conducted case studies on four companies that underwent government counseling, and discussed the application scope, implementation strategies, promotion model, outcomes, and future logistics planning on the e-Business in machinery industry.

2. BACKGROUND

The machinery industry in Taiwan generally refers to the machinery manufacturing, covering machine tools, industrial machinery, general machinery, power generating machines and mechanical components & parts. The representative mechanical equipment include machine tools, plastic machines, woodworking machines, textile machines,

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leather machines, shoe-making machines and compressors; the machinery industry is even called "the mother of the Taiwan's industry" with a wide range of associated industries (IT, photoelectricity, aerospace, semiconductor device, transportation, energy resources, civil chemical industry, automation and material), almost covering all the important industries in Taiwan. In terms of the industrial chain distribution, the machinery manufacturing is close to downstream or "Terminal" industry. Its major upstream industries are metal industry, electromechanical industry and plastic industry. The Machinery manufacturing is mainly made up of medium and small-sized enterprises in Taiwan coexisting with the system supplier, which forms an industrial community. Thereinto, the machine tools industry in Taichung, Taiwan occupies 37% of the machinery industry as the majority of machinery manufacturers and distributors, where the machine tool industry occupies 12% of the machinery industry. Total number of 1400 upstream and downstream manufacturers and the annual output value of the machinery manufacturing is more than NT$50 billion, which is the highest value in the machinery industry [7]; in fact, the Taiwan's machinery industry enjoys good international reputation with its high quality with recent years of experience, which owes thanks to the devotion of the practitioners to the processing and improvement of the machinery industry [3,16].

Due to the trend of globalization, Taiwan's machinery industry is encountering the rapidly changing information technology and the competition from Mainland China, South Korea and countries in Southeast Asia. The domestic machinery industry have built its competitive advantages through severe tests which now turn to be a costly dilemma for the domestic practitioners in the machinery industry to survive. The practitioners would be eliminated or removed soon under the severe competition if they keep on with the traditional business model of 'Win by Quantities'. Only by continuously improving quantities and qualities of productions, and involving new hi-tech into the management model can get rid of the potential deficiency in competition.

The machinery industry is a typical technology-intensive industry with most machines closely linked with the technologies concerning the applied industries downstream. Therefore, the demands of the applied downstream industries for the production technology are generally the main drive to improve the products of the upstream machinery industry, whose product quality has great influence to the external competition of the applied industries downstream. Generally speaking, the characteristics of the machinery industry are as follows [14]:

(1) The indicator of the national industrialization

The main countries involved in the machinery industry such as Japan, Germany and the United States, which are famous industrial countries in the world. The Taiwan area has stepped into the community of developed countries. Hence, the development of the machinery industry acts as the great significance to the improvement of the domestic industrialization.

(2) Relatively high processing level

Generally speaking, from processing to finished products, the machinery must go through hundreds of processing programs ranging from the processing and assembly of the raw materials upstream and various parts & components to the machines production. Planning and application of the automation system covers a wide and deep industrial range.

(3) An industry incorporated with professional technology

Up to now, the innovation breakthrough of the technology and the improvement of quality and levels are beyond the ability of the sheer machinery industry to overcome and support, which demands its combination with the industries under all kinds of professional technologies, such as electronics, photoelectricity, material study and physics. In addition, the research & development demands huge and successive investment combined with increasingly accumulation of the technique and experience. Hence, it tends to become a technology-intensive and capital-intensive industry.

(4) An industry that greatly depends on professionals

The machinery industry covers a wide range of fields with independent technologies and high expertise. At the same time, it has great varieties and various specifications and stresses experience as an industry that greatly depends on professionals.

(5) An Industry with Slow Investment Repayment

Featured by great investment, long production process and complicated production, the machinery industry demands a longer investment repayment time than other industries. At the same time, its boom reaction is slower than other industries -- it seldom gives reaction until other industries pick up.

(6) Product Lifecycle Tapers

In the past, due to the limited downstream industries and stable demand, the machinery industry had a relatively long product lifecycle, and the product performance was improved step by step instead of breakthrough innovation, hence the industry was classified as an investment on capital goods. Nowadays, with the change of times and the fluctuation of demand, the product lifecycle of the machinery industry tapers.

(7) A Technology-intensive and Capital-intensive Industry

The machinery industry is a technology-intensive and capital-intensive industry

that demands a great number of professionals combined with abundant capital.

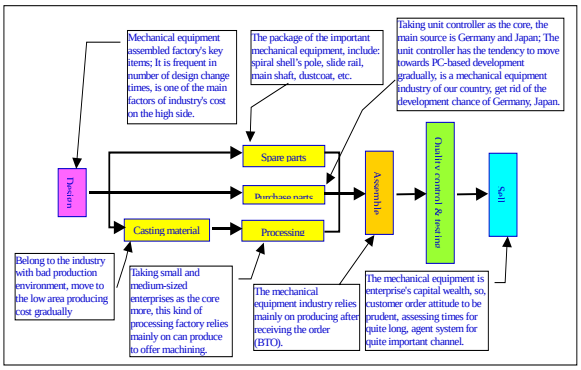


Figure 1: Configuration and operational analysis of the machinery industrial chain [5,9]

Figure 1 is the general configuration diagram and operational analysis of the machinery industrial chain ranging from machinery design, raw materials purchase, parts & components processing, assembly and QC & test to sales. All of these processes were done with different suppliers and customers. This paper discusses and analyzes theB2B e-Business application range, implementation strategy, promotion mode, benefit & outcome and the future global logistics in the case of four machinery enterprises (Company A: Woodworking machinery; Company B: Machine tool; Company C: Air compressor; Company D: Plastic injection molding machinery) sponsored and guided by the Industrial Development Bureau (IDB), which gives a general idea of the current state and trend of the e-Business in the machinery industry in Taiwan. The four manufacturers might have different supply chains in form, breadth and depth, but all regard uniting the suppliers and the clients upstream and downstream to give play to the whole competitiveness as their e-Business target; the four manufacturers are not comprehensive but influential in the machinery industry as typical ones. The brief introduction to the four manufacturers is as follows [5,9].

Company A specializes in woodworking machinery as the largest professional manufacturer of CNC nonferrous metal processing machines in Taiwan. Its machinery is designed and developed by itself to keep in pace with the world trend of CNC, automation and PC-based controller for precision machinery in terms of electric control, structure and software application, and sold in its own brand both at domestically and abroad. In order to meet different customers' desires and demands for the product performance, it usually adopts custom-made production upon order by designing, revising or adding functions to change the old models based on the material, purpose and precision required by the customer, or by assembling machines of different functions into whole-plant full-line processing machines with complementary combination of products in different brands, so as to meet different customers' demands.

Company B specializes in the manufacture of machine tools as the largest grinding machine manufactory in Taiwan. The company began with the manufacture and sales of manual grinding machines. In the past over ten years, it has developed all types of precision and CNC products successively. Thanks to the great demand from abroad, its products are mainly focused on overseas markets. Up to now, it has set up more than 300 sales spots in more than 70 countries. In order to offer better after service, it has set up a subsidiary in U.S.A. with the main marketing strategy of setting up a pan-American professional sales network. In addition, it has machines and parts warehouses to facilitate to master the market trend and offer quick and effective after service. Its European subsidiary is located in Germany, which facilitates to take order locally with good after service, so as to increase its market share in Europe.

Started from the manufacture of compressors, Company C occupies a market share of over 30% in Taiwan as the largest professional manufacturer of air compressors and screw refrigerant compressors in Taiwan and Mainland China and about the tenth largest compressor factory in the world at present. Under the "B2B e-Business Plan in the Manufacturing System" sponsored and guided by the Ministry of Industry, it has set up the e-Business platform to give quick response to customers' order demand, shorten the lead time, reduce the inventory cost of the system, and enhance the efficiency of the whole industrial supply chain.

Company D takes the lead in the field of plastic injection molding machine manufacturing in Taiwan. With the largest scale, it is leading in the business management and product R&D. In order to keep ahead and strengthen its competitiveness to expand the Mainland China market, it takes production automation and the implementation and establishment of the computerized management as a most important part in the business strategy map. It wishes to reduce costs, increase incomes, accelerate the listing time of products, communicate with local and international business partners accurately, and be capable of locating the appropriate target market by means of B2B e-Business.

3. FRAMEWORK AND IMPLEMENTATION STRATEGY OF E-BUSINESS

3.1 Application Range and Framework

Judging from the B2B e-Business programs among the above four manufacturers, their operating

modes are without exception to accord the e-Business Model with the enterprise's blueprint based on the solution concept, thereat specifying e-Business strategy and policy within the e-Business range, so as to proceed with the relevant process of operational activities or the business process re-engineer to draw up the 'Re-engineer e-Business Process', and lastly determine the IT system accordant with the requirements, namely the IT-Model, as shown in Figure 2. In terms of the functions of the four cases, the application range covers inventory enquiry, E-undersigning for purchase, purchase by order, lead time determining, order check, order input return, check system, inventory transfer, checklist mechanism, payment list, supply quality analysis, supplier delivery analysis and supplier payment analysis for the supplier end; the product E-Catalog, advertisement & news, on-line order, order follow-up, on-line enquiry & offer, FAQ, technical manual, change records search and purchase history for the customer end. In addition, it covers the co-operating system and production management system.

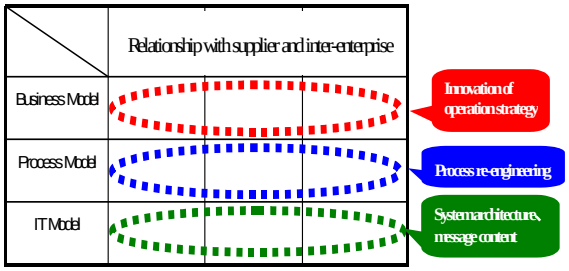
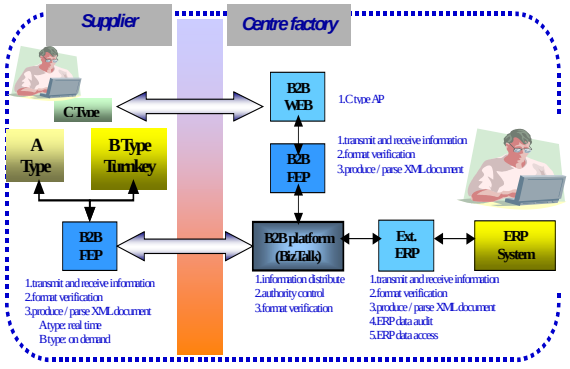


Figure 2: Three key models of e-Business [6,11]



*FEP: Front-End Processor

Figure 3: e-Business system configuration [5,9]

The B2B e-Business framework among the four manufacturers (key factories) is to establish the B2B platform to facilitate the B2B info exchange and transfer. The tie-line working mode between key factories and the suppliers within the system falls into three categories:

(1) Type A: Suppliers and key factories have separate ERP systems to enable the AP-to-AP functional objective via the established B2B platform for info exchange and data transmission. Generally speaking, this kind of linking is of great difficulty and high trading frequency.
(2) Type B: Suppliers use B2BTurnkey software interface for info exchange and data transmission with key factories.
(3) Type C: Suppliers directly input or search info and data provided by the key factories by means of web browser.

Figure 3 shows the general configuration of B2B e-Business among the four manufacturers. In general, this kind of linking is of relatively low difficulty and uneven trading frequencies.

3.2. e-Business Implementation Strategy

Generally speaking, from processing to finished products, the machinery must go through hundreds of processing programs ranging from the processing and assembly of the raw materials upstream and various parts & components to the production of machines and the planning and application of the automation system, covering a wide and deep industrial range. Therefore, the inter-system e-Business in the machinery industry will take advantage of BPR and information technology to link the key factories, the suppliers, the co-works and the client-side closely, so as to improve the operational performance jointly. At the same time, in the machinery industry, which is of intensive division of labor, the supplier and co-works rely relatively less on a single key factory.

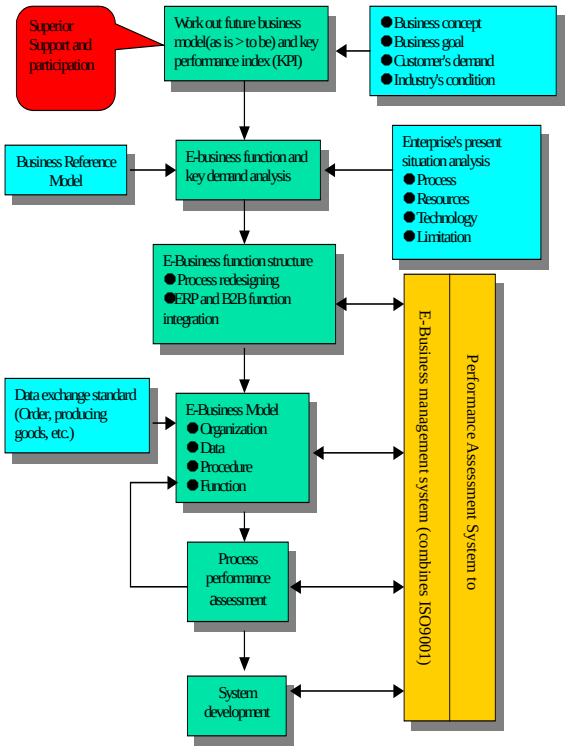


Figure 4: e-Business implementation strategy [5,9]

The full considering of inter-system demands is one of the keys to successful e-Business in the machinery industry. Therefore, the prescription and promotion of the e-Business standard becomes an important task for the e-Business in the machinery industry.

The four cases all begin BPR with the key factories, combined with new working process, to exert the actual performance of e-Business. Figure 4 illustrates the implementation strategy of e-Business.

4. PROMOTION MODE AND KEY PERFORMANCE INDEX

4.1 e-Business Promotion Mode

The four cases promote e-Business step-by-step from interior e-Business (mainly ERP) to inter-enterprise e-Business (mainly B2B) and then to global logistics e-Business (deepening of e-Business). In general, they implement the e-Business plan by stage combined with their own business strategy. (See Figure 5):

Stage 1: establish and conform infrastructure of internal information.

Stage 2: reorganize internal value process and combine it with the business information blueprint to develop the structure, so as to develop the integral system for separate plant sections and spots to get ready for B2B.

Stage 3: develop inter-system e-Business by establishing strategic partnership working mechanism with manufacturers upstream and downstream.

Stage 4: adopt the medium and long-term operational strategy to deepen inner management and inter-system cooperation, such as GLM, CD and CPFR.

Stage 5: develop such systems as the KM system, so as to promote the creation of study teams, which will guarantee sustained and outstanding business.

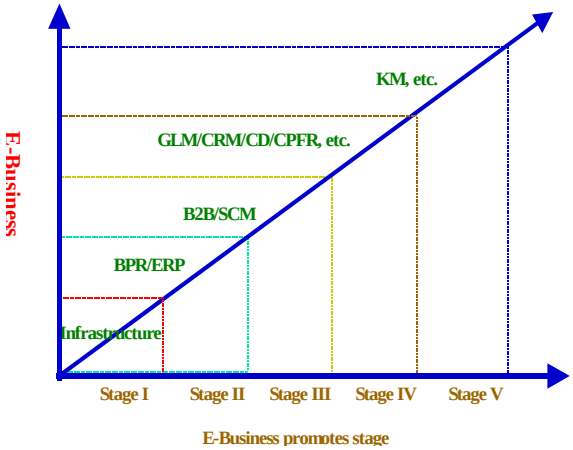


Figure 5: e-Business Promotion Mode [5,9]

Up to now, with the help and instruction of the Ministry of Industry, the four manufacturers have completed the Stage 3 of B2B e-Business system construction, heading for the global logistics e-Business. The promotion program and executive mode for division of labor in Stage 3 are shown in Table 1.

4.2 Key Performance Index of e-Business

The KPI varies in the four cases, but there is still something in common. Under the three principal axes---'Time', 'Cost' and 'Quality', induce and analyze to work out the key KPI in the business value chain by means of balance scorecard, and one can measure the input and output values of the plan [6]. For example, reduce stock turnover time, shorten purchase cycle, increase settlement rate and decrease operating cost, etc. The following is a brief introduction to KPI and its benefits in the four cases.

The e-Business execution benefit in the key factory is shown in Table 2. The e-Business execution benefit for the manufacturer within the system is shown in Table 3. (By form of questionnaire on suppliers)

5. FUTURE DIRECTION AND PROSPECT

5.1 Future Direction

The common problems faced by the Taiwan's mechanic practitioners are mainly the increase of manpower cost and the threat from the Mainland market, which is recognized as a market with great potentials. Large factories from different countries set up factories in Mainland China in succession in order to decrease the cost and get close to clients for a better understanding of their demands. Such a market-oriented marketing concept has greatly influenced the operational manner of Taiwan merchants. Accordingly, the manufacturers of machine tools and moulds well developed in Taiwan also tend to move to Mainland China and Vietnam. On the other hand, in the severe competition with USA, Japan, Germany and South Korea, the profitable output value of the domestic machinery industry begins to decline. According to the statistics from the Statistics Department under the Ministry of Economics, the output value of the machinery industry dropped from NT$454.3 billion in 2000 to NT$404.9 billion in 2002 [3].

Additionally, the e-Business in the machinery industry faces the following challenges:

(1) The industrial structure faced by the machinery industry includes: a) How to closely link the manufacturers upstream and downstream to optimize the resources allocation and profitability. b) How to establish a feasible e-Business operating mode in line with the global situation. Both are challenging topics at present.

Table 1: e-Business action items and execution plan [5,9]

Action Items	Content	Execution Plan	Responsible Unit
1. Process examined and system analysis	• Procedure analysis of the current process • The drafting of procedure of the rationalized process • Procedure e-Business system analysis of the rationalized process	• Execution group to make together	• Execution group
2. To establish e-Business standard	• The procedure standard of process, information exchange form set up • The relevant systems of e-Business are designed	• Assistant, cooperate with the TAMI to make, promote relevant e-Business standards • Asks the information service manufacturer to design the system	• Taiwan Association of Machinery Industry • User's group (Include execution group)
3. Construction activity	• A type connection construction • B type connection construction • C type connection construction	• Develop with the information service manufacturer together	• Centre manufacturer • Information service manufacturer
4. Implementation	• The center manufacturer implementation • B, C type manufacturers implementation • A type manufacturers implementation	• Run education and training and train the seed teacher to popularize • System implement, KPI value collects, analyses, examine	• Execution group

Table 2: e-Business execution benefit in the key factory [5,9]

Tangible Benefit			
KPI items	Before implementation	After implementation	Improving value (%)
Reduce days for stocks turnover	89 days	67 days	22 days less (24.7%)
Shorten purchase cycle	60 days	51 days	9 days less (15%)
Improve the fulfillment rate (*)	75.55%	86.53%	10.98% up (14.5%)
Reduce purchase money	NT$850,000,000	NT$841,500,000	NT$8,500,000 less (1%)
Reduce operation man-hour for log-in (moon)	139.04 hours	22.55 hours	116.49 hours less (83.7%)
Intangible Benefit			
(1) Make the work flow standardized and efficient and set up long-term mutual trust and interdependent business relations with the manufacturers within the system. (2) Diminish repeated work within the system. (3) Deepen the manufacturers' reliance on the key factory. (4) Improve the mastery of relevant information.			

* Fulfillment rate = (total fulfillment count / total deliver count) x 100%,
Fulfillment definition: Delivery date < = fulfillment date in advance

Table 3: e-Business execution benefit for the manufacturer (supplier) within the system [5,9]

Tangible Benefit			
KPI items	Before implementation	After implementation	Improving value (%)
Reduce the stock cost	NT$10,152,000	NT$4,777,000	NT$5,375,000 less (52.9%)
Improve the fulfillment rate	60%	80%	20% up (33.3%)
Reduce operational man-hour (moon) *	56.8 hours	15.02 hours	41.78 hours (73.5%)
Intangible Benefit			
(1) Establish synchronous e-Business with the key factory to improve e-Business effect. (2) The key factory transfers quick and complete data, which facilitates to arrange production and get enough relevant information. (3) Deepen the key factory's reliance on the manufacturers within the system.			

* The operational man-hour covers enquiry & offer, order, drawing confirmation, delivery and account checkup.

(2) In the machinery industry, which is of extremely intensive division of labor, there are numerous manufacturers upstream and downstream, including some large-scale ones. However, there are so many medium-sized and small-sized enterprises in Taiwan that most suppliers are in a small scale and lack of full understanding of the infrastructure of e-Business. It is thus a hard work to communicate with the suppliers effectively to enable synchronous e-Business and proceed with relevant training.

(3) The transparency of information is the footstone for the members in the supply chain to trust one another. However, there is still no unified standard for the information exchange format among various suppliers in the machinery industry. The lack of a unified e-Business standard will lead to lack of common understanding among the members, which will influence the further e-Business and information application.

(4) The problem of safety control over the network data transmission still exists. How to balance the speed of data transmission and the degree of data encryption and how to avoid data leakage rely on the effective and safe design and management of the e-Business system combined with relevant operational regulations and legal norms established by the governmental offices.

Generally speaking, the machinery industry has gradually lost its traditional advantages in competition due to the rapid change of industrial structure and the increase of operating cost. At the same time, such key factors as “Innovation”, “Speed” and “Flexibility” have become the key values for future competitions in the domestic machinery industry with e-Business as one of the most significant solutions. Accordingly, the machinery industry generally falls into the category of capital goods, and the mechanical equipment manufacturing is the leading boom reaction and subject to the influence of the prosperity fluctuation. Most clients expect timely delivery and good after service on order and purchase, resulting in the following: 1. How to shorten the R&D and production cycles, including the change of model specifications and the coordination with suppliers, is the bottleneck of timely delivery. 2. How to maintain good customer relationship, including the after service. This is a key index to hold old clients and to develop new ones. Accordingly, the cost of after service becomes an important cost item in the investment of the machinery industry.

At the same time, with the development of globalization, such feasible labor-dividing modes as inter-spot order and purchase are the key for the machinery industry to get involved into e-Business [8]. Figure 6 illustrates the general condition of the e-Business in the machinery industry.

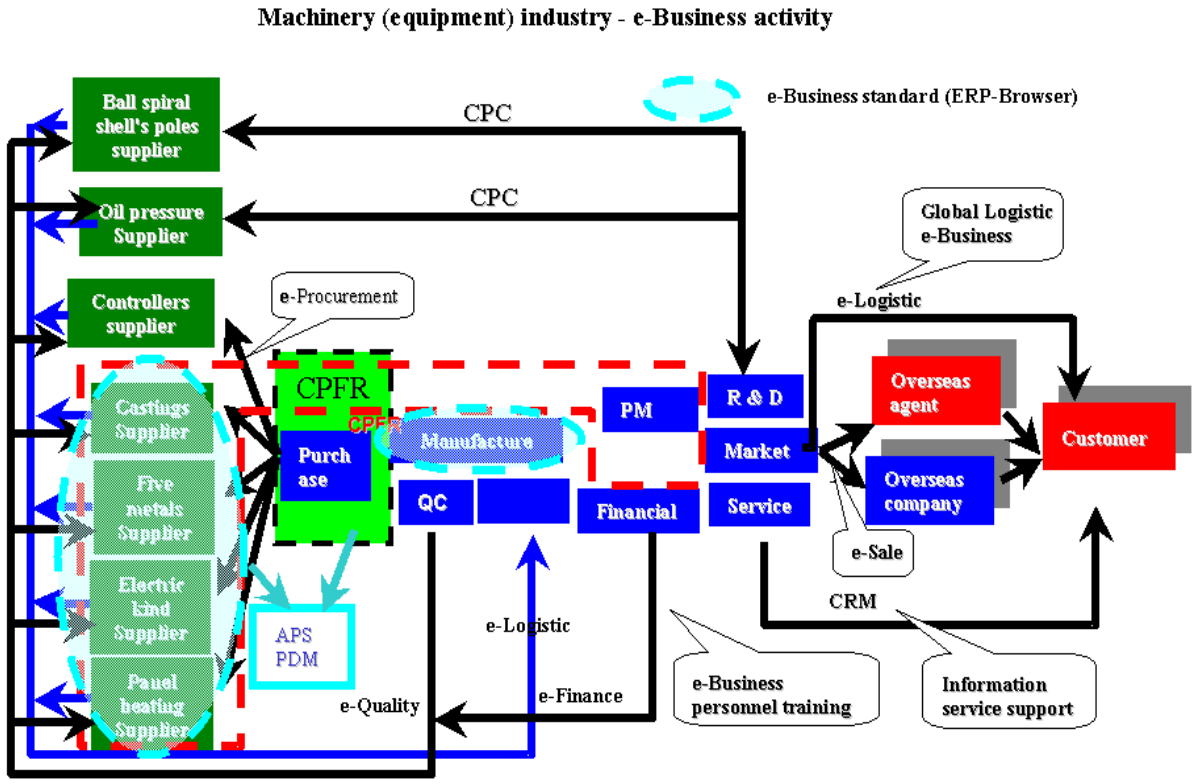


Figure 6: e-Business promotion mode in the machinery (equipment) industry [8,11]

5.2 Prospect

In the course of construction of the B2B data exchange system, the common understanding of adopting the e-Business standard that accords with the industrial characteristic is a key to the successful application of the system. Especially in the machinery industry, which is of intensive division of labor, the supplier and co-works rely relatively less on a single key factory. The full considering of inter-system demands is one of the keys to successful e-Business in the machinery industry. Therefore, the prescription and promotion of the e-Business standard becomes an important task for the e-Business in the machinery industry. During the implementation of inter-system e-Business, these four manufacturers had found out that the inter-system demand of the upstream parts & components supplier was directly influence its will of cooperating with the implementation of e-Business. After the negotiation with the Taiwan Association of Machinery Industry and relevant authorities and with the support from the Ministry of Industry, they formulate the e-Business standard (TAMInet) by means of standard setup, implementation and promotion in turn, which is well recognized by the upstream parts & components manufacturers. In addition, the benefit is directly reflected by the respective outcomes of the implementation of the B2B e-Business plan.

The mode of the setup and application of e-Business standard in the machinery industry is to aim at the user group, cooperate and assist the key industrial organization (association) to lay out the e-Business standard, implement it to meet the industrial demand, and gradually turn to self-support planning and operation, so as to keep the sustained operation of the e-Business standard, as shown in Figure 7.

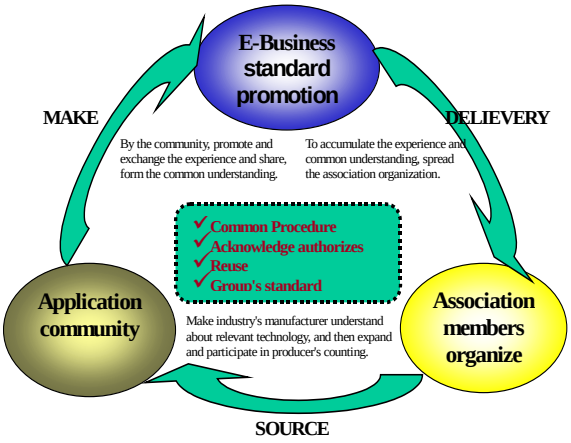


Figure 7: e-Business standard mode in the machinery (equipment) industry [4,11]

The manufacturers within the system are to participate in the formulation and maintenance of the e-Business standard for the machinery industry. The blueprint for the e-Business standard is shown in Figure 8.

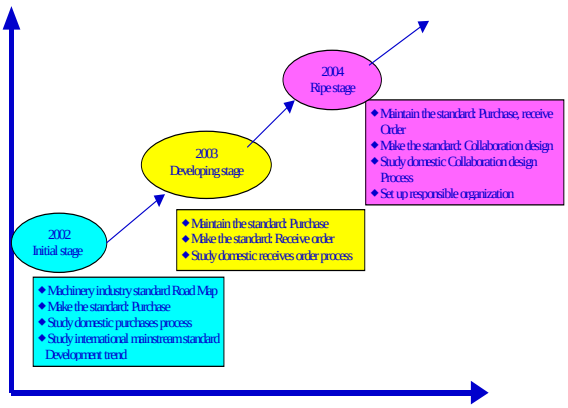


Figure 8: Blueprint of the e-Business standard for the machinery industry [4,10]

The e-Business standard implementation strategy for the machinery industry is divided into three stages [4,10]:

(1) Stage I: the key factories reserve their respective unique functions on Web, make data exchange in a common trading mode according to the e-Business standard, and adopt the design of shared interface to offer the operating interface to facilitate the suppliers and co-works to receive order from and reply to several key factories synchronously, so as to improve the B2B trading step by step for a great reduction of both manpower and time cost.

(2) Stage II: Boost the demands of the suppliers and co-works for relevant IT application, and help them into the B2B field. Accordingly, the information structure on the shared interface shall adopt the modular design, which facilitates to transfer the transaction data to the back-end systems of the suppliers and co-works to further guarantee quick response, auto-processing and accuracy of the transaction data.

(3) Stage III: To meet the demand of the IT development, introduce the concept of Enterprise Distributed Computing by means of such technologies as Web Services, so as to help the enterprise with further e-Business application including co-design, making B2B trading more flexible and safer.

In addition to the formulation, promotion and implementation of the e-Business standard, one should apply the concept of business globalization to the machinery industry by means of global logistics e-Business to meet the demand of the future global competition. In terms of the existing industrial chain configuration and operational state of the machinery industry, the regional logistic management is dominated, as shown in Figure 9: the regional subsidiaries take order directly from the clients, followed up by their local manufacturers. They

inform their head quarter with the order details to follow-up but only in case of special demands and specifications, so that it is difficult to coordinate all resources for an effective allocation on later stage.

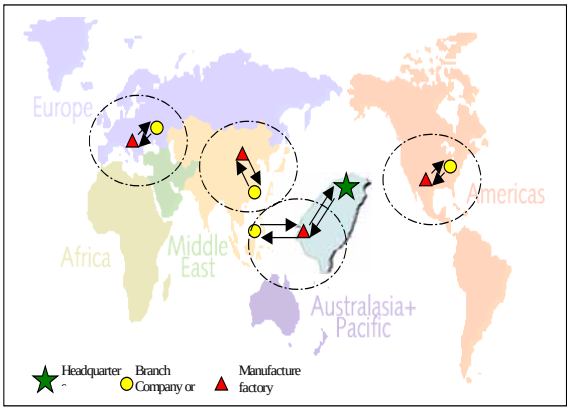


Figure 9: Local area logistics business model [5,9]

The machinery industry has entered the globalization era facing the challenge of diversification, which requires the enterprises to intensify production R&D and manufacture, professional marketing, good service and financing, as well as strengthen their global logistic e-Business quality, so as to guarantee their competitive energy and advantage. To achieve the goal of global logistics, the enterprises should establish the global logistics (operation) head quarter in Taiwan as the decision-making hub of global operation, so as to develop the business model of taking order from Taiwan combined with global purchase / manufacture / delivery/service; set up the global logistic management system ranging from the centralized order pickup by the Taiwan head quarter (all subsidiaries take orders and report them to the head office) to the unified order discharge, unified key parts & components purchase and unified logistics by the head office, as shown in Figure 10.

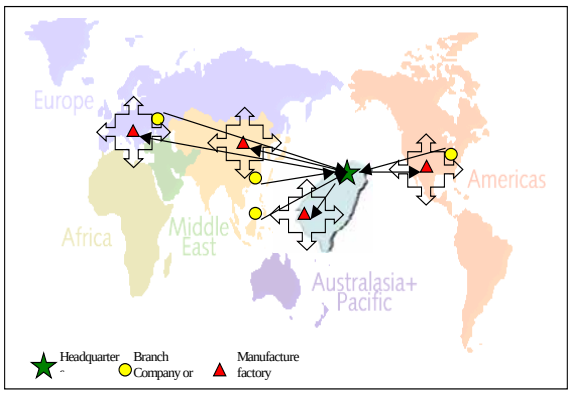


Figure 10: Global logistics business model

6. CONCLUSION

Based on the above discussion, we learned that the challenges facing the e-Business of machinery industry are as follows:

1. Optimal distribution and profit making of industrial resources, e-Business logistics model for the global market;
2. Fundamental structure of the e-Business and training;
3. Uniform e-Business standard and operating platform;
4. Information security operation and legal guidelines established by the government.

Based on the data analysis on the companies, the incorporation of advanced information technology, corporate reengineering, and entry into the emerging e-marketplace is the best model for companies to gain competitiveness through e-Business. Since the competitiveness is built upon effective strategic planning (government policy), the critical success factors include unique strategic positioning, utilization of electronic technology to improve the efficiency and competitive advantages, gaining support from the senior management, and emphasis on the quality of e-Business.

The e-Business implementation and promotion model discussed in this study may provide a guideline and reference to the government organizations and other industries on developing e-Business.

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(Received September 2004, revised November 2004, accepted December 2004)