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Transforming Inter-Organizational Information Systems into Electronic Commerce Marketplaces:
Development of B2B Electronic Commerce in China's Pharmaceutical Industry*

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ABSTRACT

The aim of this paper is to identify the barriers to the B2B e-commerce development in China's pharmaceutical industry and to devise an effective strategy for its future development. Built on a detailed investigation of the market structure and recent development of electronic commerce in China's pharmaceutical industry, this paper proposes that the key issue in the development of effective B2B e-commerce business models is the successful transformation of the inter-organizational information systems into electronic marketplaces. In order to ensure the success of such electronic marketplaces, a government driven approach will be needed. In the process, designing an incentive compatible mechanism of coordinating the interest of all the market players will be the prerequisite.

Keywords: Electronic Commerce, Interorganizational Information System (IOS), E-bidding System, B2B, Value Chain, Pharmaceutical Industry

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1. INTRODUCTION

The characteristics of B2B electronic marketplaces such as reducing search and transaction costs and increasing information transparency, have the potential of overcoming the factors causing market failure in the pharmaceutical industry including asymmetric information, agency problem, difficulty in government regulation etc. In recent years, the Chinese government has been making great effort to introduce B2B e-commerce systems into China's pharmaceutical industry However, empirical studies and industry interviews indicate that the process has been slow and lack of substantive progress, compared with the rapid paces of B2B e-commerce practices in other industries, such as agriculture, textile, etc.

The aim of this paper is to identify the barriers to the B2B e-commerce development in China's pharmaceutical industry and to devise an effective strategy for its future development. Built on a detailed investigation of the market structure and recent development of electronic commerce in China's pharmaceutical industry, this paper proposes that the key issue in the development of effective B2B e-commerce business models is the successful transformation of the inter-organizational information systems into electronic marketplaces. In order to ensure the success of such electronic marketplaces, a government driven approach will be needed.

Firstly, we present an overview of China's pharmaceutical B2B e-commerce development. Then, we introduce a conceptual framework for the e-bidding systems in China's pharmaceutical industry. After an analysis of the differences between IOS and e-marketplaces, we then apply the multi-level theoretical framework of devising an effective B2B e-commerce strategy of Reimers, Li and Chen (2003) to the analysis of this industry. The empirical data for our analysis draws upon interviews with major players in the industry and the government agencies. Based on our analysis of the "institutional barriers" and "technological barriers" to the implementation of the e-commerce marketplaces, we conclude that the ultimate bottleneck of implementing B2B e-commerce strategies lies in the market power of hospitals, the last segment of the pharmaceutical value chain. However, the success of overcoming this bottleneck will be far more complex than it first appears since it is closely related and will hinge upon the successful reform of the overall medical systems in China. The e-commerce strategies in China's pharmaceutical industry will need to follow a government driven approach. In the process designing an incentive compatible mechanism of coordinating the interest of all the market players will be the prerequisite.

2. A BRIEF DESCRIPTION OF CHINA'S PHARMACEUTICAL MARKET STRUCTURE

In this section we describe the industry structure and market power allocation of China's pharmaceutical industry. Firstly, we will describe the overall characteristics of the pharmaceutical Industry in general. Secondly, we develop a value chain based framework of analysis for China's pharmaceutical industry. We divide the pharmaceutical industry value chain into three tiers: the initial market, the middle market and the end market and try to pinpoint the major problems.

2.1 Overview of China's Pharmaceutical Industry

Most of the pharmaceutical markets in the world are highly monopolized. In 2000 the top ten pharmaceutical manufacturers' market share was 50% of the world total. In comparison, China's pharmaceutical market is highly competitive with a large number of manufacturers and distributors.

The taxonomy of medicines in China consists of prescription drugs and over-the-counter drugs. The over-the-counter drugs such as vitamins and parts of the antibiotics could be bought in any pharmacy. The total revenue in the US drug market was 214.7 million dollars in 2002, but the OTC market was only 57.8 million dollars. And the sale of prescription drugs is controlled strictly. The buyers have to hold a prescription by doctors and can only buy the drugs listed on the prescription. In fact, the prescription drugs take the main market share and have stable demand. As a result, the market for medical products could generally be divided into prescription market and over-the-counter market. One of the most important characters of prescription drugs is that the end consumers have less freedom to choose the products at their will. Instead, doctors or apothecaries make choices regarding the category of drugs and also brands within the category The unique type of principal agent relationship causes problems in the market including price insensitivity in the retailing market, asymmetric information, agency problem, necessity for government regulation etc.

2.2 A Value Chain Analysis of the Three –Tier Pharmaceutical Markets

The industry value chain in China has some special characters (See Figure1). One of the most important features is that the hospitals also sell medicines as the normal pharmacies in China. So Chinese pharmaceutical retailers include both the pharmacies and hospitals. The hospitals' market share is over 80% in the

drug wholesale market. They are the most valuable customers to the wholesalers and manufacturers. In fact, in the prescription market hospitals nearly take the whole market share. But in the OTC market, the pharmacy's market share is increasing.

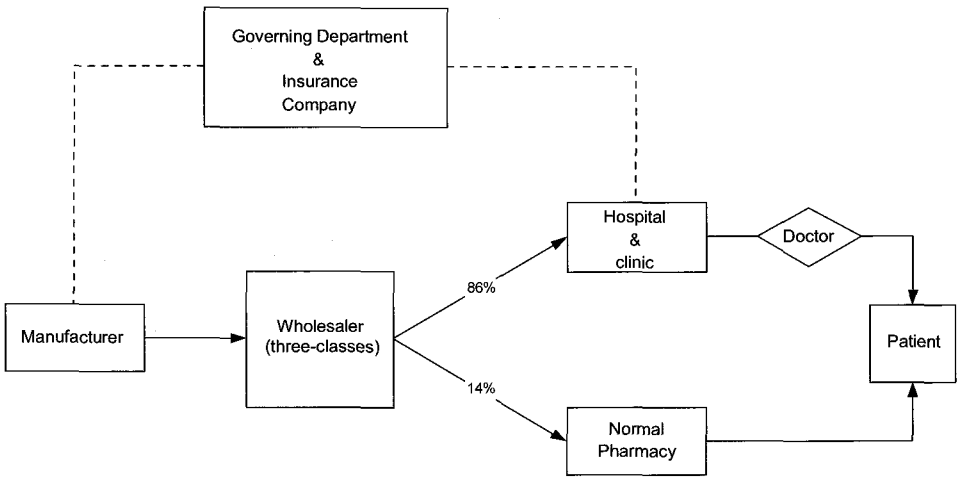
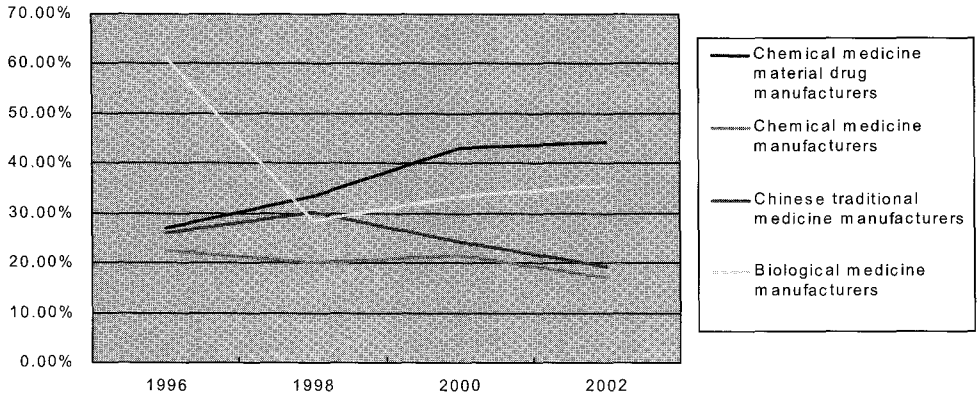


Figure 1. Chinese pharmaceutical industry Value chain

In our analytical framework we divide the value chain into three tiers and analyze them separately. The buyer in the former class market would become the seller in the latter market. We define three-tier markets as the initial market, the middle market and the end market.

This **initial market** is the first market of pharmaceutical products. The manufacturers are the sellers, and the buyers are wholesalers. At present there are more than 6000 pharmaceutical manufacturers in China. The average firm size is very small, and the biggest one's sale revenue is equal to 1% of the whole market revenue in the US. The firms are competing intensely on regional basis and there's no real industry leader. Another feature is the manufacturers simply focus on production and highly rely on the downstream firms who handle the market channels, which make their market power weaker when facing the distributors and sale agents.

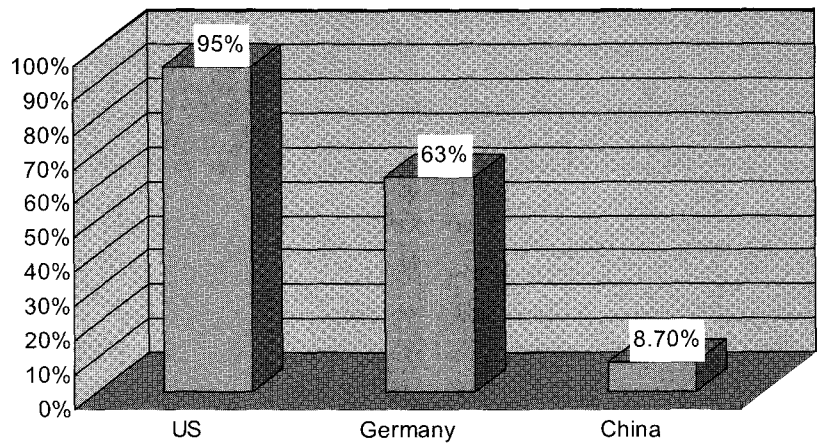
We subdivide the manufacturers into four types and show the top ten firms' market shares from 1996-2002 in Figure 2. It's clear that the market concentration rate is low. Considering the fact that few of the top ten firms in the four subdivided types are cross sector firms, the market concentration of the whole pharmaceutical manufacture is even lower.



Source: *Chinese Market Yearbook*, 1999-2004.

Figure 2. The total market shares of the top ten pharmaceutical manufacturers

As for the wholesalers, the situation is similar. Currently there are more than 16000 pharmaceutical wholesalers in China. Only 5% of them have annual revenue higher than ￥20,000,000 (about US$2.5million). In 2002, there are 17 pharmaceutical wholesalers on the list of China top 500 wholesalers, the total market share of them is 25.88%. (See Figure3) In such a situation none of the buyers and sellers have great bargaining power. But in the regional markets some wholesalers have relatively high monopoly power due to the isolation of the markets.



Source: *Chinese Market Yearbook*, 2002.

Figure 3. The CR_3s of three countries' pharmaceutical wholesale industries

In the **middle market**, the wholesalers are sellers and the retailers who are the buyers include two groups: pharmacies and hospitals (clinics). The hospitals are the more important customers to the wholesalers, especially in the prescription drug market. Since hospitals have the right to decide the drugs to be sourced from the wholesalers, there are many secrete "under table" trades in this market. Doctors in the hospital who could submit medicine orders play an important role in the trading and the sellers have to incur some additional costs, like commission paid to the doctors for their choice of some particular drugs. This tier of market has been very inefficient which has been the major reason for the government's push of the adoption of the more transparent e-bidding systems, on which we will give more details in Section 3.

The sellers and buyers in **end market** this market are hospitals and patients The demand of the pharmaceutical products in this market is very stable and has low price elasticity. The agency problem between the doctors and patients is very remarkable. Since doctors prescribe the medicine for the patients, they are the de facto decision makers, which gives the hospital an absolute advantage and leaves little bargaining power to the patients.

3. DEVELOPMENT OF ELECTRONIC COMMERCE IN CHINA'S PHARMACEUTICAL INDUSTRY

We give an overview of the E-commerce development in China's Pharmaceutical industry and focus on an important application of E-commerce in China, the E-bidding system that are being applied to the government-led hospitals centralized procurement process, which is regarded as a key action in the anti-corruption and price-controlling reform in the industry. At last, we would introduce the layout of the future pharmaceutical e-commerce system designed by some industry leaders.

3.1 Current Status of Pharmaceutical EC development

Since the end of the last century, the Chinese government has paid great attention to e-commerce and social digitalization, regarding it as a chance for promoting economic development and for enhancing China's competitiveness in the world market. To some degree, the development of the information technology industry and electronic commerce in China has been keeping up the pace with the rest of the world.

3.1.1 An overview of E-commerce development of China's Pharmaceutical industry

The pharmaceutical industry is recognized worldwide as one of the industries which will be adapted to the adoption of e-commerce. Compared with the US and Europe, the concept of e-commerce was introduced into China's pharmaceutical industry several years behind, which first caught up people's attention in 1996. At that time, there were just some experiments and they were not formally approved by the government. Until 1999, pharmaceutical e-commerce had been authorized and formally started.

Although the e-commerce use in pharmaceutical industry falls under the strict regulation or supervision of a variety of government departments, on account of the peculiarity and importance of medicine product and pharmaceutical industry, the government is also the most active driver and supporter of the diffusion and development of e-commerce in the pharmaceutical industry. Starting from March 1999 when Ministry of Information Industry set up a pharmaceutical e-commerce website, China Medicine & Health E-commerce (www.gmec.net.cn), as a part of the national industry-level e-commerce application demonstration project, the Chinese government started its continual promotion of e-commerce use in pharmaceutical industry, with support in the form of resources input and policy support, which has laid a good foundation for the e-commerce development and has also given tremendous impetus. The government-implemented hospital central procurement tending system is also viewed as an important push for the application of e-commerce systems, as government required that all the asks & bids should be operated in the e-bidding platform (more in section 3.2).

Besides the goal of accelerating the informatization and modernization process of the industry, the pharmaceutical e-commerce adoption were entrusted with some other special missions, which include playing an active role in promoting the Chinese medicine distribution system reform, curbing drug related expenses and lowering the high prices of drugs.

Under the strong promotion of the government and learning the successful experience of developed countries, the confidence and expectation with the pharmaceutical e-commerce among the industry players climbed to a peak in the year 2000. E-commerce was regarded as the future trend of the industry and this process would not be too costly and too lengthy. These pictures attracted a lot of leading industry manufacturers, such as North China Pharmaceutical Corporation, Beijing Pharmaceutical Group, Tongrentang Pharmaceutical Group etc., to invest in the pharmaceutical e-commerce projects. And a lot of pharmaceutical e-commerce companies emerged; the early-movers and famous ones include Beijing

Qiuen Pharmaceutical e-commerce (www.pharm2b.com), Shanghai Pharmaceutical (www.e135.com), and Haihong (www.emedchina.net), etc.

However, as time passed, many of these pharmaceutical e-commerce companies are struggling instead of realizing their previous ambition. So far, there is no authorized record of the e-business trading volume of the pharmaceutical industry, and although some e-commerce websites boast a high volume of transaction, our interviews revealed that manufacturer groups did not feel much benefits brought by adoption of the e-commerce system and most of the products are still traded off-line, including some of the leading manufacturing companies in the industry.

3.1.2 Existing patterns of E-commerce business models

Generally speaking, there are 2 types of pharmaceutical e-commerce models, B2C and B2B. In the US, B2B accounts for 85% of the pharmaceutical e-trading volume. In China, B2B plays an even more dominant role in the pharmaceutical e-commerce, since the government does not authorize B2C. As for the so called "online pharmacies", most of them in fact sell healthcare products which are not comprised in the medicine category; some are just the websites or information platforms. Existing pharmaceutical B2B e-business modes in China could be divided into 3 types:

(1) B2B e-business between the pharmaceutical manufacturers and raw material suppliers takes up a considerable portion of pharmaceutical e-commerce. But actually, this B2B has no difference compared with e-commerce in other manufacturing industries' material procurements, such as textile, food industry, etc., and it also faced the same problem which is common among all the e-commerce systems in China: the low informatization level of the enterprises This problem may be more serious to some extent in the pharmaceutical industry, since the low market centralization of the pharmaceutical manufacturers caused the size and the revenue of these enterprises to be very small and lack of resources in updating their information technology adoption. Besides, these e-business technologies aim to reduce the production cost of manufacturers, but do not have much effect on the improvement of drug distribution.

(2) Some websites serve as information platforms for the three tier markets (as we analyzed in section 2). Manufacturers, distributors or retailers can post and exchange their demands or supplies information on the platform. These websites do make a positive contribution to reduce the search costs, but do

not have the trading functions.

(3) Electronic bidding/bidding system that is applied in the hospital centralized procurement process is viewed to be the killer and most innovative application of the pharmaceutical B2B e-commerce. Compared with other two types, the e-bidding system directly influences the drug distribution process, and aimed to be not only an information exchange center but also a trading platform. At the beginning, it was entrusted with the mission of improving the structure of the current distribution models and promoting the institutional reform of hospital. Therefore, we want to put more emphasis in this system and will explore it in more detail in section 3.2.

3.2 The bidding system and its impact

3.2.1 The bidding system

In 2000, a bidding system has been implemented through government action that aimed at curbing drug-related expenses. One year later, the government issued a regulation according to which all hospitals will ultimately go through the bidding system. The system works roughly in the following way (from the interview with Mr. Li, Sept. 14, 2004): Hospital procurement is centralized on the municipal or provincial level. Bidding rounds are usually organized twice per year. For each city/province, hospitals designate a group of experts from which a body is randomly chosen to select the winning bids. For each class of hospitals these decisions are uniform and binding. Manufacturers have to commit to one distributor when preparing their bids. Thus, developing good relationships with hospitals is still the main success factors for distributors/wholesalers. While committing manufacturers to their quoted prices the bidding process does not commit hospitals to definite purchasing quantities. The implementation of the system is in a step-by-step fashion. Currently, only drugs are required to be purchases through the bidding process.

The extent to which this system is used varies greatly across municipalities / provinces and types of hospitals. Larger hospitals are more likely to use it extensively than smaller ones[1]; also the most extensive use is found in Beijing where only two distributors are allowed – the major one being state-owned – and about 70% of drugs (except for traditional Chinese medicine) purchased by hospitals are

[1] However, leading hospitals such as Beijing University Hospital also have more bargaining power vis-à-vis municipal authority so that the bidding system tends to not significantly reduce their range of choice thus raising doubts about the effectiveness of the system.

purchased through the bidding system wherelse the average share is about one third. This figure is expected to rise to 100% next year. Similarly, organization of the bidding process varies across regions. In Beijing, the bidding process is controlled by Beijing University Hospital that commissioned an intermediary with running it while in Shanghai the system is run by the local government.

Regarding the bidding process, the main advantage of using the system for the bidding process consists of selecting among drugs in drug categories where there is a large number of alternative (in the thousands) which, however, account only for a small fraction of total expense. In contrast, most heavily used drugs were still selected by a manual process through an expert group (about 200 brands of drugs account for 80% of revenues; those will continue to be selected by experts).

3.2.2 Impact and Problems of the Electronic Bidding system

The bidding system had a noticeable effect on drug-related expenses via drug prices and purchasing behavior. According to the Ministry of Health, the share of drug-related expenses per patient in hospitals has decreased as a result of using the bidding system. For instance, in Hainan Province, since the implementation of electronic bidding system, the average retail price of medicine in hospital has been decreased by 13%. However, it should be kept in mind that the bidding system has been heavily promoted by the Ministry of Health that probably views the bidding system as a better way to curb drug-related expenses than promoting the emergence of an independent retail pharmacy sector. It is also anticipated that prices established via the bidding system will be used as benchmarks for setting retail prices

However, so far the system has raised a great number of concerns by all industry players. It continues to lack transparency and is fraught with inconsistencies. While improvements are due to be made to the bidding system, local interpretations of the policy will remain a challenge for manufacturers which will devote significant resources into winning bids. Specifically, the following points have caused concern:

- Purchasing from lists established through the bidding system is enforced weakly.
- The system has failed to curb retail (patient) drug prices since hospitals depend upon drug sales for their own financial support.
- The bidding system has dramatically increased competitive intensity among manufacturers especially among generics manufacturers with the effect that product quality begins to suffer.

- Since bidding is organized on municipal or provincial levels, participation in bidding incurs high costs for manufacturers who have to participate in multiple bidding rounds and prepare loads of documents for each. These costs add to manufacturers' sales costs since they still need to maintain and develop good relationships with hospitals so that participating in the bidding system does not eliminate direct sales costs while it also does not support logistical processes.
- The bidding system is misused in some municipalities to further protectionism. For example, in Qingdao tender products are grouped according to subcategories and the distributor that wins the most products within a subcategory will be awarded the tender to supply all products in the group. Any manufacturer that has never had business with the selected distributor faces exclusion from the tender.

These problems have lead to massive resistances in the whole industry. For example, all relevant associations in the industry are planning a petition to be filed with the Ministry of Health in which they speak out against this system (interview with Mr. Zhu, Sept. 16, 2004). However, hospitals, which initially opposed the system, also often benefit from it since purchasing prices have been reduced while selling (patient) prices could be maintained on their original levels. This has "eroded" their resistance towards this system. However, the intention of using the bidding system to set/curb retail prices (see above) will eliminate this extra-profit.

The only group that, so far, as unambiguously profited from this system are newly established intermediaries that run or help participate in the bidding system. They were allowed to charge distributors or manufacturers a commission of 0.6% of the tender value. However, new rules (which supposedly take effect in 2004) forbid this practice and require that hospitals pay the commission. Hospitals, however, are likely to try to recoup these costs from manufacturers. All these shows the problem of squeezing out corruption in the drug supply chain. While the bidding system presumably was set-up for this purpose, it reproduced the problem to a certain extent which can be seen from this planned change of regulation.

In Henan province, the introduction of the bidding system went hand in hand with the creation of an e-business system which had been designed and run by Mr Li (interview Sept. 14, 2004). This system was used for half a year until it was ruled illegal under Zhu Rongji's government since government institutions were to be barred from participating in business operations (ibid.). The system was

then sold to an intermediary in Beijing – Haihong – which continues to use it for running tenders in Beijing. Mr. Li claims that substantial amounts of bidding were done via this or similar systems in Guandong (3 billion RMB in 2003), Hainan (1 billion RMB in 2003), and Beijing (10 billion RMB). This compares with an estimated volume of 80 billion RMB worth of purchasing done through the bidding system. However, according to Mr. Zhu from the China Association of Pharmaceutical Commerce the extent of use of this system is negligible.

3.3 The Future of the Pharmaceutical E-bidding System

Recently, the government and some industry leaders are planning for a comprehensive system organizing all processes between hospitals and manufacturers. Currently, it is only partially functional but will be fully implemented in later November 2005. The system will become an industry level mechanism of organizing the relationships between drug manufacturers, hospitals, wholesalers, and banks. Wholesalers will become purely logistic firms, and will cover all transaction phases, from the bidding process to the order fulfillment process.

4. FROM INTER-ORGANIZATIONAL SYSTEMS TO ELECTRONIC MARKETPLACES: A GOVERNMENT DRIVEN APPROACH

4.1 Difference between IOS and Electronic Marketplaces: review of literature

Bakos [1] defines inter-organizational systems as "systems spanning more than a single organization" and categorizes two types of IOSs: information links and electronic markets. An inter-organizational *information link* is an IOS at the interface of the value-added chains of supplier and customer and represents an investment in *bilateral* integration. An electronic marketplace, on the other hand, is an IOS that allows the participating buyers and sellers to exchange information about market prices and product offerings and thus represents an investment in multilateral information sharing. These definitions distinguish the key differences between an information link and an electronic marketplace as whether the bilateral relationships between the buyers and sellers have already been established. If the answer is "yes", there are information links in place; otherwise the establishment of e-marketplaces will have the potential of helping match a buyer and a seller.

Reimers [2] define electronic markets in a narrower sense as the ones, which

support the negotiation phase of a business process. He further proposes some non-market preconditions of electronic markets: (1) the institutional regime shaping market participants' transaction behavior; (2) a set of meta-activities which establish and maintain the institutional regime, and (3) a generative regime, which is the group of actors performing meta-activities.

In this paper we follow the definition of Reimers (1996) in order to pinpoint the differences between the current e-bidding systems in use in China's pharmaceutical distribution and the "ideal" model of electronic marketplaces we propose in the next section. According to this categorization, the current e-bidding systems will be called "interorganizational information systems" since they mainly provide the functions of information exchange. A genuine e-marketplace as we propose in the next section must have all the functions for the fulfillment of market transactions.

4.2 A Conceptual Framework for an Electronic Marketplace of China's Pharmaceutical Industry[2]

Our previous analysis indicates that the current major functions of the e-bidding systems are information provision. Although the government has the purpose of using the e-bidding systems to overcome the problems encountered in the pharmaceutical industry, as described in previous sections, firms in the industry value chain try to go around the bidding systems and perform their transactions offline. In this section we introduce a conceptual framework of an full-function e-marketplace which we believe will help solve the problem of pharmaceutical products distribution in China. We also analyze the barriers to the implementation of such e-marketplaces and propose strategies to overcome the barriers.

4.2.1 Industry Value Chain of China's Pharmaceutical Industry after the introduction of electronic marketplaces

Many scholars and industry practitioners have figured out different mechanisms of leveraging the characteristics of electronic commerce in order to solve the problems of Chinese pharmaceutical industry. We describe a new value chain model which separates the E-business system from the function of logistics (Figure 4).

This proposed value chain would consist of six primary parts. The manufactures, medicine governing department & insurance company, and the patients are

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[2] This insight of this framework is out of our interview with Mr Li Xianfa, the designer of the Haihong e-bidding system. Haihong is exploring the possibility of implementing this platform in practice.

remained as in the value chain described in Figure 1. For convenience, we generalize the hospital and normal pharmacy into one part as retailer. Comparing with the present value chain, the greatest differences in this value chain are the two new players added, E-Business System and Logistics, and a disappeared old player, distributors.

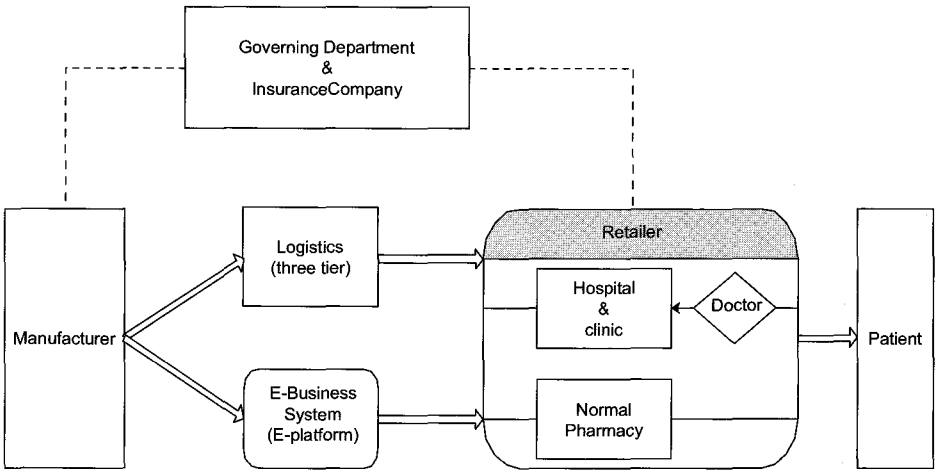

Figure 4. The intending pharmaceutical value chain

4.2.2 The E-Business System

Based on our analysis of the problems in pharmaceutical industry, we could find two primary responsible factors in the present value chain: the long distribution chain and the under-table trades in the middle market. To overcome these problems, the intending value chain would not use the traditional trading approach in the middle market but use an E-Business system instead.

All the manufacturers and retailers would come together on this E-platform with the elimination of distributors. The product information from the manufactures and the demands of retailers would be sent to this system, so the buyers and sellers could get information and clinch a deal without meeting each other. And the principles and details of the trades would be more transparent than at present and each participator's decision-making process of the trade would be independent.

In this system, there would be no chance and need to undergo the under-table trades between the buyers and sellers. By leveraging the characteristics of E-Business, the transaction cost of the two participators in the system would be much lower.

4.2.3 The Logistics

It is obvious that the wholesalers disappear in this intending chain; actually they would transform into or be substituted by another kind of participator in this market: the logistics firms. This kind of firms would not take part in the dealing process as the distributors. They would compete on efficiency in logistics only. They could be the third party logistics or affiliated firms of either the buyers or sellers.

4.2.4 E-bidding systems' impacts on the Relationships among the Market Players

The separation of logistics from the E-Business system would lead to some important changes in the value chain. The most remarkable one is that the middle market in the present value chain will disappear. The manufacturers could deal with the retailers directly on the E-Business system. The market power of both sides would be reallocated in this new market. And the industry structures would change as well.

(1) *The Manufacturers*

In this new market structure, the manufactures could sell their products to the retailers by getting around the distributors who used to take margins from the transactions. So the manufacturers' profits could be potentially higher even if the retail prices of pharmaceutical products would decrease. Further more, the trading process in E-Business system is more transparent and efficient, and the under-table trades would be more difficult to conduct. The manufacturers could save a large part of the transaction cost raised by the under-table trades.

(2) *From Distributor to Logistics*

After the use of such a system, there would be no need for the traditional distributors. Meanwhile there is another participator in the value chain, which is the logistics. The E-Business system only supplies a platform for the buyers and sellers to negotiate and make a contract. After that process the physical products need to be delivered from the buyers to sellers. Therefore the roles of the traditional distributors would transform into pure logistics.

(3) *The Retailers*

Theoretically speaking, the retailers should benefit from this system due to the saving of transaction cost which they will share with the manufacturers. But in China, due to the complex situation of having hospitals as the major retailers, the

doctors and relevant personnel in hospital would most likely lose the incomes from the under-table trades. Although because of the realized benefits from this system, they may get some compensation from the hospital, it is hard to estimate whether the compensation could cover the under-table income. Besides, this transformation means reallocation of benefits, which in no doubt will encounter resistance, as we will describe in the next section.

The retailing price of pharmaceutical products would decrease since the transparent of the trading make the consumers could get more information. And the monitoring would be much easier and less costly.

4.3 Barriers to the implementation of the E-commerce Systems: a government driven, multi-level approach of overcoming the barriers

Our proposed e-commerce systems consist of the two separated segemtns, "e-bidding platform" and "logistics". In order to explore the feasibility of its implementation, we have interviewed government officials in the Ministry of Health, leaders of the Associations of China's Pharmaceutical Industries, highly ranked managers from manufacturers and distributors, and the designers of the E-business systems. The attitudes toward the proposed e-business systems cannot be more opposite. As described in the previous section, introduction of the electronic marketplaces into the pharmaceutical industry value chain will rebalance the market power allocation among the market players. In particular, the following factors which we term "institutional barriers" will become the factors against the implementation of the e-systems (e-platform).

- Relevant personnel in hospital who are benefiting from the current under-table trades
- Hospitals will lose revenue if the retail drug prices will be lowered after the implementation of the e-marketplaces since hospitals depend upon drug sales for their own financial support. Currently revenues from the sale of drugs account for about 45% of the hospital revenues. How can the lost revenue be recouped will depend on a more fundamental reform of the current medical systems.

Besides the institutional barriers, there are also technological barriers which are due to the imbalance of IT development on the company level and on the industry level. Based on some empirical evidence from a variety of Chinese industries' stage of IT adoption, Reimers, Li and Chen [4] propose that a multi-level approach has to be devised in the process of devising effective B2B e-commerce development strategies in the Chinese context since there are mismatches be-

tween company level intra-organizational information systems and the industry level inter-organizational information technology infrastructure. As one top manager from a leading manufactures told us "we are more comfortable with using EDI in our transactions and don't need to submit our orders and finish our transactions on the e-bidding systems".

In order to overcome both the institutional barrier and the technological barrier, only the government can play the role of implementing the e-commerce marketplaces it China's pharmaceutical industry. How to design an effective incentive compatible mechanisms of coordination will be critical for the success of the e-marketplaces in China's pharmaceutical industry.

5. CONCLUSION

In a well-developed mature market economy, typically the rationale for electronic commerce lies in the factors such as lowering transaction costs by increasing information transparency. In the case of China, the promotion of e-commerce will have far more impacts. The Pharmaceutical industry is one of the major sectors in China's economy that is undergoing rapid reform. In this process the introduction of electronic commerce marketplaces will have the potential of helping overcoming the market distortion as exist in the industry. For exactly the same reasons, introduction of e-marketplaces into the market have encountered huge barriers both in terms of institutional and of technological factors. Whether the effort of transforming inter-organizational information systems into electronic marketplaces can succeed will depend on the determination and intelligence of the government.

This research is just our step of trying to understand the impacts of e-commerce on China's pharmaceutical industry. Future efforts will be on the directions of exploring more fundamental issues regarding the interaction between institutional reform and technological revolution, both theoretically and empirically.

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