

The Impact of RFID on Pharmaceutical Supply Chains: India, China and Europe Compared

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Abstract

This paper analyzes the impact of Radio Frequency Identification (RFID) on pharmaceutical supply chains in Asia and Europe, focusing particularly on India, China, France and the UK. As the global pharmaceutical industry is rapidly expanding due to the entry of generic drugs coupled with the prevalence of business process outsourcing activities among companies there is a heightened risk of counterfeit drugs becoming more easily available in the market place. The application of RFID, both as a security measure and as a device for optimizing supply chain efficiency, will bring about a significant change in the functioning of the industry's distribution network. The present paper discusses several applications of RFID in regard to both the Asian and European pharmaceutical supply chains and points to its potential use as a Business Intelligence (BI) tool. RFID, used as a modern BI tool, provides several advantages to the enterprise, among the most prominent of which is the transformation of raw RFID data into vital business information. Through this mechanism a company can be better positioned to efficiently analyze customer needs and buyer behavior, as well as forecast sales and improve potential profit margins.

Keywords: Business Intelligence, China, France, India, Pharmaceutical Industry, RFID, Supply Chains, UK

1. Introduction

Providing proper healthcare to the patient is one of the most important priorities of any healthcare institution, including the pharmaceutical industry. Pharmaceutical companies play a vital role in today's society by way of manufacturing innovative and generic drugs. Drug manufacturing is a difficult task as there are many outside parties involved in the process. These include contract manufacturers, suppliers, and other participants in the supply chain. It is therefore of the utmost importance for the pharmaceutical company to see to it that it is receiving proper services from suppliers as well as outsourced manufacturers because even the slightest error could cause serious problems to the organization as the case of "Vioxx" for the manufacturer Merck demonstrates.

Today, drugs supplied by the Pharmaceutical industry are worth billions of dollars on the global market and it is the responsibility of each and every company in the

industry to supply effective drugs efficiently to its customers. The period 2004 through 2014 will no doubt be a crucial one for the industry because patents for many of the presently used innovative drugs are due to expire. And this, in turn, will create a market boom for generic drugs, their demand of which is expanding at an unprecedented rate. Just a few years ago many of the top selling innovative drugs such as Lipitor (Pfizer's, Anti-Cholesterol), Paclitaxil (Anti-Cancer drug) lost their patent rights thus creating the start of the boom period for generic drugs on the global market. As the pharmaceutical industry is booming, the threat for counterfeit drugs is clearly visible. Counterfeit drugs are rapidly being introduced into the global pharmaceutical supply chain at an unprecedented rate by unscrupulous traders. Counterfeit medicines are drugs that do not contain the requisite Active Pharmaceutical Ingredients (API). Patients taking these drugs often do not notice any improvement in their illnesses and often doctors do not know the reasons why.

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In the worse cases the patient dies. Increased application of RFID technology will significantly improve the trafficking in counterfeit drugs.

2. What is RFID?

Radio Frequency Identification (RFID) is often referred to as the Automated Data Capture (ADC) technology due to the fact that it uses low-power radio waves to communicate between readers and tags on items such as medicines, component parts, food products, etc. RFID is one of the fastest growing technologies in the field of Supply Chain Management (SCM). There is an increasing number of RFID application technology in a wide variety of industries. In the pharmaceutical industry RFID is increasingly being used to track and trace products movement on the global supply chain. As Kotler and Armstrong¹³ have observed:

“An individual firm’s success depends not only on how well it performs but also on how well its entire supply chain & marketing channel competes with competitors channels.”

Pharmaceutical companies are aggressively expanding their global market share through strategic alliances with channel partners. And sometimes these partners number well into the thirties which, in turn, make it very difficult for the pharmaceutical company to properly monitor their activities in the supply chain. Accordingly, as the size of the channel partners increases, so there is a corresponding decrease in supply chain visibility due to the company’s inability to effectively monitor the activities of these partners on a day-to-day basis. RFID technology can enable companies properly monitor the activities of their partners thus enabling them maintain a correct market visibility. RFID is one of the greatest technological breakthroughs in the field of supply chain. By simply tagging the product with RFID the company can effectively monitor product movement at a distance as it passes through the entire supply chain. RFID tags have the ability to detect even the slightest mishandling of a product along the supply chain. Through this mechanism it becomes extremely difficult for the unscrupulous distributor or intermediary to carry out its fraudulent activity.

2.1 RFID as a Business Intelligence (BI) Tool

RFID has significant potential as a BI tool. It can be used

to monitor detailed event information thus providing the organization with better visibility into product movement. As RFID also reduces the cost of collecting product events, BI experts believe this will contribute to the possibility of more events being recorded accurately and in a timely manner. RFID will enable BI experts analyze more frequently and in a timely manner important issues in the supply chain such as: duration of a product on the shelf, dwell time at the distributor, time required to move inventory to the sales floor, which employee handled what product, etc. With the application of RFID technology, information such as these can be collected automatically and in a timely manner. The technology is also being used by some companies (e.g. the U.K. company Rees Exhibition) to improve visitor experience at trade shows and also deliver greater value to exhibitors (RFID Briefing, U.K. Department For Business, Entrepreneurship and Regulation Reform, 2007). Mary Catherine O’Connor writing in the March 18, 2008 issue of RFID Journal notes that the technology is also being used by some companies to monitor their fleet trailers at distribution centers and expedite the receipt of goods in real time. The use of RFID as a BI tool seems limitless.

2.2 RFID and the Pharmaceutical Industry

As the number of channel partners increases so is the increase in the chance of product theft, replacement or diversion. Today, the threat of counterfeit product is real for all companies irrespective of industry. However, the threat faced by companies in the pharmaceutical industry is a much more sensitive one since if life saving drugs turn into death traps people will ultimately lose confidence in the industry and, finally, pharmaceutical companies will be forced to go into liquidation resulting to inevitable job losses.

Jonathan Collins writing in the October 27, 2005 issue of RFID Journal notes that the U.S. arm of RFID industry body EPC Global has developed and RFID software and documentation which is aimed at enabling pharmaceutical manufacturers find business cases for using RFID. The software (and supporting white paper), entitled “Assessing the Value of EPC/RFID in the Pharmaceutical Industry” looks at the benefits which could be derived from using RFID technology. And these include: reduction of product counterfeiting, reduction of product diversion, reverse logistics, etc. According to Collins, “the EPC Value Model for Healthcare and Life Sciences software

comprises a Microsoft Excel spreadsheet and supporting documentation that calculates specific detailed projections of potential costs and savings based on numerous real-world variables. These include the number of products to be tagged, as well as factories and distribution centers to be equipped with RFID interrogators (readers). The Value Model can assess the potential of tagging at the pallet, case and even individual packaging levels, as well as determine the value of tracking those units throughout the global supply chain". Pharmaceutical manufacturers who are currently using the model include: Aventis, GlaxoSmithKline, Johnson & Johnson, Merck, Pfizer, Wyeth, Purdue. And wholesale distributors in the industry who have also adopted the model include: Pharma, Mckesson, and Cardinal Health. The top three business issues involved include product counterfeiting, production diversion and order reconciliation.

The U.S. pharmaceutical company, Purdue Pharma, has already started adding RFID labels to each and every bottle of its pain-relieving drug 'Oxycontin'. The bottles are shipped to two of its major distributors, namely Wal-Mart & H. D. Smith. It is an 18 month pilot project and Purdue Pharma has already selected its hardware suppliers as well as integrated its automated RFID labelling capabilities into its manufacturing facilities.

"RFID is all about supply chain visibility." – Simon Langford, RFID Strategy Manager, Wal-Mart.

Purdue Pharma produces the 'Oxycontin' in four different dosage strengths and all of these have been tagged and tracked from its Wilson, N.C., manufacturing plant to its two pilot customers. The company has tagged the bottles with the Read-only tags, as part of the final manufacturing/packaging process. Purdue Pharma says that initially it doesn't want to tag the cartons as the bottles inside them have already been tagged and readers have the capacity to read each bottle's tag with a 100% accuracy rate.

"We are making a multimillion investment in the area of product safety and product integrity, but not one penny of the costs will be passed on to the consumer or the patient," – Says Aaron Graham, Vice President & Chief Security Officer for Purdue Pharma.

The threat of counterfeit drugs is clearly visible in a good number of countries in Africa, Asia, and even Europe and North America. Pharmaceutical companies are finding themselves in a helpless situation because they do not have sufficient resources to closely monitor all activities in their supply chains. RFID can make a signifi-

cant contribution toward change in this area. The spread of counterfeit drugs in the global pharmaceutical supply chain is occurring through two principal methods: online pharmacies and parallel trading. Let us take a brief look at each of these.

3. Online Pharmacies and Counterfeit Drugs

Online pharmacies provide a number of convenient services to the customer irrespective of geographic region, economic or social status. These services include professional consultation, privacy, promoting generic or cheaper drugs, etc. Davis³⁶ and Davis³⁷ suggest that the use of the internet has a democratizing effect.

But, unfortunately, there are currently hundreds of fake websites selling prescription drugs, and more especially so in the therapeutic segments of anti-obesity, Erectile Dysfunction (ED), cosmetic, immuno-suppressants, dermatological, etc. These fake website traders know that there is so much market potential in these therapeutic segments and that is the reason why their businesses are flourishing today. In the therapeutic category of ED drugs, the fake websites mostly sell drugs such as Viagra and Cialis. Today, Viagra and Cialis are among the world's online top-selling ED drugs whereas, hair loss and obesity related products are the top online selling beauty related or cosmetic drugs. The immuno-suppressants like oncological drugs and other chemotherapy. However, there is a high risk involved in buying drugs online. And a good number of customers who buy drugs from online pharmacies are not fully aware of the presence of counterfeit drugs and even when they do largely ignore the risks involved in buying them.

The reasons for the growing popularity of the online drugs are that prices are generally significantly less expensive when purchased online. The top 5 online fake drugs in the U.S and in the E.U are Lipitor (Pfizer's Anti-cholesterol drug), Viagra (Pfizer's ED drug), Reductil (Anti-obesity drug), Procrit & Epogen (Anti-Anaemia & Fatigue drugs) and Globulin (Immuno-suppressants drugs). B2C pharmacies in the European Union (EU) are steadily increasing in number. Of course, not all EU countries allow online drug distribution. The ones which allow include the following: the Netherlands, Denmark, Germany, Austria & the U.K.

It is not a simple task to sell drugs through the medium of the internet. In order to carry out a B2C drug distribution, a business has to follow many norms and standards such as professional online consultation, selling drugs which are manufactured under the cGMP and US-FDA guidelines, as well as putting into place a timely delivery system. In a number of E.U countries (e.g. Germany, Denmark & Austria), it is a must that the B2C pharmacy should also have a store front. B2C pharmacies with a store front are also referred to as “Click & Mortar” pharmacies. Click & Mortar pharmacies provide valuable services like selling efficient drugs (manufactured under cGMP & US-FDA guidelines) professionally, online consultation, timely delivery of the drugs, etc.

4. Parallel Trade and Counterfeit Drugs

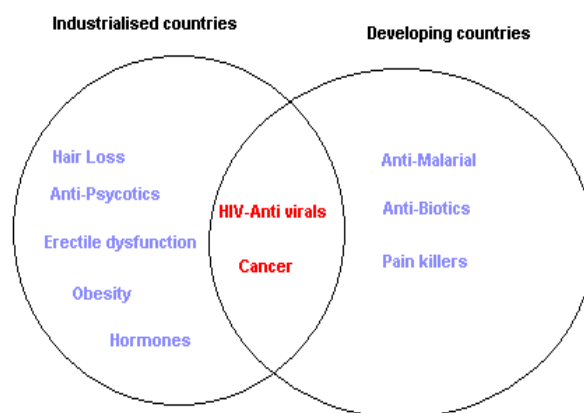
According to Kasturi Rangan, a Harvard University professor,

“Most company distribution systems are designed ad-hoc when needed, and serve neither value chain partners nor end users well. At the same time, distribution channels are the hardest to change of all the elements of marketing strategy. Clearly, companies need a new strategy for going to market”,

The term “parallel trade” denotes purchasing goods from a lower priced country and re-selling them in a higher priced country without the authorization of the local company which holds the intellectual property rights of that product. It is a cross-border trading of goods outside a manufacturer’s distribution channels. Parallel traders seek to gain from the difference in prices from a product across different markets. As the demand for cheaper products has grown, parallel trade businesses have flourished. Today, pharmaceutical companies are adopting different strategies to prevent parallel trading in drugs. These strategies include: trademark infringements, supply restrictions, price dumping, etc. But, it is still difficult for pharmaceutical companies to trace products through each of their channel partners across the supply chain. Moreover, it is also difficult for these companies to know what has been sold where and whether it was used in the country of purchase or re-exported, etc. due to the fact that often there a quite a number of intermediaries involved in the distribution channels.

Retail pharmacies in some developed countries profit from parallel imports because the reimbursement is the same regardless of the source of the drug. Thus, the retail pharmacy can keep difference between the price of an imported drug what they pay to a wholesaler. In this regard pharmaceutical companies come out as the big losers as cross-country trading of drugs costs them billions in lost revenue. Finally, the end user or the customer receives no price benefit at all from parallel trade, especially in countries with flat-rate patient co-payment such as UK and Germany and also the consumers bear the risk when drugs are counterfeited.

Figure 1 is an illustration of counterfeit drugs that are in great supply both in the industrialized and developing countries. As the diagram shows, most of the counterfeit drugs relate to hair loss, anti-psychotics, ED, obesity & hormones can be found in the industrialized countries whereas, counterfeit drugs such as anti-malarial, anti-



Source: Pharmaceutical Anti-counterfeiting strategies

Figure 1. An illustration of the presence of counterfeit drugs on the global market.

biotics & pain killers are found primarily in developing countries. Finally, it should be added that the majority of counterfeits drugs related to conditions such as HIV-Anti virals, and cancer are found in both industrialized and developing countries.

In view of the above how can RFID help curb these problems and particularly so as it relates to pharmaceutical supply chains in Asia and Europe?

RFID tags provide various applications for today’s businesses. These include: tracking and tracing the product from a distance, improved visibility, avoiding unwanted product recalls, warehouse and factory man-

agement, information handling and improved inventory management, to name but only a few. The reader automatically captures the data from the RFID tag, unlike the barcodes, where each and every product must be separately scanned. RFID readers can scan multiple numbers of products in one single scan. This kind of unique ability of the RFID tag shall replace the labour intensive procedures such as checking and scanning inventory. For typical distribution centres, the major cost component is labour, accounting for around 50-80% of their total distribution costs. Kearney et al.¹² predict that receiving check-in time could be reduced by 60-93% with RFID technology. Moreover, the retailers can immensely benefit from RFID by way of removing the large labour component required to manage stock in their stores.

“RFID is all about total supply chain visibility.” – says Simon Langford, Strategy manager, Wal-mart.

It is estimated that the U.S retail industry is losing about US\$70bn annually from its supply chain management practices. The visibility offered by RFID may reduce this loss by reducing waste, lowering inventory levels & improving safety. With RFID products can tracked in real time across the supply chain providing accurate and detailed information on all items, allowing organizations to use this information in order to increase efficiency. The real-time information about the product can be obtained through smart shelves, which have in built RFID tag receivers. This would help retailers track the exact number of products they hold.

A recent Aberdeen Group survey of 200 companies found that more than half of the companies with RFID systems were using the technology in asset tracking. Sometimes, the shipping companies find it difficult to trace the containers as they are continually transported around the world. RFID can help shipping & logistics organizations accurately track such valuable assets. Moreover, RFID can log a container's history if the container has been used for the delivery of dangerous items such as chemicals. Product recalls are a costly source of loss in the supply chain. Sometimes it is extremely difficult for organizations to accurately point at a faulty product which often leads to the destruction of perfectly good products. The RFID can identify every individual item in the supply chain, allowing manufacturers to obtain instant access to information that allows them to issue targeted recalls of only affected products. Hence, the suppliers can maintain a strong brand image as well.

It is difficult for the companies to know what goods are on which truck without first unloading the truck, which also makes it complicated to direct the truck to the parking yard location. The RFID tags can be placed over the trailers of the truck and the RFID readers placed at entry and exit points of yards allowing management systems to log the incoming and outgoing data in real time. RFID technology promises to transform the way organizations currently forecast demand, manage inventory and distribution. The product level tracking is important to effective inventory management. The smart shelves will allow exact inventory stock tasks to be carried out simultaneously. Thus, it is achieved by the RFID's tracking the product from a distance technique.

5. An Overview of the Indian Pharmaceutical Industry

Few advantages which India has over its competitors are its cost competitiveness, well developed industry with strong manufacturing base, access to a large pool of highly trained scientists, strong marketing and distribution network, rich bio-diversity and competencies in chemistry and process development. Many of the global pharmaceutical companies are looking to outsource manufacturing processes to Indian companies in order to take advantage of its lower costs. Moreover, many of the Indian companies have made their plants cGMP compliant and India is also has the largest number of US-FDA approved plants outside USA. Today, many of the top Indian pharmaceutical companies are US-FDA, MCC & cGMP approved for their manufacturing facilities.

As the Indian pharmaceutical industry has clear cost advantages compared to, for example, Europe and the U.S.A., it is also important for the Indian pharmaceutical industry to promote drugs for the convenience of the local manufacturers and other buyers. The www.medindia.net is a privately funded company and the content and medical expertise for the site is provided by Medindia Health Network Pvt., Ltd. It has started to provide consumers with essential health related information including drug related information like drug prices of similar drugs manufactured by different pharmaceutical companies, etc. Moreover, it is easier for the international pharmaceutical companies to have information about the Indian drug prices in order to sign agreements with companies for outsourced manufacturing process.

5.1 The Indian Generic Drug Industry

India has over the last few years acquired the status of a global hub for generic drugs manufacturing. This status has come about largely due to the fact that the country was not a signatory to the World Trade Organisation (WTO)'s Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement. Due to this fact India has enjoyed the "Bolar Provision" (BP) which allows the development, testing and experimental work required for the registration of a generic medicine during the patent period of the original product. The purpose of BP is to allow the immediate entry into the market of generic drugs following the expiration of their patents. This, it is argued, would improve accessibility to these drugs and encourage competition among manufacturers.

India has specialized in generic drug manufacturing by taking advantage of the 'Bolar' provision, thus attaining its status as the global hub for generic drugs. Of the 25,000 drug manufacturers in the Indian market today only 250 are big companies. Due to its specialization in generic drug manufacturing a great number of foreign drug companies are now collaborating with Indian firms as a means of getting a larger share of that market. Figure 2 is an illustration of the structure of generic drug contract manufacturing in India and the nature of relationships among partners to the agreement.

As can be seen, in this kind of manufacturing arrangement the licensor passes the know-how and the

patent rights to the principal seller as well as the contract manufacturer and in turn the principal seller pays royalty to the licensor. Under this arrangement the principal seller becomes the key unit in the sale of the finished products to the distributors. Neither the licensor nor the contract manufacturer has the right to directly sell the finished products to the distributors or any other third party. Whereas, the licensor and the contract manufacturer doesn't have any right to sell the It is within this context that we can appreciate the Indian drug supply chain system and the role RFID can play in improving it

5.2 The Indian Pharmaceutical Supply Chain

The pharmaceutical supply chain in India is tier-based and highly regulated unlike its counterparts in Europe and North America where drug manufacturers are completely free to distribute finished products directly to the retailers. In India products have to go through a complex network of distribution outlets and other intermediaries.

Figure 3 is a basic illustration of the structure of the Indian pharmaceutical supply chain.

As can be seen in this structure, the manufacturer supplies goods to the first tier (layer) comprising a Carriage and Freight Agent (CFA), a super stockist, or a company owned depot. These, in turn, supply to stockists from where the products are forwarded to the wholesalers, medical institutions, hospitals, and retailers.

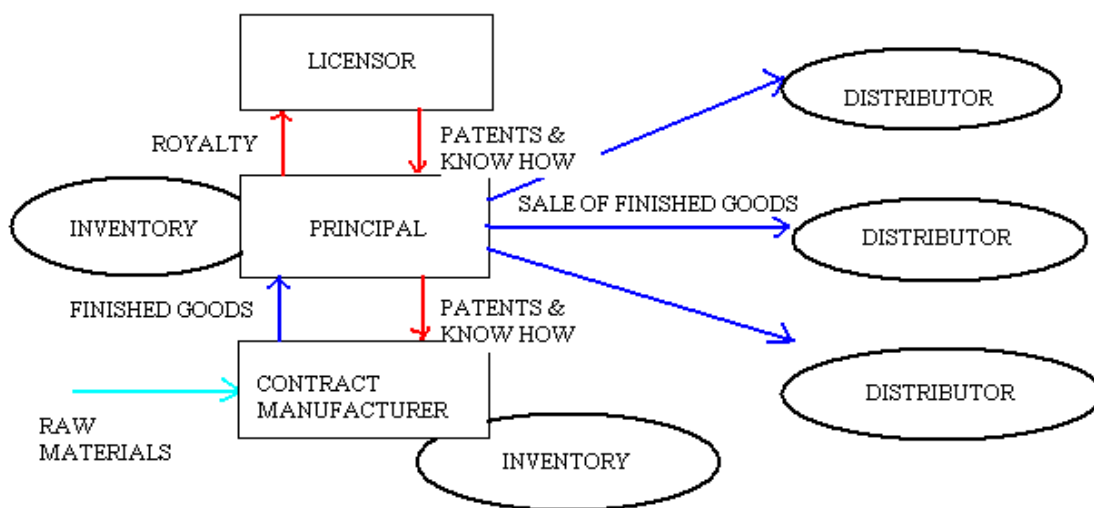


Figure 2. Structure of generic drugs distribution in India.

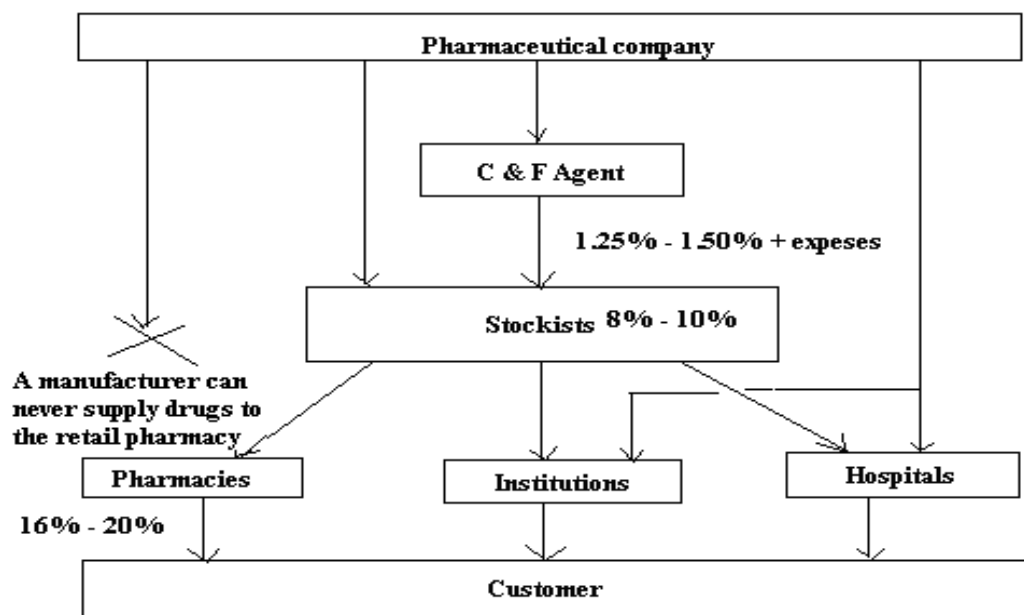


Figure 3. Structure of the Indian pharmaceutical supply chain.

The retailer then dispenses the products to the end users (consumers). The manufacturers are, however, allowed to supply the finished products directly to institutions and hospitals, but never to the retailer.

Within this structure the stockist charges the margin 8-10% on the Maximum Retail Price (MRP) of the drug. It is estimated that there are approximately 60,000 stockists operating in the Indian pharmaceutical market today. Apart from margins, the retailers and wholesalers are also remunerated through union's trade schemes²⁷. The highly fragmented pharmaceutical industry in India has resulted to not only higher margins for intermediaries but also multiple stock points.

The nature of the Indian pharmaceutical supply chain as described above makes it vulnerable to the entry of counterfeit drugs. There are too many intermediaries involved in the system and some are rather small in size. The World Health Organization (WHO) has described counterfeit drug as a "...*medicine which is deliberately and fraudulently mislabelled with respect to identity or source. Counterfeiting can apply to both branded and generic products and counterfeit products may include product with the correct ingredients, wrong ingredients, without active ingredients, with insufficient quality of active ingredient or with fake packing*".

Unfortunately, counterfeit drug trade is becoming rampant in the Indian pharmaceutical industry today and is having a negative effect on both its contract manufacturing sector and many of the top global pharmaceutical companies such as GSK, Sanofi-Aventis, BMS, etc. That is the reason why the industry is now urgently exploring many avenues of finding sustainable solutions to the problem. And the use of RFID is one of the solutions that a number of companies in the industry are now in the process of introducing. The next stage of this research shall explore the matter in greater detail drawing on the result of an empirical survey focusing on the problem.

6. An Overview of the Chinese Pharmaceutical Industry

The annual output of China's pharmaceutical industry during the period 1978 to 2005 averaged the rate of 16.1%. However, during the past five years its annual sales grew about 19.4%, totalling \$51.4 billion in 2005. Chemical drugs still dominate the Chinese market, with 54% of the total market sales. Generic drugs account for the major market share of pharmaceutical sales in China. In the past few years China has done exceedingly well in the pharmaceutical sector and some of its strengths can be attributed to the rapidly expanding domestic market

with rising disposable incomes, comparatively lower cost in research and manufacturing, strong talent pool returning from overseas with experience in technology and industry and considerable experience in running clinical trials at a discounted cost. However, several weaknesses have also been identified in the industry. And these relate primarily to a highly fragmented industry and poor optimization of talent pool.

Traditional generic drug companies are looking toward china for the supply of Active Pharmaceutical Ingredients (API) drugs. China is also a viable source for key intermediates and active ingredients as well. Today, there is also collaboration between India and China, as China is sufficient in supplying API and other intermediates for the key drugs. As indicated earlier India is well-versed in the field of generic drugs manufacturing. As the number of companies and intermediaries in the Chinese pharmaceutical industry continue to expand at an unprecedented rate, there are mounting concerns about the threat of counterfeit API's emanating from this country on the global pharmaceutical market. Like India, several companies operating in the Chinese market have started to introduce RFID tags as a way of controlling the distribution of counterfeit drugs and the next stage in our research shall focus on this issue from an empirical point of view.

China currently has about 3,500 drug manufacturing companies, from more than 5,000 in 2004⁹. The domestic companies are competing in the \$10 billion market without a dominant leader. As of 2007, China is the world's ninth drug market and it's expected to become the world's 8th largest market by 2008. The Chinese domestic pharmaceutical industry has invested very little in the R&D with regard to new drugs. However, it is presently receiving encouragement from the central government to build a world class pharmaceutical industry.

Some of the well known domestic drug companies actively involved in R&D activities in China include: Shijiazhuang Pharma Group, WuXiPharmaTech (Cayman) Inc., Harbin Pharmaceutical Group, Sinovac biotech Ltd., etc¹⁶.

All of the top 20 pharmaceutical companies in the world currently have manufacturing facilities in China either through joint-venture arrangement with local firms or wholly- owned manufacturing facilities. There are a total of 1,800 foreign funded pharmaceutical companies currently operating in the Chinese market. Table 1 depicts the situation with regard to top six foreign drug companies in the Chinese market today.

7. The Pharmaceutical Supply

Table 1. List of the major foreign pharmaceutical companies in China

Company Name	Description
Pfizer	Produces and markets more than 40 innovative drugs in China.
GSK	Has 2,000 employees in China and its drugs are sold in 60 cities across China.
Merck	Sells the following types of drugs: anti-biotics, prostate cancer drugs, cardiovascular drugs, pain relievers, osteoporosis and vaccines.
Novartis	Has invested about \$100 million in China, with four manufacturing facilities in Beijing & Shanghai.
Sanofi-Aventis	The German-French company sells several drugs in China.
Astra-Zenica	Headquartered in Shanghai, it has established the largest manufacturing site in Asia with a total investment of \$US170 million in Wuxi.
BMS	Is one of the earliest entrants in the Chinese market.

Chain in France

Figure 4 provides an overview of the structure of the pharmaceutical supply chain in France. There currently are 330 pharmaceutical laboratories in France with a total annual market turnover of EUR16.7bn.

they benefit largely from the current phenomenon of direct sales. These agents provide good logistical support to the pharmaceutical companies. They also deliver drugs directly to dispensaries, distributors, hospitals and to the private clinics. The agencies are generally remunerated by the pharmaceutical laboratories in the form of commissions and sales turnover. The five largest agents

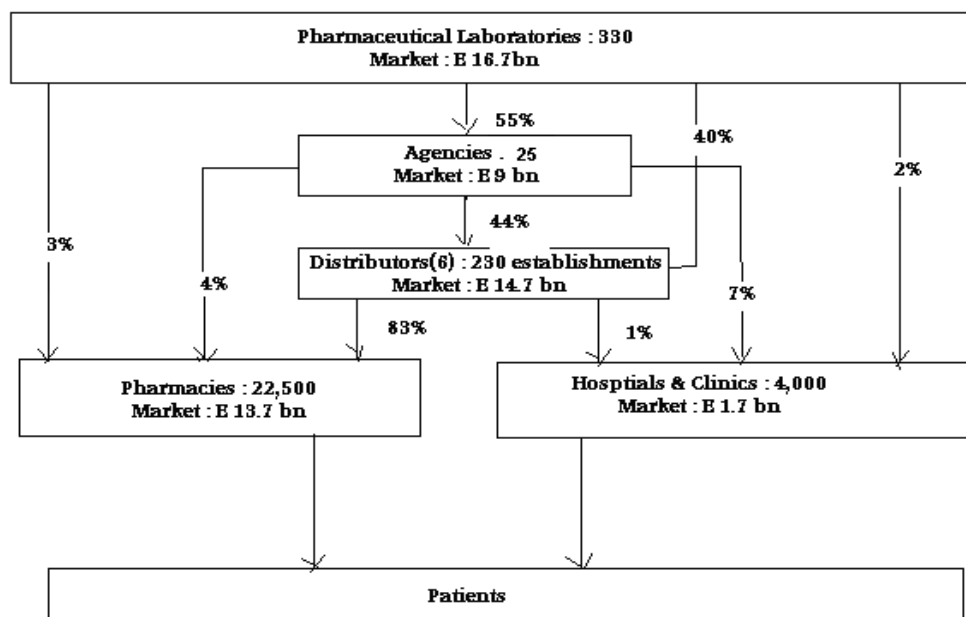


Figure 4. The structure of the pharmaceutical supply chain in France.

Source: Derived from the doctoral thesis of Christophe Mairie, Université des Droites et Santé de Lille (Lille-II), France

Of these approximately 55% of the drugs are supplied to various agencies (or depositors), 40% to the distributors, 3% to retail pharmacies, and the remaining 2% to hospitals. In order to restrict the margins of the wholesalers, the laboratories have some tie-ups with retail pharmacies and hospitals. However, pharmaceutical laboratories in this market generally tend to rely on logistics providers and agents in order to have access to the double competencies required in order to effectively distribute drugs. These companies are product promotion and logistical support.

As Figure 4 shows, agents or depositors are the first contact points in the French pharmaceutical supply chain. There are a total of 28 agents today in the French pharmaceutical market and half of these are subsidiaries of the pharmaceutical companies. The concentration of agents is relatively strong and tends to increase because

currently operating in the market: Pharmaservices (a subsidiary of Aventis Pharma), Distriphar (also a subsidiary of Aventis Pharma), Dépolabo, Cooper, (acquired by Aventis in 2000) and DépôtsGénéraux, (a subsidiary of the OCP).

The agents ensure that the logistics of the drugs is efficiently carried out by their group members. On the other hand, the wholesale distributors play the role of proximity outlets by allowing the pharmacies to quickly deliver prescribed drugs. As shown in Figure 4, wholesalers are the principal intermediaries between the laboratories and the retail pharmacies and they, on average, make at least three deliveries per day.

Sales turnover for wholesale distributors is much more highly concentrated as compared to agents. Indeed, the first 3 groups represent more than 95% of the distribution market in France as clearly shown in Figure 5.

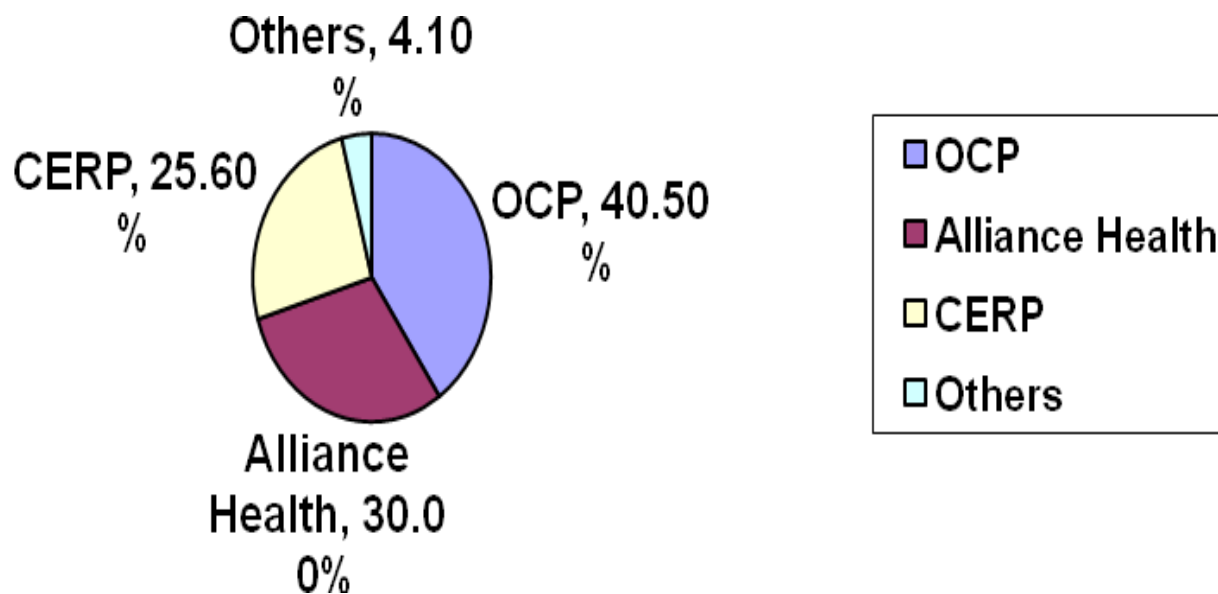


Figure 5. Top 3 Wholesalers in the French pharmaceutical industry.

Source: Derived from doctoral thesis of Christophe Mairie, Université des Droits et Santé de Lille (Lille-II), France

The remainder of the market is divided between a small number of companies such as West distribution, Dapharm and Phoenix Pharm. Wholesalers are required to deliver the drugs to the retail pharmacies within 24 hrs (except during the weekends) and need to permanently store the stock worth the previous year's sales turnover of one month. The distributors today are subjected to a severe competition in all the fields (fast service, security of supply, commercial handover). The key factors of success for the wholesale distributors will undoubtedly lie in their ability to maintain or even increase their level of service while minimizing costs.

There are at present approximately 339 pharmaceutical companies in France engaged in R&D activities. Among the for most French companies engaged in R&D activities include: Sanofi-Aventis, Galderma Laboratories, Ipsen, NicOx, Servier, etc.

8. The Pharmaceutical Supply Chain in the U.K

The U.K has made tremendous strides in the pharmaceutical industry and today some of the U.K pharmaceutical companies such as GSK, Astrazenica, etc., are playing a crucial role in the global healthcare industry. The National Health Service (NHS), accounts for more than 98% of the U.K prescription drugs market, which is the sixth larg-

est pharmaceutical market in the world²⁸. Most of this market is driven by the U.K's approximately 35,000 general physicians. The U.K's pharmaceutical industry is the world's third largest exporter of drugs. The principal overseas market for the U.K pharmaceuticals is Europe, North America & Japan.

The pharmaceutical wholesalers in the U.K supply medicines to doctors, pharmacists and hospitals. They act as a link between manufacturers, doctors, pharmacist and hospitals. Moreover, the U.K wholesalers not only provide simple supply service; they also stock the entire range of 20,000 licensed medicines, ready for dispatch at any time. They operate around the clock and also provide around half of all the computer equipment used in pharmacies. Some of the full-line wholesalers in the U.K are: Gehe U.K (AAH), Alliance Unichem & Phoenix²⁹.

At the 2006 WHO meeting in Rome, Dr. Nils Behrndt, Deputy Head of Pharmaceuticals unit described a one thousand percent growth in European counterfeit drug seizures between 1998 and 2004. Industry experts believe that the main entry rate for such counterfeits is hidden within legitimate parallel trade. The U.K government has for many years actively encouraged the use of parallel imports as a means of limiting the total NHS pharmaceutical expenditure. The U.K's Department of Health has also made parallel import a relatively cheap and straight forward process. The Department of health also pro-

vides indirect incentives for pharmacists to source low cost parallel imports. Thus, during the repackaging and re-labeling process fake drugs can very easily enter the distribution system. For example, in 2006 there were several cases of recalls made by Eli Lilly (Zyprexa tablets), Sanofi-Aventis (Plavix) & Astra-Zenica (Casodex).

9. Counterfeit Drugs and RFID Pilot Projects in Europe

The European pharmaceutical companies have made tremendous strides in the global healthcare by bringing out innovative drugs to counter the life threatening diseases, but what if the medicine is counterfeited in the distribution system itself? Hence, now some of the well known semi-conductor and pharmaceutical companies have come together in order to more effectively tackle the problem of counterfeit drugs entering the supply chain through the increasing use of RFID technology.

Several European semi-conductor firms are in the race in making a pilot study about the usage of RFID to counter the problem of counterfeit drugs in the pharmaceutical supply chain. In November 2004, Aegate, a U.K based firm made a pilot study about the impact of RFID in the pharmaceutical distribution system. British Telecom (BT) and six other U.K pharmaceutical companies such as Merck Generics U.K, Merck Pharmaceuticals, Novartis, Schering Healthcare, and Solvay joined Aegate and examined the usage of RFID technology at the point of dispensing in 50 outlets as a way to detect fraudulent and counterfeit medicines³⁰. This is one of the largest pilot projects of its kind involving both innovative and generic drug products.

The patient safety implications, according to Aegate, are that it provides a real time check for recalled, expired and illegal products at the unit-of-use level. The three month pilot backed by a number of pharmaceutical companies which ended at the end of January 2008 added RFID tags to 180,000 medicines to improve visibility in the supply chain and to counter the counterfeit drugs in the distribution chain. The actual aim of the pilot study was to assure the patient that the product will be received as intended when leaving the manufacturer and dispensed as prescribed by a doctor.

10. The Impact of RFID on the European and Asian Pharmaceutical Supply Chains

Counterfeit drug manufacturing is fast becoming a profitable business in China and India. The Chinese have mastered the art of manufacturing APIs and other drug intermediates, whereas, Indians have excelled in the science of producing generic drugs by using APIs. In turn, these generic drugs are now sold in the European and North American markets by many European distributors. But, what if there is any contamination in the distribution system? Unlike any other industry, the healthcare industry is very sensitive, even a slight alteration in the drug will bring a drastic affect on the patient's health. Every year there are thousands of cases relating to counterfeit drugs in both India and China. Western pharmaceutical companies are very much interested in collaborating with these countries even though there is a tremendous threat of counterfeit drugs. Even though it is a well known fact that contract manufacturing firms in India and China are well reputed and pose no particular threat when it comes to counterfeit drug, these companies are still in their infancy in this business. There is every reason to suggest that there's going to be a marked increase in the production of drugs on a global basis in the not too distant future. When this happens there will be an increased risk of the entry of fake APIs, Intermediates and other drugs into the supply chain. Even the slightest error in manufacturing or distribution of the drugs is likely to spoil a company's brand image. Sometimes, counterfeit drugs enter the distribution system by unknown means that even for channel partners it remains a complete mystery. And there is also the possibility of channel conflict in this regard.

Hence, in order to avoid all kinds of difficult circumstances related to the above, some European companies have already made a pilot study by using RFID technology in the distribution system. As noted above, the pilot project was first conducted by the U.K. semiconductor company "Aagate" in collaboration with six U.K. pharmaceutical companies. The result of the pilot project has been very positive. This will obviously delight all channel partners, from suppliers all the way downstream to the end users.

A good number of E.U. countries are still facing serious threat of counterfeit drugs as many of their companies have joint-venture and contract manufacturing arrangements with local companies in Asia (especially China and India).; Moreover, parallel trade is still rampant in Europe. Surprisingly, in the U.K, the parallel trade has been legalized and there are several incentives to the pharmacists who promote drugs that are imported through parallel trade.

India and China are the major suppliers of generic drugs as well as API's and intermediates to the European, North American and African drug markets. With the increased movement of products from Asia to these markets there are no guarantees that the supply chains will be free of counterfeit drugs. The increased use of RFID technology to track and trace the movement of products along the supply chains will go a long way in ameliorating the problem.

In the increasingly globalized pharmaceutical market it is not always easy to quickly trace and isolate the source of a counterfeit drug since there are several channels through which it can enter the supply chain. Such channels include the increasing phenomenon of internet pharmacies, parallel imports, re-labeling and repackaging, etc. Hence, in the future technologies such as RFID will become crucial for pharmaceutical companies in optimizing their supply chains.

11. Conclusion

The present study provides an overview of the way RFID technology is impacting global pharmaceutical supply chains and particularly so with regard to a number of selected countries in Asia and Europe. The application of RFID technology in this industry is recent and as such the findings of the present research should only be regarded as preliminary. However, it lays the foundation for a more comprehensive future research concerned with these issues once the application of this technology is more widely adopted by a greater number of companies in this industry on a global basis.

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