Master's Degree Thesis

LOG950 Logistics

Investigating the Drivers and Barriers of Reverse Logistics Practices in the Supply Chain of Pharco Pharmaceuticals

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Preface

This master's thesis is the final and mandatory part of the two-year Master of Science in Logistics program, with specialization in supply chain management, at Molde University College in Norway. A proposal document was written and approved in December 2014. The thesis has been written during the time-period of December 2014 to May 2015 under the academic supervision of Prof. Hajnalka Vaagen.

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Finally, this thesis is dedicated to my mother—without her support during my weak periods and her continuous motivation I would never have achieved any success in my life.

Abstract

Reverse logistics can no longer be treated as an afterthought, especially for industries that are susceptible to product recall or for products whose existence in market after their sell-by date can cause severe problems. One such industry is pharmaceuticals where it is very important to properly dispose of the recalled and expired drugs. This has legal implications as some of these products contain hazardous chemicals. Hence, pharmaceutical companies can no longer opt for effective implementation of reverse logistics. In Egypt, the problem related to reselling expired pharmaceuticals is increasing and it has raised the need for a proper management and disposal of pharmaceutical returns. In light of the above-mentioned problem, this empirical research investigates the reverse logistics practices adopted by "Pharco Pharmaceuticals," a pharmaceutical company in Egypt, the drivers behind the applied reverse logistics activities, and the barriers affecting the application of reverse logistics. A mixed approach has been followed: First, the case study helped to identify and understand the drivers for reverse logistics, the applied reverse logistics activities, and the faced barriers. Then, Interpretive Structural Modeling (ISM) has been applied to understand the mutual influences among the identified barriers which hinder Pharco in implementing reverse logistics. The research reveals that the implementation of reverse logistics at Pharco is regulation-driven and the main reasons for returns from its downstream partners are product expiration, followed by damaged packaging returns. The dominant reverse logistics activity is the disposal by incineration through third-party disposal companies. As many as 17 reverse logistics barriers are affecting Pharco in implementing reverse logistics and these barriers have been ranked into 10 levels by using the ISM method. The analysis also shows that eight dependent barriers are influenced by nine driving barriers. A key finding of the analysis is that lack of regulation enforcement and lack of public awareness regarding the importance of reverse logistics are the most driving barriers influencing the rest of the identified barriers.

Keywords: *Reverse logistics; Reverse logistics driver; Reverse logistics barriers; Pharmaceuticals; Egypt; Pharmaceuticals returns; Interpretive Structural Modeling (ISM)*

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LIST OF ABBREVIATIONS

API	Active Pharmaceutical Ingredient
CAPA	The Central Administration of Pharmaceutical Affairs
EDA	Egyptian Drug Authority
EEAA	Egyptian Environmental Affairs Agency
EGP	Egyptian Pound
GDP	Good Distribution Practices
GMP	Good Manufacturing Practices
GSP	Good Storage Practices
ISM	Interpretive Structural Modeling
MENA	Middle East North Africa
MOH	Ministry of Health
OTC	Over the Counter
POS	Points of Sale
PSC	Pharmaceutical Supply Chain
SCM	Supply Chain Management
WHO	World Health Organization

1. INTRODUCTION

This introductory chapter provides the background to the research presented here, defines the research problem, and the associated research questions. The structure of the research is also provided.

1.1 Research Background

Reverse logistics is one of the most critical aspects for any business related to manufacturing, distribution, and service and support of any type of product (Donald F Blumberg, 2004, p. 1). It is also practiced in different industries, including those producing steel, commercial aircrafts, computers, automobiles, appliances, and chemicals and medical items (Dowlatshahi, 2000, p. 144). The importance of reverse logistics is underscored by its increasing popularity in both business and academic communities since the last decade (Nikolaou, Evangelinos, & Allan, 2013, p. 173).

Earlier, reverse logistics was often considered as a process that has little effect on enterprises as a whole. However, the evolving financial and competitive pressure, as well as the complexity in environmental regulations, have made it clear that reverse logistics is no longer an option for an organization to meet its goals and increase profitability (Partida, 2011, p. 62).

Deployment of reverse logistics is not free from barriers (Ravi & Shankar, 2005, p. 1012). Some of the most common barriers facing companies implementing reverse logistics in different industries are: Importance of reverse logistics relative to other issues, company policies, lack of systems, competitive issues, management inattention, financial and personnel resources, and legal issues (Dale S. Rogers & Tibben-Lembke, 1998, p. 32). In spite of these barriers, companies are becoming active in reverse logistics for different reasons, including economic reasons, legislative reasons, and corporate citizenship (de Brito & Dekker, 2003, p. 6). Growing concerns relating to environmental issues, coupled with legal regulations, have made organizations responsive to reverse logistics not only in developed countries but also in developing countries (Samir & Rajiv, 2006, p. 525).

Reverse logistics is very important in the pharmaceutical industry—not only from the economic point of view but also from the environmental and the regulatory points of view. In addition, the application of reverse logistics in this industry is more challenging than in

any other industries, as most pharmaceuticals get destroyed when they are recalled or returned, they are seldom repaired or resold (Kabir, 2013, pp. 89, 97).

Proper disposal of recalled, unused, and expired pharmaceuticals is an important issue with legal implications, as some of these products contain hazardous chemicals. Also, the sensitive nature of medicines as well as the potential harm from use of expired or non-effective medicines means that pharmaceutical companies must effectively implement reverse logistics to promptly clear their supply chain channels of expired and non-conforming drugs (Shaurabh, Saurabh, & Moti, 2013, pp. 12, 18).

In Egypt, The head of the General Directorate of Pharmaceutical Inspection and the head of the Pharmacist Syndicate explained that "only slight amounts of expired medicines are accepted by pharmaceutical companies to be returned from distributors and pharmacies which, in turn, leads to the improper handling and disposal of expired pharmaceuticals" (Seif, Tharwat, Naser, & Madiha, 2010). Furthermore, The General Directorate of Pharmaceutical Inspection in Egypt discovered 48 cases where they found a large amount of expired pharmaceuticals in pharmacies and in distributors' warehouses, which have not been returned to manufacturers (General Directorate of Pharmaceutical Inspection, 2010). In addition, 150 pharmacists were arrested in a recent government crackdown on pharmacies; they have been charged with selling drugs past their sell-by date (BMI, 2014, p. 84).

1.2 Research Problem

Reselling expired pharmaceuticals in Egypt is an increasing problem with severe consequences (Ramadan, 2014; RASSD, 2015). Recent studies by Kabir (2013); Kwateng, Debrah, Parker, Owusu, and Prempeh (2014) suggest extended focus on reverse logistics to potentially reduce this problem. There are however several barriers which hinder or prevent the application of reverse logistics in pharmaceutical industry. Accordingly, this research attempt to explore these barriers that hinder or prevent the application of reverse logistics practices at a leading pharmaceutical manufacturer in Egypt.

The methodological approach of Interpretive Structural Modeling (ISM) is applied to study mutual influences across barriers listed by a preliminary case analysis, and to identify the "driving" barriers which may lead to other barriers, and "dependent" barriers influenced by the driving barriers.

Ravi and Shankar (2005) indicate that "*we lack a holistic view in understanding the barriers that hinder reverse logistics*" (p. 1011), and highlight that the ISM approach allows for a more in-depth understanding of the situation than observing individual barriers in isolation.

Structural modeling was defined by John N. Warfield (1974) as a methodology that employs graphics and words in carefully defined patterns to illustrate the structure of a complex issue or problem. The ISM method can be used to employ a systematic and logical thinking process while approaching a complex issue and then to communicate the results of that process to others (Malone, 1975).

1.3 Research Purpose

The purpose of this research is to *first* explore the reverse logistics drivers, practices and barriers at Pharco Pharmaceuticals, a leading pharmaceutical manufacturer in Egypt. *Next*, this research applies the ISM methodology to explore the mutual influences between the identified barriers affecting the implementation of reverse logistics practices at the case company.

The research questions to be explored are as follows:

(1) Why Pharco implements reverse logistics practices?

(2) What are the reverse logistics practices implemented by Pharco?

(3) What are the barriers hindering Pharco in implementing reverse logistics?

The above-mentioned research questions are covered by the following set of objectives**:**

- To identify the drivers for implementing reverse logistics in Pharco.
- To identify the reasons for distribution returns from Pharco's downstream partners.
- To identify the reverse logistics processes implemented by Pharco.
- To identify the reverse logistics activities practiced by Pharco.
- To identify and rank the barriers of reverse logistics in Pharco by using ISM.
- To determine the interaction between the identified barriers by using ISM.
- To discuss the managerial implication based on the analysis results.

1.4 Research Structure

This research is composed of six main chapters. *This chapter* provides the research background, defines the research problem with the research questions to be addressed.

Chapter 2 provides a theoretical framework for the research by reviewing the current literature on reverse logistics drivers from the perspectives of the receiving and returning parties, the main reverse logistics activities and processes, and the reverse logistics related barriers. This chapter also discusses reverse logistics in the pharmaceutical supply chain.

Chapter 3 presents the research approach, the data collection methods, and explains the ISM methodological approach, with its benefits and limitations.

Chapter 4 presents the empirical case description—it starts by providing an overview of the Egyptian pharmaceutical industry and the associated published guidelines concerning reverse logistics in this particular industry. The chapter subsequently presents the case study and interviews findings.

Chapter 5 presents the ISM analysis of the mutual influences across the barriers, which hinders the application of reverse logistics in Pharco Pharmaceuticals. Managerial implications of the findings, and potential actions to alleviate these barriers are also discussed.

Chapter 6 summarizes the research findings, draws conclusions based on the findings from the analysis, states research limitations, and provides recommendations for further research in the particular area addressed in the research.

2. THEORETICAL FRAMEWORK

This chapter starts by defining reverse logistics as well as showing the main differences between reverse logistics and other related concepts. The next section covers the main reverse logistics drivers from the perspectives of the receiving and returning parties, the main reverse logistics processes and activities, and also the barriers related to reverse logistics. The last section of this chapter reviews the existing literature for reverse logistics in the pharmaceutical supply chain.

2.1 Reverse Logistics and Related Concepts

The concept of reverse logistics is relatively old. Lambert and Stock (1982) provide one of the oldest descriptions of reverse logistics by saying that it is like "*going the wrong way on a one-way street because the great majority of products shipments flow in one direction"* (p. 19). In the 1980s the field of reverse logistics was only limited to the movement of materials in the opposite direction of the primary flow—i.e. from the customer toward the manufacturer (Rogers & Tibben-Lembke, 2001, p. 129).

Carter and Ellram (1998) provide a summary of the general literature, saying that the concept of reverse logistics came into being in 1970's. However, the focus shifted from recycling toward the effect of environmental issues on logistics management in the 1990's. Hence, Carter and Ellram (1998) defined reverse logistics as *"a process that enables companies to become environmentally efficient through recycling, reusing and reducing the amount of materials used"* (p. 85).

During the late 1990s Dale S. Rogers and Tibben-Lembke (1998) defined reverse logistics as "[t]*he process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal"* (p. 2).

The above-mentioned definition by Dale S. Rogers and Tibben-Lembke (1998, p. 2) was criticized by de Brito and Dekker (2002, p. 3), as returns could be generated at any point in the supply chain before consumption and could be returned to any point of recovery other than the origin. Accordingly, de Brito and Dekker (2002, p. 3) adopted the following definition provided by The European Working Group on Reverse Logistics REVLOG (1998):

> *The process of planning, implementing and controlling flows of raw materials, in process inventory, and finished goods from a manufacturing, distribution or use point to a point of recovery or point of proper disposal. (p. 3)*

This definition clearly illustrates that the concept of reverse logistics focuses on activities with the goal of both value recovery and proper disposal. In this way, a clear distinction between reverse logistics and waste management concept is made, as the latter primarily focuses on waste collection and processing, and thus there is no reuse or recovery of economic value (de Brito & Dekker, 2003, p. 3).

Also, a distinction between reverse logistics and green logistics is that the latter considers the environmental aspects in all logistics activities—specifically, on forward logistics (Bonev, 2012, p. 6).

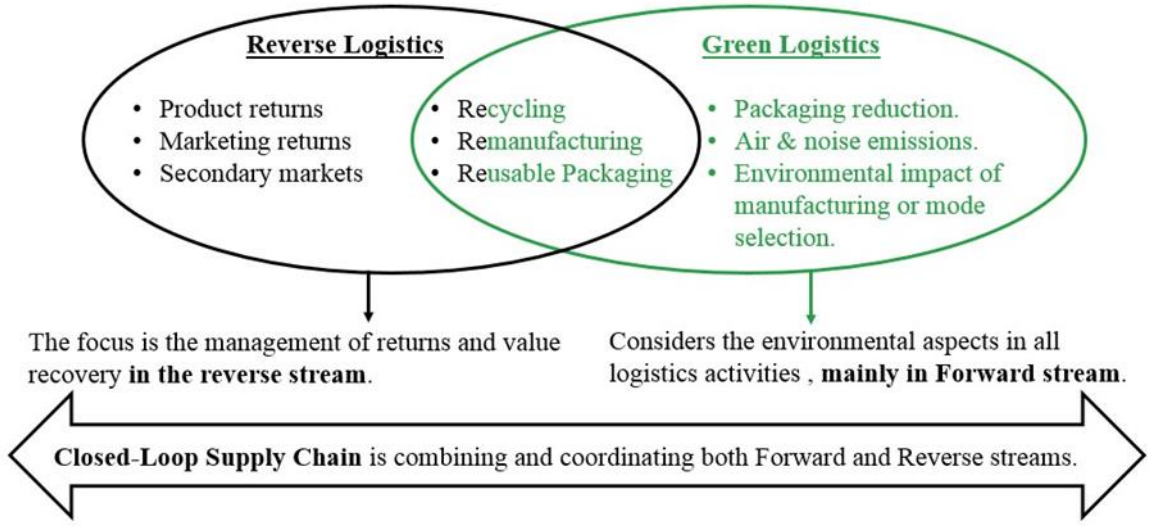

Figure 1 Difference between reverse and green logistics

Adopted from (Rogers & Tibben-Lembke, 2001, p. 131) and (de Brito & Dekker, 2003, p. 4)

van Hoek (1999, p. 129) differentiates between reverse and green logistics as the latter refers to those practices and activities within the supply chain, which aims to reduce the sources of waste and resources of consumption. However, as shown in Figure 1, there is a number of interrelated activities which can be equally applied in both reverse and green logistics. For example, utilization of reusable packaging in order to eliminate the non-reusable cartoon packaging could be classified as reverse as well as green logistics, while a packaging reduction activity is classified as green logistics activity but not reverse logistics (Rogers & Tibben-Lembke, 2001, p. 130). The holistic view embracing both forward and reverse logistics in a supply chain is the closed loop supply chain concept (de Brito & Dekker, 2003, p. 4).

Therefore, the distinction between waste management, reverse logistics, green logistics, and closed loop supply chain concepts justifies the use of reverse logistics, instead of the other concepts, in the context of this research.

2.2 Importance of Reverse Logistics

The evolvement of financial, competitive and customer pressures, as well as the increased complexity regarding the environmental policies and regulations, raised the need for organizations to engage in reverse logistics processes (Partida, 2011, p. 64).

According to Dowlatshahi (2000, p. 144), reverse logistics enables companies to achieve the goal of sustainable development, as it focuses on environmental and economic goals. Hence, reverse logistics aims to maintain the environment and also to generate profits. In addition, effective implementation of reverse logistics can help companies to better compete in an industry characterized by intense competition and low profit margins.

Reverse logistics is also gaining interest in developing countries due to increased competition, market growth, and large numbers of products users. Therefore, the management of product returns in an effective as well as a cost-efficient way has become important as it leads to profitability and elevation of customer service levels, and ensure higher customer retention (Samir & Rajiv, 2006, p. 524).

2.3 Reverse Logistics Drivers

As the main driver for forward logistics is to satisfy customer demand at the end of the supply chain, the main drivers in reverse logistics are not that clear (Bonev, 2012, p. 7). Two main parties are involved in reverse logistics: First, the returning party which possesses the product; and second, a receiving party which is interested in capturing value from the product. In this regard, the driving forces from the receiver's perspective are different than those from the returning party's perspective (de Brito & Dekker, 2002, p. 6).

2.3.1 Drivers from the Receiver's Perspective

According to de Brito and Dekker (2003, p. 6), Gupta (2013, p. 64), and Samir and Rajiv (2006, p. 524), there are three main drivers that drive companies to receive and accept returns

and for other independent companies to be involved in the returns and recovery process, as shown in Figure 2.

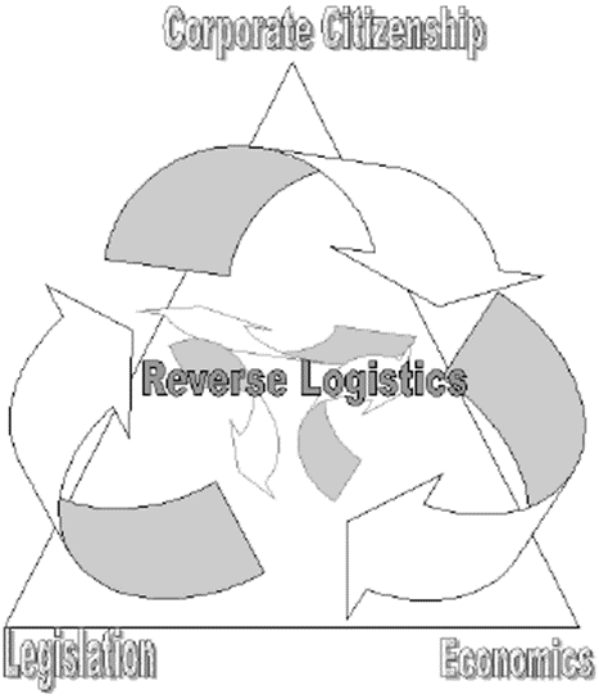

Figure 2 Driving triangle for reverse logistics

Source (de Brito & Dekker, 2003)

2.3.1.1 Economic Driver

C. K. M. Lee and Lam (2012, p. 591) and Gupta (2013, p. 64) consider the economic driver as the most important driving force for companies to get involved in reverse logistics, since the application of an effective reverse logistics program can positively affect a company's bottom-line by recapturing the remained economic value in the returned product. Economic reasons also contribute to the increasing importance of reverse logistics, as the intense market competition is increasingly shrinking the firm's profit margins. Hence, companies have become more interested in the efficient application of reverse logistics (Quesada, 2003, p. 1).

de Brito and Dekker (2003, p. 7) classify the economic drivers into direct and indirect economic benefits for companies. Direct economic benefits are profits resulting from the recovery actions. Such actions in reverse logistics enable companies to reduce their use of raw materials, to add value with recovery, and to decrease their disposal costs. Moreover, independent companies are also interested in reverse logistics because of the expected financial benefits offered in the market, which deal with refurbished, remanufactured, and recycled products, and also discarded materials.

On the other hand, companies might be engaged in reverse logistics for marketing, competition, or strategic reasons—other than direct profits—as they might use recovery processes to protect their markets and to prevent competitors from obtaining their technology or to deter market entry (Bonev, 2012, p. 8).

Table 1 below summarizes the economic drivers for getting involved in reverse logistics.

Table 1 Economic drivers of reverse logistics

Adopted from (Bonev, 2012, p. 8)

Direct Benefits	Raw materials reduction. Disposal cost reduction. Value-added recovery.
Indirect Benefits	Anticipating upcoming legislation. Market protection. Green image. Improve customer/ supplier relations.

2.3.1.2 Legislative Driver

Legislation refers to any juridical regulation addressing product recovery instruction or take-back obligation of companies (de Brito & Dekker, 2002, p. 6). Such legislations can be attributed to governmental pressure and the increasing awareness toward environmental protection. Therefore, companies are aiming to adopt various sustainable business practices by applying reverse logistics (Mafakheri & Nasiri, 2013, p. 185).

Earlier, once the product left the manufacturer's facilities, the disposal responsibility disappeared. Moreover, manufacturers could easily dispose of products in a landfill. However, the emergence of strict environmental regulations has put a limit on such practices by specifying the permissible quantities that can be landfilled; certain products containing hazardous materials have also been banned from being disposed of in landfills (Schatteman, 2003, p. 270).

Dale S. Rogers and Tibben-Lembke (1998, p. 100) also mention that environmental consideration have a great impact on many logistics decisions as many products can no longer be landfilled due to environmental regulations, and, subsequently, the landfill cost is rising. Also, in many countries, companies are forced to use reusable packaging and to take back their packaging materials and products past their sell-by dates. In Europe, various environmental regulations were made in order to protect the environment and make

companies think in a new direction. Moreover, other regulations, such as the manufacturer's take-back responsibility, oblige the original manufacturer to be fully responsible for the final disposal and recycling of its products (Bonev, 2012, p. 8).

Such growing attention to the environmental regulations in many regions around the world motivates some countries to set some objectives and targets in relation to reverse logistics activities to be reached in certain periods of time (Quesada, 2003, p. 1).

2.3.1.3 Corporate Citizenship Driver

The third reverse logistics driver is related to corporate citizenship in which companies adopt reverse logistics through a set of corporate values. Companies establish such values and incorporate these aspects in their strategies in order to operate in a social and environment-friendly manner, and to express their respect to the environment, society, and nature (Gupta, 2013, p. 64). All these help to create a green image that satisfies the customer's expectations and render a competitive advantage (Bonev, 2012, p. 9).

Competitive advantage based on a green image can significantly influence retention of customer loyalty and can protect the brand image (Rogers, Lembke, & Benardino, 2013, p. 42). Hence, it has become a priority for many companies to create extensive programs on corporate responsibility toward the environment and society (de Brito & Dekker, 2003, p. 8).

2.3.2 Return Reasons from the Returning Party's Perspective

Generally, companies initiate reverse logistics activities as a response to actions by downstream channel members or by consumers (Ronald & Dale, 2002, p. 272). de Brito and Dekker (2003, p. 9) differentiate between the reasons for returns in accordance with the traditional supply chain hierarchy—starting from the manufacturing phase, and then moving to the distribution phase until the product reaches the end customer. This research will mainly focus on distribution returns that are generated during the distribution phase, as the returns initiated in this phase are mainly related to manufacturers and retailers, as well as to distributors that are intermediaries between both parties.

A major reason for distribution returns is **product recalls** in which products are returned to manufacturers due to safety and health problems or quality issues. Therefore, producers can voluntarily recall their products after they have been distributed in the market or mandated by a government agency. Accordingly, product recalls requires a substantial planning from

companies, which is different from other types of returns, especially in automotive, food, and pharmaceutical industries as they are more susceptible to product recalls than other industries (Dale, Douglas, Keely, & Sebastián, 2002, p. 4).

de Brito and Dekker (2003, p. 9) mention the **business-to-business commercial returns** in which retailers and distributors, or wholesalers, are allowed to return products to manufacturers as per their contractual agreement. It includes returns for products whose remaining shelf-life is too short or which have remained unsold due to lack of demand. Also, commercial returns cover wrong or damaged deliveries. It is worth mentioning that in pharmaceutical and food industries, the outdated products may no longer be sold if the shelf-life has been too long.

In cases where products at a retailer are experiencing slow sales, the distributor or the manufacturer may have the ability to resell the product for the full retail price to a different retailer that is experiencing higher demand for this particular product (Ronald & Dale, 2002, p. 274). In this regard, **Stock adjustments** is another major reason for product returns, where products are returned from a position forward in the supply chain due to slow sales, or, in case of seasonal products, in order to be redistributed back to the chain (Dale et al., 2002, p. 3). Finally, during distribution, pallets and containers or packaging move back and forth in the chain—this type of return was explained by Bonev (2012, p. 12) as **functional returns**. Table 2 summarizes the main reasons for product returns in the distribution phase.

Table 2 Reasons for distribution returns

Adopted from (Bonev, 2012, p. 11)

Reasons for Returns	Explanation
Product Recalls	Recall from manufacturer due to health or safety problems.
Commercial Returns	From retailer to manufacturer due to contractual reasons.
Stock Adjustments	Redistributed stocks by an actor in the supply chain.
Functional Returns	Pallets or packages moving back and forth in the supply chain.

2.4 Manufacturers' Return Policies

This section provides a brief overview of different types of manufacturers' return policies. Padmanabhan and Png (1995, p. 65) define return policy as a commitment by the producer or an upstream member to accept product returns from a downstream channel member—i.e., distributors, wholesalers, or retailers.

According to Padmanabhan and Png (1995, p. 65), Kandel (1996, p. 330), and Pasternack (2008, p. 132), return policy can be classified into *liberal, partial, and restrictive return policies* in which no returns are allowed.

In a liberal return policy, an upstream partner agrees to refund the full wholesale price for all returned products from a downstream partner. Therefore, this is the most generous type of return policies (Padmanabhan & Png, 1995, p. 65), which allocates all the burden to the manufacturer (Kandel, 1996, p. 330). Companies use a liberal return policy in a situation where there is a high uncertainty in product demand or when the product life is limited, because the downstream partners in such situations are reluctant to carry excess inventory due to the high risk of obsolescence. Hence, the use of liberal return policies transfers the cost of excess inventory and the product obsolescence risk from the downstream partners to manufacturers, which encourages the downstream partners to increase stocks (Padmanabhan & Png, 1995, p. 66).

The second and most common type of return policy is partial return which provides only partial credit or refund for returned products (Padmanabhan & Png, 1995, p. 65). Brown, Chou, and Tang (2008, p. 129) differentiate between two basic types of partial return policies—the first type is "*full return with partial credit*" and the second type is "*partial return with full credit.*" Under the first type, the distributor has the ability to return any amount of each product but will be compensated by an agreed-upon fraction of the wholesale price for each returned item. In contrast, under the second type, the distributor will be compensated by the full wholesale price for each returned item but can only return up to an agreed-upon percentage of the original order (Brown et al., 2008, p. 129).

According to Pasternack (2008, p. 132), a return policy in which returned products are limited to a fixed percentage of the total purchased amount will not be able to optimize channel profits in a supply chain. On the other hand, a return policy, which allows for unlimited returns for a partial credit, could enhance the channel profits. The logic behind the previous argument is that the full returns for partial credit is similar to the revenue-sharing mechanism, while the retailer or distributor pays a lower amount for the purchased products but accepts sharing of revenues collected from the sale of the item with the manufacturer. Similarly, under partial return policy, manufacturers and downstream partners share the risk of returns as the manufacturers provide a partial returns policy by deducting only a small amount of the wholesale price for the returned items (Pasternack, 2008, p. 132).

Therefore, the partial return policy will allow the manufacturer and downstream partners to share the risk and consequently create incentives for all partners to do their tasks. This is because the partial risk motivates the downstream partners to place orders conservatively and to promote the product while motivating manufacturers to enhance the product and to introduce it to the market carefully (Padmanabhan & Png, 1995, p. 70).

In short, a manufacturer's return policies play an important role in adjusting the relationship between channel partners by sharing the risk associated with returns (Tsay, 2002, p. 458). Nevertheless, some manufacturers might misuse return policies to raise their own profits and diminish profits of their supply chain partners (Schmid, 2008, p. 7).

2.5 Main Processes of Reverse Logistics

Dale S. Rogers and Tibben-Lembke (1998), de Brito and Dekker (2003), and Fleischmann, Krikke, Dekker, and Flapper (2000) provide a general classification for the key processes in reverse logistics, as shown in Figure 3.

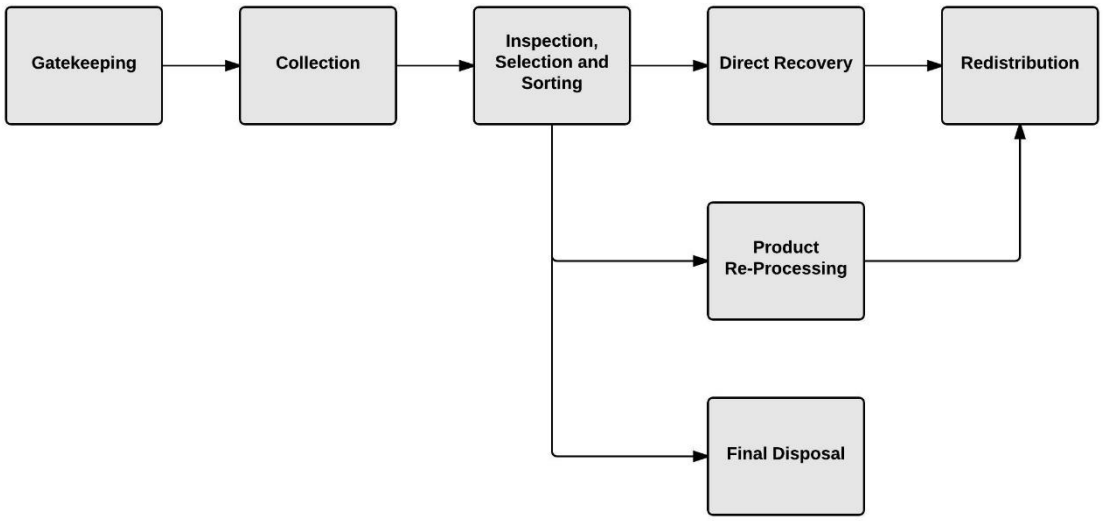

Figure 3 Reverse logistics processes

Adopted from (Fleischmann et al., 2000, p. 657) and (de Brito & Dekker, 2003, p.12)

2.5.1 Gatekeeping

According to Dale S. Rogers and Tibben-Lembke (1998, p. 38), gatekeeping is the first step in the returning process and represents the point of entry into the reverse logistics pipeline. This step determines which products would be considered defective and allowed to be returned, and which would not. Therefore, gatekeeping is the best point to eliminate

unnecessary cost associated with returning products as early as possible, by screening the return request, to identify the unwarranted merchandise (Dale S. Rogers & Tibben-Lembke, 1998, p. 38).

2.5.2 Collection

The next step is the collection process by which companies physically move the products to a point of recovery for further treatment (de Brito & Dekker, 2003, p. 11). Collection may be imposed by legislation and may include transportation as well as storage activity (Fleischmann et al., 2000, p. 5).

2.5.3 Inspection, Selection, and Sorting

After collection there is a combined processes involving the inspection of product quality in order to determine the reusability of the returned product, selection of the recovery method, and sorting (routing) of the products in accordance with the selected recovery method (de Brito & Dekker, 2003, p. 11). Therefore, the inspection, selection, and sorting processes result in separating the flow of returned products between direct reuse, reprocessing, or disposal options (Fleischmann et al., 2000, p. 657).

2.5.4 Direct Recovery or Reuse

Direct recovery, resale, and reuse constitute a desirable option for returned products whose quality is as good as that of new products. In this case, the returned products are immediately sent back to the market for potential buyers and users (de Brito & Dekker, 2003, p. 11).

2.5.5 Reprocessing

The reprocessing involves transformation of the returned product into a usable product (Fleischmann et al., 2000, p. 657). There are several product recovery options such as product repair, refurbishing, remanufacturing, cannibalization as well as recycling (Thierry, Salomon, Van Nunen, & Van Wassenhove, 1995, p. 117).

2.5.6 Disposal

Landfilling or incineration as a disposal method is an option for products that cannot be reused due to technical or economic reasons. Also, during the sorting level, disposal could be an option for those rejected products which do not have satisfactory market potential or which require extensive repair (Fleischmann et al., 2000, p. 657).

2.5.7 Redistribution

The final process is the redistribution of reusable products in the market for potential users. This process encompasses different activities such as sales, transportation, and storage activities (Fleischmann et al., 2000, p. 658).

2.6 Reverse Logistics Activities

A general classification of reverse logistics activities related to the discussed processes is given by Dale S. Rogers and Tibben-Lembke (1998, p. 9). This classification differentiates between the numerous recovery and disposal options in accordance with products returns and packaging returns, as shown below by Table 3.

Table 3 Reverse logistics activties

Adopted from (Dale S. Rogers & Tibben-Lembke, 1998, p. 10)

Type of Returns	Reverse Logistics Activities
Returned Products	Return to Supplier Resell the Product Sell Via outlet or Discount Store Sell to Secondary Market Donate to Charity Recondition - Refurbish – Remanufacture Reclaim – Recycle - Landfill Materials
Returned Packages	Reuse - Refurbish Reclaim - Recycle - Salvage Materials

When the product is returned, there are more than one recovery or disposal option from which the company can select. A brief explanation for each activity is given below.

- **Return to Supplier**

A firm might prefer to return the product to the supplier as a first choice if there is a possibility of getting a full refund. This option depends on the supplier's motivation to help the returning party to avoid inventory obsolescence. Based on the returned product's condition, the supplier may be able to reshelf and resell this product as new. Also, suppliers may accept product returns in order to be certain that defective products are not sold again

as new ones, and also to prevent the returned products from entering another disposition channel and affect future demand.

- **Resell the Product**

Reselling the product to different customers is also a favorable option if the product has not been used or opened. The product in this case might need to be repackaged. However, Dale S. Rogers and Tibben-Lembke (1998, p. 81) explain that there are legal restrictions and regulations in strongly regulated industries which state once a product is returned, it cannot be resold as new.

- **Sell via Outlet or Discount Store**

In cases where a large inventory of a particular product is carried or the product has been returned, it can be sold via an outlet or a discount store. The main advantage of selling via an outlet store is that firms maintain control over their returned products by knowing where those products will be sold (Dale S. Rogers & Tibben-Lembke, 1998, p. 82).

- **Sell to Secondary Market**

In some cases where the product is not as new, it might be sold to a salvage broker that will sell it in the secondary market where firms are specialized in buying surplus and salvage products at a reduced price. Those firms sell the products either at their own stores or through markdown retailers at a significantly reduced price from its original retail price.

- **Donate to Charity**

Schatteman (2003, p. 274) point out that if the returned products quality is not satisfactory for selling, companies may donate the returned products through charitable organizations. Also, Dale S. Rogers and Tibben-Lembke (1998, p. 84) explain that although firms usually do not receive money for the product, they are able to gain a tax advantage for the donation and receive other values such as a good corporate citizenship image.

- **Recondition, Refurbish, or Remanufacture**

Some activities are preferable when the product cannot be sold as it is. Therefore, firms will attempt to recondition, refurbish, or remanufacture such products in order to increase its selling price. However, Dale S. Rogers and Tibben-Lembke (1998, p. 84) mention that refurbishing and remanufacturing options depend on the returned product types and the reason for which it was returned, as many products cannot be remanufactured.

- **Materials Reclamation, Recycling, and Landfill**

In cases where the returned products cannot be remanufactured due to environmental restrictions or legal implications, the firm will search for the least cost disposal option. But, before the disposition, the firm will try to capture or reclaim any valuable materials from the product, while any recyclable materials will be extracted before sending the rest of materials to landfills or incinerators (Dale S. Rogers & Tibben-Lembke, 1998, p. 85).

- **Returned Packages**

When a product package is returned, it can be reused unless it gets damaged. In cases where the packaging materials or pallets are damaged, they can be refurbished and returned to use. If there is no possibility to repair the damaged package, firms will try to capture any value from the material before sending the rest to landfill for proper disposal.

Finally, it is worth mentioning that reverse logistics activities vary with respect to the industry and the position of firms in the distribution channel. Thus, within specific industries, reverse logistics activities can be of great importance for the firm (Dale S. Rogers & Tibben-Lembke, 1998, p. 12).

In this regard, in industries where the product value is high or the return rate is great, companies are willing to invest for enhancing their return processes (Dale S. Rogers & Tibben-Lembke, 1998, p. 6).

2.7 Reverse Logistics Barriers

Although the application of reverse logistics practices can result in environmental and economic benefits, it is not free from barriers. The most common barriers in implementing good reverse logistics, according to Dale S. Rogers's and Tibben-Lembke's (1998, p. 32) examination of 300 companies in different industries, are as follows: Importance of reverse logistics relative to other issues, company policies, lack of system, competitive issues, management inattention, financial and personnel resources, and legal issues.

In addition, different studies (Donald F. Blumberg, 1999; Chouinard, D'Amours, & Aït-Kadi, 2005; Cojocariu, 2013; Eric, Thomas, & Lauren, 2010; Gupta, 2013; Ismail et al., 2010; Lau & Wang, 2009; Ravi & Shankar, 2005; Richey, Chen, Genchev, & Daugherty, 2005; Ronald & Dale, 2002) have identified similar barriers as those identified by Dale S. Rogers and Tibben-Lembke (1998, p. 32) as well as other different barriers.

2.7.1 Lack of Company Awareness Regarding Reverse Logistics

According to Dale S. Rogers and Tibben-Lembke (1998, p. 33) many companies do not consider reverse logistics as a priority and they face difficulty in justifying the cost of reverse logistics application. Moreover, product returns for many companies represent failure and hence they do not want to devote their attention to reverse logistics.

Also, Dale S. Rogers and Tibben-Lembke (1998, p. 34) explain that top management is not committed to adopting reverse logistics in many firms. In addition, Ismail et al. (2010, p. 50) states that managers lack interest in reverse logistics strategies due to the possibility that recycling or recovering materials and using them in sale or manufacturing will harm the company's image since customer's expectations of the product's quality may be lower than that of the new product. In this regard, Ravi and Shankar (2005, p. 1016) suggest that successful implementation of reverse logistics requires an efficient leadership to establish a clear vision and value to reverse logistics programs as well as integration of reverse logistics activities in strategic plans, action plans, and organizational goals.

2.7.2 Restrictive Firm Policies

Companies sometimes develop restrictive policies that constrain their ability to handle return efficiently and limit their potential to recover value from returns (Dale S. Rogers & Tibben-Lembke, 1998, p. 34). One of the main reasons for adopting restrictive policies is that companies do not want to reuse the recovered materials or the redistribution of returned products to negatively affect the quality of their end products (Ravi & Shankar, 2005, p. 1015).

2.7.3 Lack of Personnel Training and Support

Personnel training and education are crucial requirements for achieving success in reverse logistics in any organization. If employees are not trained or encouraged to manage reverse logistics, they can become impediments to reverse logistics processes (Cojocariu, 2013, p. 162). Also, employees in many situations are reluctant to change—especially in companies where there is a lack of trained and educated employees. In this respect, reverse logistics implementation requires substantial changes in employee mindsets and practices because the lack of personnel support in organizations can affect their application of reverse logistics (Ravi and Shankar, 2005, p. 1015).

2.7.4 Lack of Information System

Ravi and Shankar (2005, p. 1013) mention that the lack of advanced information system is a major barrier in implementing good reverse logistics, as the implementation of efficient reverse logistics requires an advanced information system which enables companies to track and trace returns as well as to link returns to previous sales in order to forecast the product returns across the supply chain.

Dale S. Rogers and Tibben-Lembke (1998, p. 43) as well as Richey et al. (2005, p. 830) reveal that many of the existing information systems are designed mainly for supporting forward logistics more than reverse logistics processes, and that they lack flexibility. Such flexibility is essential in reverse logistics information systems because reverse logistics processes have numerous exceptions.

2.7.5 Lack of Performance Metrics

The lack of performance metrics is a major barrier that can limit the success of reverse logistics programs, because a process which is not measured cannot be managed (Ravi & Shankar, 2005, p. 1015). In this regard, measuring the performance of reverse logistics is a prerequisite to managing and improving its performance.

Moreover, performance metrics that measure the financial impact of returns on companies and its supply chain partners are important, in order to monitor the progress of a reverse logistics plan. Therefore, developing specific reverse logistics metrics would enable companies to analyze return rates as well as to identify the root cause of returns (Rogers et al., 2013, p. 47).

2.7.6 Financial Constraints

Even though financial constraints are not the most significant barriers, according to Dale S. Rogers and Tibben-Lembke (1998, p. 34), Ravi and Shankar (2005, p. 1016) state that financial constraints constitute a key barrier hindering reverse logistics programs. In this regard, huge finance and allocation of funds are enablers for having an advanced information system that serves the complex reverse logistics processes and activities as well as for providing training to personnel related to reverse logistics.

2.7.7 Legal issues: Lack of Legislations and Enforcement of Regulations.

One of the barriers identified by Dale S. Rogers and Tibben-Lembke (1998, p. 35) is related to legal issues, as many companies primarily implement reverse logistics strategies due to government regulations as well as pressure from environmental organizations and not for economic benefits. Also, Lau and Wang (2009, p. 457) identify the lack of laws and legislations enforcement as a major barrier in implementing reverse logistics. Similarly, Ismail et al. (2010, p. 52) observe that the absence of legislations leads to unwillingness from companies to implement a successful reverse logistics.

2.7.8 Lack of Economic Support and Preferential Tax Policies

Ismail et al. (2010, p. 50) as well as Lau and Wang (2009, p. 447) observe that the absence of economic support, incentives, and preferential tax policies, which help the manufacturers to compensate the high investment costs of reverse logistics, act as a barrier to implement reverse logistics. Without economic support from governments, managers will lack the motivation to invest in reverse logistics and hence the collaboration between supply chain partners will be limited.

2.7.9 Lack of Public Awareness

Donald F. Blumberg (1999, p. 147) identify that high consumer awareness is one of the crucial needs for implementing good reverse logistics. Moreover, the creation of consumer awareness is derived from the imposed governmental legislations toward the creation of environment-friendly and recyclable products. Similarly, Ismail et al. (2010, p. 51) identify that the public awareness of environmental protection is positively related to the environmental legislations. Accordingly, the high level of public and customer awareness are essential requirements to increase the need to implement effective reverse logistics programs for handling waste; in fact, their absence can act as a major barrier to reverse logistics (Donald F. Blumberg, 1999, p. 147).

2.7.10 Lack of Cooperation between Supply Chain Partners

Since several channel partners are involved in reverse logistics and other external parties are interested in reverse logistics for the expected benefits, Ravi and Shankar (2005, p. 1017) point out that the support from supply chain partners is an essential factor for the success of

any reverse logistics program. Consequently, companies face difficulties to effectively implement reverse logistics without cooperating with their different channel partners.

2.7.11 Different Partners' Objectives in Reverse Logistics

Tibben-Lembke (2002, p. 226) explain that the conflict between retailer and manufacturer usually arises as they tend to look at reverse logistics from opposite perspectives: Retailers would like to return as much product as possible and receive as much credit as possible, while manufacturers would prefer to minimize both. Also, Dale S. Rogers and Tibben-Lembke (1998, p. 29) mention that manufacturers or retailers might disagree on the condition and quality of the returned product or the value of the product for crediting. Such conflicts might result in long processing time of returns and cause harm to both firms, and, subsequently, a developing partnership based on mutual benefit is beneficial for both partners.

2.7.12 Inappropriate Incentive Systems

Dale et al. (2002, p. 3) point out that when sales forces bonuses and incentives are linked to revenue generation, and returns are not taken into account, the objective of sales persons will be to push products in the channel pipeline. This results in high return rates due to the unjustified loading of the channel with products. Therefore, company policies, firm objectives, and the related employees' incentives must be aligned to ensure that they are not obstacles to reverse logistics programs (Cojocariu, 2013, p. 162).

2.7.13 Opportunism Resulting in Lower Reverse Logistics Capabilities

Eric et al. (2010, p. 231) pointed out that the lack of trust and collaborative behavior between partners involved in reverse logistics would result in opportunistic behavior. Some firms might tighten their return policies as a response to opportunism, which results in reducing reverse logistics capabilities, because when partners try to take the advantage of return policies by improving their benefits at the expense of other parties, returns and reverse logistics costs will increase.

2.7.14 Uncertainties in the Return Process

Chouinard et al. (2005, p. 106) pointed out that the uncertainty related to quality, quantity, and the time of returned products influence the scope of reverse logistics activities in companies, as companies seek to minimize the impact of returns on their current activities

related to the distribution of new products. Consequently, companies will choose the easiest disposal methods for the returned products without assessing the opportunity of reintroducing them into the market. In this regard, reverse logistics activities are considered a source of cost rather than income.

In addition, Cojocariu (2013, p. 162) states that the involvement of multiple chain partners in reverse logistics as well as other entities require an adequate system support, because relying on paperwork and poorly defined workflow processes tend to affect reverse logistics operations by increasing uncertainties about return causes and current costs associated with reverse logistics. Dale S. Rogers and Tibben-Lembke (1998, p. 30) reveal that uncertainties about the total cost of return process and the difficulties to identify return causes indicate that there is a significant problem in the company return process.

2.8 Reverse Logistics in Pharmaceutical Supply Chain

Due to the unique nature of supply and demand for drugs, the pharmaceutical market is strictly regulated in many countries (Yu, Li, Shi, & Yu, 2010, p. 8). Also, the pharmaceutical industry is characterized by its complex processes, numerous operations, and multiple organizations involved during the discovery, development as well as manufacturing of drugs (Shah, 2004, p. 929).

According to Shah (2004, p. 929) two different types of manufacturers are involved in the pharmaceutical upstream supply chain. Primary manufacturers are responsible for producing the Active Pharmaceutical Ingredient (API)—the manufacturing process of API is characterized by long processing time due to multiple production stages. Moreover, after production, the API must pass a quality control test to gain approval to be used downstream.

The other type is constituted by secondary manufacturers, where the API is mixed with other materials during the formulation stage to produce the final product. Similar to primary manufacturing, the final product is subject to quality control before packaging. Singh (2005, p. 32) points out that responsiveness and agility are the main objectives dominating the upstream phase in order to quickly respond to any contingency; however, after production, the Pharmaceutical Supply Chain (PSC) downstream objective is concerned with the high availability of their products in the market. This is mainly because of the high development and production cost which compose a big portion of the drug price and also because most drugs have low to moderate shelf-lives (Asma & Masood, 2009, p. 30).

There are multiple large independent organizations involved in the PSC—these organizations are supply chain partners, as illustrated in Figure 4 and other key stakeholders. Partners could be one or more distributors, hospital, clinic, pharmacy-chain and retailer, other key stakeholders such as government agencies; World Health Organization (WHO) and research organizations are also involved (Singh, 2005, p. 32).

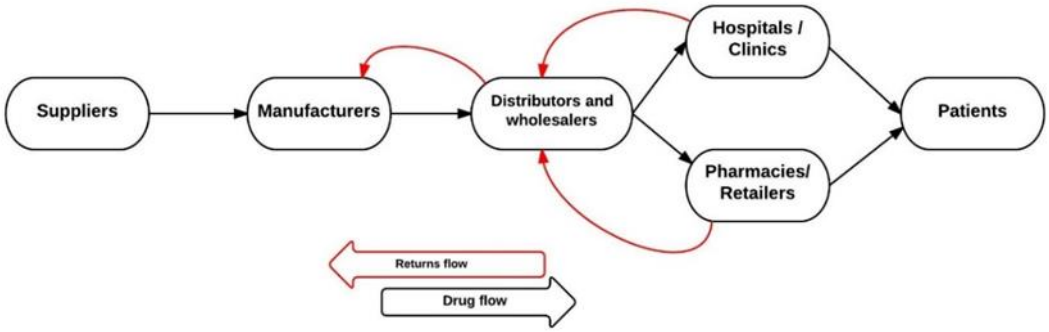

Figure 4 Pharmaceutical supply chain

Adopted from : (Singh, 2005, p. 32)

In PSC, managing reverse logistics is a challenging issue with legal aspects. This is mainly due to the sensitive nature of drugs and their potential effects on health (Singh, 2005, p. 44). Moreover, many pharmaceutical companies consider reverse logistics as a bullet in their profits and an expensive process (Kabir, 2013, p. 100). According to Bravo and de Carvalho (2013, p. 233) as well as Singh (2005, p. 44), the two main reasons for returning pharmaceutical products are drug recall and drug expiration.

Drug recall: The manufacturer recalls drug from other partners (distributors, wholesalers, hospitals, and pharmacies) in the supply chain due to a temporary problem or a permanent removal of the product from the market due to health and safety issues. The difficulty in drug recall is that the manufacturer must coordinate and organize the removal of every unsold drug from every point in the supply chain (Singh, 2005, p. 44). Kabir (2013, p. 97) explain that the complexity in drug recall increases when companies execute recall for a specific single production batch that contains defects. In such cases product recall is subject to multiple legal considerations as well as financial implications.

Drug expiration: The expired drugs must be removed from the supply chain and customer locations and thus one of the main challenges for the pharmaceutical manufacturers is to monitor the quantity of expired drugs in the market (Singh, 2005, p. 44). During product recall or removal of expired products from the market, pharmaceutical companies rely on

distributors' and wholesalers' information because most producers lack control over the entire supply chain for product distribution (Kumar, Dieveney, & Dieveney, 2009, p. 192). In this way, the return of the drug can be a very complex process because product returns in the pharmaceutical industry are mostly handled by either third parties or distributors (A. Narayana, A. Elias, & K. Pati, 2014, p. 381).

2.8.1 Importance of Reverse Logistics for Pharmaceuticals

Reverse logistics in the pharmaceutical industry is very important from the environmental and regulatory points of view, as well as from the economic point of view (Kabir, 2013, p. 96). It is worth mentioning that the lack of proper application of reverse logistics practices for managing the returns of expired drugs would affect the patient.

Also, improper application of reverse logistics would result in facilitating the way for unauthorized intermediaries to exist in the pharmaceutical supply chain and allow them to perform illegal activities such as relabeling the package and extending the expiry date for the purpose of reselling the expired pharmaceuticals into the market (Kwateng et al., 2014, p. 18). Similarly, Kabir (2013, p. 97) highlights that unnecessary multiple handling in reverse logistics and delays of returns increase the chance for unauthorized intermediaries to divert drugs into the black market, where expired products will be modified and labeled as saleable.

Therefore, it is very important for pharmaceutical companies to implement reverse logistics right from the beginning due to the severe impact on human health from using expired or ineffective drugs (Ritchie, Burnes, Whittle, & Hey, 2000, p. 31).

The reverse logistics for pharmaceuticals differ from other industries in the sense that when the pharmaceuticals are returned they are destroyed, they are seldom repaired or resold, and also it is difficult to recapture the economic value from the expired products (Kabir, 2013, p. 97). However, in cases where damaged packaging is the reason for the returned drug, the full market value could be recovered. Also, donation of unexpired medicines to charitable organizations can enhance the company's corporate image (Asma & Masood, 2009, p. 27).

Teunter, Inderfurth, Minner, and Kleber (2003, p. 2) explain that there is a possibility to recapture the economic value by recycling the by-products obtained in many stages of the production process and also by recycling the impure solvents obtained during the formulation stage.

Pratyusha, Gaikwad, Phatak, and Chaudhari (2012, p. 121) mention that improper treatment and disposal of pharmaceutical waste would have a severe impact on human health and the environment in the long run. They categorized pharmaceutical waste into *hazardous waste, non-hazardous waste, and chemo waste.*

Pharmaceutical waste includes, but not limited to, expired drugs, drugs that are discarded, and open containers of drugs that cannot be used (Pratyusha et al. 2012, p. 123). Hazardous waste is potentially harmful for human health and/or the environment. It can be liquid, solid, or gaseous, and have one or more of the following characteristics: ignitability, toxicity, corrosiveness, and reactivity. Even if the non-hazardous waste is related to materials that are considered to present no significant hazardous properties, these products may become contaminated or mixed with other compounds and therefore require assessment for hazardous properties prior to disposal (Pratyusha et al., 2012, p. 125).

In this regard, it is very important to properly dispose of recalled, unused, and expired pharmaceuticals, as some of these products contain hazardous chemicals (Shaurabh et al., 2013, p. 18). Also, the disposal of pharmaceutical waste requires more attention compared with any other industry, and more attention should be devoted to application of reverse logistics at pharmaceutical companies.

3. METHODOLOGY

This chapter describes the research approach used in conducting the research, the data collection methods, and the ISM methodology applied for data analysis. Potential benefits and limitations of the ISM methodology are also discussed.

3.1 Research Approach

In this empirical research, a mixed approach is applied. The research starts by a qualitative case study, to describe the reverse logistics drivers and the applied practices at the case company and to identify the barriers that potentially hinder their reverse logistics applications. This is followed by Interpretive Structural Modeling (ISM) to explore the interactions among the barriers identified during the case study.

The major benefits of this mixed research approach are that the case study provides in-depth understanding of the problem at hand within its real context, while the ISM analysis helps to structure and analyze the information gathered from the case study in a systematic way.

The mixed research approach is defined by (Johnson & Onwuegbuzie, 2004) as *the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study* (p. 17). A more detailed explanation is provided by Kelle (2006, p. 309) as a combination of different qualitative and quantitative methods of data collection and data analysis in one empirical research project. The combination of both methods helps the researcher to gain a full picture and deeper understanding of the investigated phenomenon by linking complementary findings to each other. Yin (2009, p. 64) states that a mixed research approach can enable the researcher to address either broader or more complicated research questions than case studies alone. He defines a case study as *an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident* (p. 18).

Hence, the mixed research approach can be used in case studies where quantitative results are expressed in numerical and quantifiable terms, while qualitative results are expressed verbally in order to create an understanding of relationships or complex interactions (M. Ellram, 1996, p. 97).

3.2 Case Selection and Data Collection

The research context is one leading pharmaceutical company in Egypt, *Pharco Pharmaceuticals*, which is producing and marketing more than 237 pharmaceutical product in the Egyptian market (Pharco Pharmaceuticals, 2014). In addition, it is the founder of Pharco Corporation, which is a group of nine companies. In 2011, Pharco's market share was 13.2 percent, and it was ranked number one in term of selling "345 million units" (Pharco Corporation, 2014). Hence, it is expected that Pharco Pharmaceuticals have a major experience in dealing with returned pharmaceuticals as well as disposal of expired and recalled pharmaceuticals.

In this research, the unit of analysis is "reverse logistics of distribution returns in Pharco Pharmaceuticals."

3.2.1 Sources of Primary Data

Sachdeva (2009, p. 109) explains that primary data is collected by the researcher through interaction with the source to extract information by using methods such as surveys, interviews, and direct observations. Thus, primary sources of information allow the researcher to access original and unedited information.

Interviews can be categorized on the basis of their level of formality and structure. They can be categorized into *structured interviews, semi-structured interviews, or unstructured interviews* (Saunders, Lewis, & Thornhill, 2009, p. 320).

In structured interviews, the researcher uses a predetermined set of questions and the responses are recorded usually with pre-coded answers. Saunders et al. (2009, p. 320) refer to this type of interview as "quantitative research interviews" in which the researcher uses structured interviews in order to collect quantifiable data.

In semi-structured interviews, the researcher prepares a set of questions to be covered by the interviewee. However, the order of the questions may vary, depending on the conversation flow, and additional questions may be required on the basis of the event to explore research questions. Semi-structured interviews are beneficial for researchers when in-depth explanation from interviewees is needed in order to build on their responses and to collect a rich and detailed set of data (Saunders et al., 2009, p. 324).

In this research, primary data has been collected by using semi-structured and structured interviews in two phases. In the first phase, **semi-structured interviews** are conducted face-

to-face with Pharco's sales manager, health and safety manager, returned products supervisor, and the health and safety supervisor. Each of the interviews with the sales manager and the returned product supervisor lasted two hours on average, while the interviews with the health and safety manager and the supervisor lasted only one hour each.

The interview questions in this phase have been formulated based on the relevant literature of reverse logistics in order to cover the research questions. Thus, one interview guide with three questions sets, in accordance with, the three research questions has been prepared. The purpose of the first set of questions is to understand the reverse logistics drivers from the company's perspective and to obtain knowledge on how Pharco's downstream partners derive the company's reverse logistics practices.

The main purpose of the second set of questions is to determine the current reverse logistics activities and processes applied by Pharco, and then, to understand how the company deals with the returned pharmaceuticals in relation to the imposed regulations. The last set of questions is prepared to investigate the different reverse logistics barriers facing Pharco in implementing reverse logistics.

During the first phase, all the conducted interviews have been audio-recorded and subsequently transcribed prior to data analysis. The interview guide containing the interview questions and participants can be found in Appendix (A).

In the second phase, **structured interviews** are conducted electronically and via telephone with the sales manager and the returned products supervisor in order to establish contextual and pairwise relationships among the previously identified barriers in the first phase. Their responses to a set of close-ended questions are the basis in filling the structural self-interaction matrix, which is one of the steps of the ISM analysis as described later in this chapter.

3.2.2 Sources of Secondary Data

According to Sachdeva (2009, p. 109), secondary sources of data are edited primary sources or secondhand versions which the researcher collects and utilizes in research. Thus, secondary data takes the role of explaining and combining the information from the primary source with additional information; it also serves as a reference base against which to compare the validity and accuracy of primary data. In this research, secondary data has been collected from various sources.

Quantitative data is collected from the company in the form of monthly reports for sales and product returns value by distributors for the year 2014. Such data has been useful for the case description. In addition, some relevant information has been collected from Pharco and its distributors' websites, as well as from published reports, and guidelines have been obtained from the Egyptian Drug Authority (EDA) website.

Moreover, a significant amount of secondary data has been obtained from scientific articles published in academic journals, which are available through online databases. Also, a number of relevant books and dissertations to this research has been collected and used in the theoretical framework chapter.

3.3 Data Analysis Methods

In this research, the ISM methodology is applied to analyze the information gathered from the case study on the barriers hindering Pharco's application of reverse logistics. A brief overview of this method and its steps are provided below.

3.3.1 Interpretive Structural Modeling

Interactive Management (IM) is a set of managerial tools invented especially to manage complexity in organizations and to enable them to cope with complex situations whose scopes are beyond the normal type of problem that they can easily solve (John N Warfield & Cárdenas, 1994, p. 1). One such tool is the ISM—it is a methodology designed for use when the researcher desires to employ systematic and logical thinking to approach a complex issue, and then to communicate the results of that thinking to others (Malone, 1975). This technique was developed by Warfield during the period 1972–1974 and published in 1974 (John N Warfield & Cárdenas, 1994, p. 82).

John N. Warfield (1974) defines structural modeling as a methodology which employs graphics and words in carefully defined patterns to illustrate the structure of a complex issue or problem. Thus, in this technique, the intention of the modeler is to embody the geometric rather than the algebraic and to describe form rather than calculating or measuring quantitative output (Lendaris, 1980, p. 807).

Ravi and Shankar (2005, p. 1017) explain ISM as an interactive learning process in which a set of different directly and indirectly related variables affecting the system under consideration are structured into a comprehensive systematic model. This methodology

helps to identify order and direction on the complexity of relationships among the elements of a system.

The ISM methodology is *interpretive* as the judgment of the expert group decides whether and how the variables are related. It is *structural* on the basis of relationships, and an overall structure is extracted from the complex set of variables. In addition, it is a *modeling* technique because the specific relationships of the variables and the overall structure of the system under consideration are represented and illustrated in a diagraph model (Ravi & Shankar, 2005, p. 1018). In this regard, the value added by using the ISM methodology is structural and no information is added by the process (Farris & Sage, 1975).

Attri, Dev, and Sharma (2013, p. 5), Luthra, Kumar, Kumar, and Haleem (2011, p. 240), and Ravi and Shankar (2005, p. 1018) explain and summarize the various steps involved in the ISM methodology into **eight steps as follows:**

1st step: Identify the variables affecting the system under consideration and which are relevant to the problem. Those variables can be objectives, actions, and individuals etc.

2nd step: Based on the identified variables in the first step, establish a contextual relationship between the variables with respect to which pairs of elements would be examined.

3rd step: Develop a structural self-interaction matrix (SSIM) for variables, which would indicate a pairwise relationship among variables of the system under consideration.

4th step: Develop a reachability matrix from the SSIM and check this matrix for transitivity. The transitivity of the contextual relation is a basic assumption made in ISM. It states that if a variable "A" is related to another variable "B," and "B" is related to "C," then "A" is necessarily related to "C."

5th step: Partition the reachability matrix obtained in step four into different levels.

6th step: Based on the relationships given in the reachability matrix, draw a directed graph and remove the transitive links.

7th step: Convert the resultant directed graph into an ISM-based model by replacing the element nodes with the statements.

8th step: Review the model to check for conceptual inconsistency and make the necessary modifications. These steps of the ISM are illustrated in Figure 5 below.

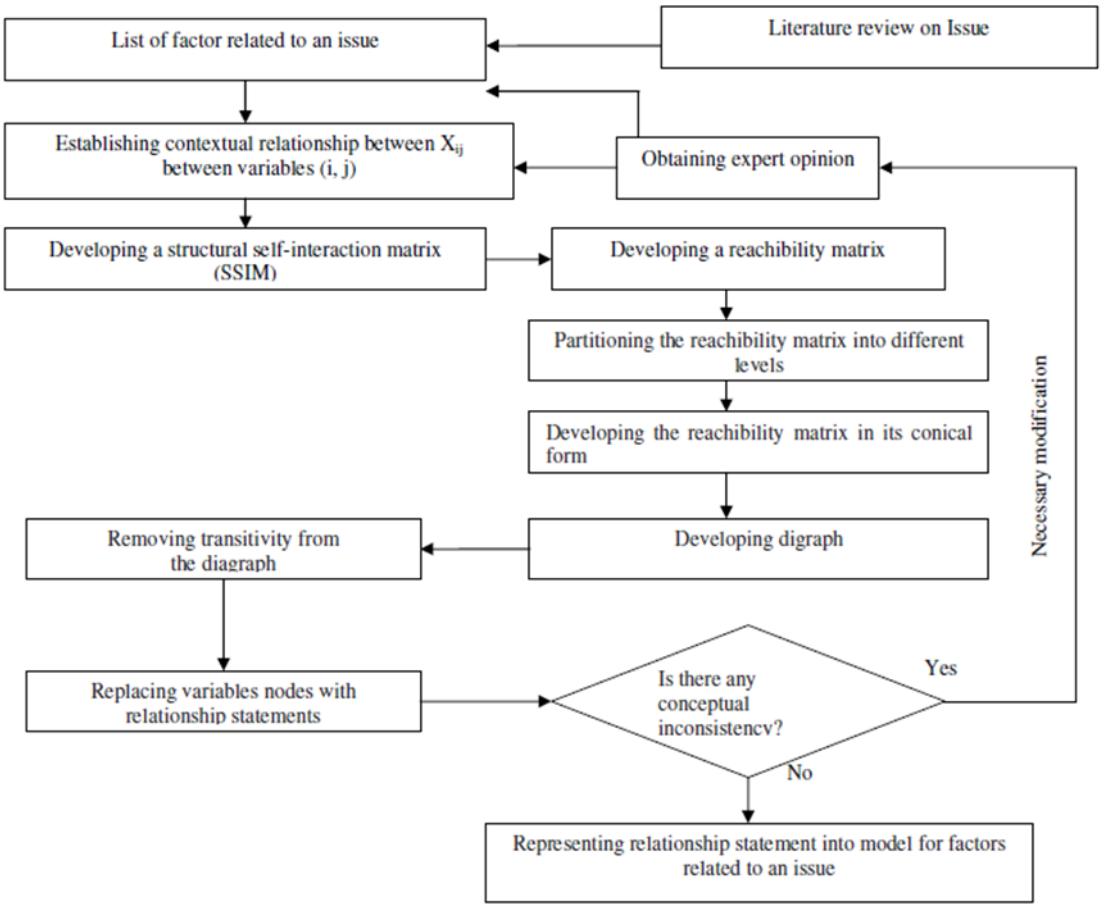

Figure 5 Flow diagram for preparing the ISM model

Source (Attri et al., 2013, p. 4)

3.3.1.1 Benefits and limitations of the ISM approach

The benefits of using ISM have been explained by John N Warfield and Cárdenas (1994, p. 194). Such benefits and others have been summarized by Attri et al. (2013, p. 6).

- The ISM methodology helps the participants to work with ideas systematically through a detailed consideration of the pairwise relationship of system elements while building up a holistic view of the situation either directly from the participant's responses or by transitive inference.
- The process is efficient as the use of transitive inference may reduce the number of the required relational queries by 50 to 80 percent, depending on the context.
- The process produces a structural model or graphical representation of the original problem situation that can be easily and effectively communicated to others.

- It enhances the quality of interpersonal communication within the problem situation context by focusing the participant's attention on one specific question at a time.
- It helps to deeply analyze a specific situation by allowing participants to explore the adequacy of a proposed list of system elements or issue statements.
- It serves as a tool for the learning process by encouraging participants to develop a deeper understanding of the meaning and significance of a specified element list and relation.
- It permits action or policy analysis by helping participants in determining particular areas for policy action that offers advantages to attain specified objectives.

Even though the application of ISM approach provides several benefits in understanding complex systems, there are some limitations associated with it. Firstly, since there may be numerous variables to a problem or issue, increasing the number of variables increases the complexity of the ISM methodology. Hence, other variables that slightly affect the problem may not be incorporated in the development of the model. Secondly, unlike structural equation modeling which has the capability to test the validity of such models, the ISM output model is not statistically valid (Attri et al., 2013, p. 6).

In addition, the ISM methodology cannot be evaluated independently but only with regard to its utility in specific application contexts (Malone, 1975).

3.3.1.2 Application of ISM Approach in Supply Chain Management

Shahabadkar (2012, p. 202) reviews the literature related to ISM and its deployment for modeling variables in the area of supply chain management (SCM). His research findings show that 23 papers were published in this area by various researchers and all of them have used ISM in order to improve the performance of the supply chain.

In the area of reverse logistics, Ravi and Shankar (2005) use ISM as a methodology to analyze the interaction among the major barriers which prevent the application of reverse logistics in automobile industry. In addition, Ravi, Shankar, and Tiwari (2005) also use the ISM methodology to determine the key reverse logistics variables on which the top management should focus in order to improve the productivity and performance of the computer hardware supply chain.

3.3.2 Research Quality

In order to evaluate the quality of research, Guba (1981, pp. 84–87) explains four aspects which are to be considered in establishing the trustworthiness of findings. These aspects are *credibility, transferability, dependability, and confirmability.*

- ***Credibility***

In addresing credibility, researchers attempt to demonstrate that a true picture of the phenomenon under study is being presented (Shenton, 2004, p. 63). One of the activities that can be used to increase the possibility that credibile findings will be produced is "triangulation," whereby a multiple data sources, different participants, different theories, and different methods are used to ensure the existence of consistent and distortion-free information (Rodwell & Byers, 1997, p. 117).

To ensure credibility in this research, multiple sources of data have been used. Primary data has been collected by using both semi-structured and structured interviews with different interviewees. In addition, sales and returned products reports from the company as well as other secondary data from different sources were collected in order to compare the validity and accuracy of the primary data.

- ***Transferability***

Transferability allows the reader to decide whether the findings of a research can justifiably be applied to other situations or contexts (Rodwell & Byers, 1997, p. 117). However, since the findings of a case study are specific to a particular situation and individuals, it is impossible to demonstrate that the findings and conclusions are applicable to other situation or context (Shenton, 2004, p. 69).

In this respect, one should be careful in interpreting the findings of this research, as the intention was not to generalize the findings or results. The intention to conduct this empirical research, as stated earlier, has been to investigate the problem in depth from Pharco, while the ISM has been used to systematically analyze the information gathered from the company.

- ***Dependability***

Rodwell and Byers (1997, p. 124) state that dependability proves the appropriateness of methodological shifts that occur during the research process. Thus, in order to address dependability, Shenton (2004, p. 71) explains that the reseach process should be reported in detail to enable the readers to understand the methods and its effectiveness as well as to enable future researchers to replicate the research.

The interview questions, interviews dates, and the interviewees' managerial positions in the company are reported in the interview guide. It is assumed that if another researcher asks the same questions to the same interviewees, they would produce similar results. Moreover, the steps conducted in the ISM are documented in sufficent details later in the analysis to enable the possibility for research replication.

- ***Confirmability***

According to Rodwell and Byers (1997, p. 117), confirmability is related to the quality of the data management and the data analysis, and hence it can be established whether the case study results can be linked to the data. To achieve confirmability, Shenton (2004, p. 72) states that a researcher must demonstrate that the research findings have emerged from the data and not from his own preferences. Thus, triangulation plays a significant role in reducing the effect of the researcher's bias.

In this research, the triangulation of data from multiple sources, as stated earlier, has been beneficial in reducing the researcher's bias. Also asking the same questions to different interviewees helped to lessen the participant's bias.

4. EMPIRICAL CASE DESCRIPTION

This chapter is organized as follows. First, an overview of the Egyptian pharmaceutical industry and the related published guidelines concerning reverse logistics is provided. Second, a description of the supply chain structure of Pharco Pharmaceuticals is given by focusing on the forward and reverse flow of products and information during distribution stages. Thereafter, the drivers of reverse logistics at Pharco's as a receiving party, and the reasons for distribution returns from returning parties are described. In addition, Pharco's reverse logistics processes and activities are presented and discussed. Finally, the barriers limiting Pharco's implementation of reverse logistics are identified and described.

4.1 The Egyptian Pharmaceutical Industry

According to BMI (2014), Egypt is the largest pharmaceutical producer and consumer in terms of volume in the Middle East North Africa (MENA) region. Also, it is one of the largest finished pharmaceutical exporters to the MENA market, the Arabian Gulf market, as well as to Romania that has become an important destination for Egyptian pharmaceutical exports. The Egyptian pharmaceutical industry develops, produces, and markets for patented and generic medicines as well as Over-the-Counter drugs (OTC) through 120 pharmaceutical companies (BMI, 2014).

Pharmaceutical producers in Egypt fall into one of the following categories:

- Local public producer (state-owned companies).
- Local private producer (Egyptian private-owned companies).
- Multinationals with manufacturing facilities in Egypt.

The Egyptian pharmaceutical demand is mostly met by domestic producers, as the local production accounts for over two-thirds of the drug market in volume terms; however, domestic producers import around 85% of their raw materials (BMI, 2014).

The sales from patented, generics, and OTC drugs grew from EGP 16.55 billion in 2013 to EGP 17.66 billion in 2014. Thus, sales has increased by 6.7% (BMI, 2014). Public producers are required to distribute a major percentage of their production through public wholesalers. This is similar for private companies, but to a lesser extent. Regarding pharmaceutical retail, most pharmacies are publicly owned in Egypt and a considerable amount of pharmacy chains has emerged.

It is worth mentioning that the number of pharmacies has increased from 27,000 pharmacies in 2001 to around 33,000 in 2009, accounting for around two-third of the pharmaceutical sales. The remaining sales are distributed among hospitals, health insurances, health units, and private clinics (BMI, 2014).

Regarding pharmaceutical returns and disposal of pharmaceutical waste, Egypt is confronted with a critical problem for safe disposal of hazardous waste due to the large quantities of hazardous waste generated in its industrial areas and with only one permitted hazardous waste treatment and disposal facility in Alexandria (USTDA, 2009, p. 5). Despite the Environmental Protection Law 4 and hazardous waste regulations, the Egyptian ministry of environment is confronted with the challenge of enforcing proper disposal of hazardous waste due to the limited number of treatment and disposal facilities in Egypt (USTDA, 2009, p. 5). According to USTDA (2009, p. 8), approximately 1,718 tons of solid hazardous waste are disposed every year in Nasreya hazardous waste management unit in Alexandria. Expired medicines generate the largest portion (around 30 percent) of the amount.

4.1.1 The Egyptian Regulatory Framework for Pharmaceutical Returns

The Egyptian Drug Authority (EDA) is the pharmaceutical regulatory body of the Egyptian Ministry of Health (MOH), which is responsible for regulating the safety and quality of pharmaceutical products, making policy for the sector, and setting standards of pharmaceutical services (EDA, 2015). The Central Administration of Pharmaceutical Affairs (CAPA) is the responsible department under EDA for establishing standards for the pharmaceutical industry in Egypt (CAPA, 2015). These standards are in the form of published reports for good manufacturing practices (GMP), good distribution practices (GDP), and good storage practices (GSP).

CAPA (2009, p. 10) is the latest published GDP guideline to assist all parties involved in trade, distribution, and pharmaceutical manufacturers in ensuring the quality and integrity of pharmaceutical products during all aspects of the distribution process. Section 15 of the GDP focuses on the operational aspects in case of product recalls, which should be followed by distributors during transiting recalled products from pharmacies to distributors' warehouses and the reporting activity to CAPA manufacturers (CAPA, 2009, p. 29). Similarly, Section 16 focuses on operational aspects that should be followed by distributors after collecting the rejected and returned products from pharmacies. This section also specifies that the disposal of those returned pharmaceuticals which are not suitable for

reissue or reuse should be executed under CAPA's supervision, taking into consideration protection of the environment in accordance with the Ministry of Environment, as specified by the Egyptian Environmental Affairs Agency (EEAA) (CAPA, 2009, p. 30).

For manufacturers, CAPA (2004, p. 80), the latest published GMP, provides guidance for pharmaceutical manufacturers concerning the rejected and recovered materials, returned goods, and recalled products.

Generally, the returned products from the market should be destroyed unless their quality is satisfactory as per the quality assessment performed by the quality control department in the pharmaceutical company. In such cases, the returned products are allowed to be relabeled with a new batch number and are permitted to be resold. Also, it is permissible for pharmaceutical companies to recover the API through basic chemical reprocessing (CAPA, 2004, p. 80).

In short, based on CAPA guidelines, there is a possibility for pharmaceutical companies to capture economic value from returned pharmaceuticals by relabeling and reselling the valid returns, as well as by recovering the API through reprocessing. CAPA is also responsible for ensuring the proper disposal of expired returns by supervising disposal activities as per the EEAA specifications (EEAA, 2015).

4.2 Company Overview: Pharco Pharmaceuticals

Pharco Corporation is a group of nine healthcare companies operating in the pharmaceutical field in Egypt since 1987. The corporation specializes in the development, manufacturing, marketing, distribution, and export of a wide range of branded, generic drugs and licensed pharmaceutical products (Pharco Corporation, 2014). Currently, the corporation consists of six manufacturing facilities in Alexandria, Egypt. In addition, there are two trading companies in Egypt while one marketing and distribution Branch in Bucharest, Romania, has been operating in the Romanian market since 1993. Through the nine companies, the corporation employs more than 5,700 employees.

In 2011, the corporation was ranked number one in the Egyptian pharmaceutical market with a market share of 13.2 percent in terms of sales units (345 million units). The corporation is focusing on increasing its product portfolio while improving efficiency and optimizing its processes to provide affordable medication in the Egyptian market.

Pharco Pharmaceuticals is the founder of the corporation and is the second private Egyptian shareholding company. The company is located and headquartered in Alexandria, Egypt,

producing and marketing for 237 brands, generics, branded generics and licensed products. Moreover, the company exports to 47 countries (Pharco Pharmaceuticals, 2014).

4.3 Supply Chain Structure of Pharco Pharmaceuticals

The special nature and high complexity of the pharmaceutical industry in Egypt greatly influence the Pharco supply chain design and objectives. There are two different phases at the Pharco supply chain: the first phase focuses on product development and production (upstream), while the second phase focuses on marketing and selling the product in the market (downstream).

Therefore, Pharco's objectives are different at each of the two phases: In the upstream supply chain the objective is to accelerate the release of the products and the approval of MOH over the production batches, which implies that responsiveness is the main driver shaping the design of the Pharco upstream supply chain.

In the downstream supply chain, the objective is to achieve high product availability in the Egyptian market and the aim is to meet sales targets. In the following sections, the focus will be on the Pharco downstream supply chain and, particularly, the product and information reverse flow.

4.3.1 Pharco Forward and Reverse Product Flow

In 2014, the company was producing and distributing 237 brands, generics, branded generics and licensed products through 12 authorized distributors and small-sized distributors to pharmacies, hospitals, and private clinics in Egypt. This is illustrated in Figure 6 below.

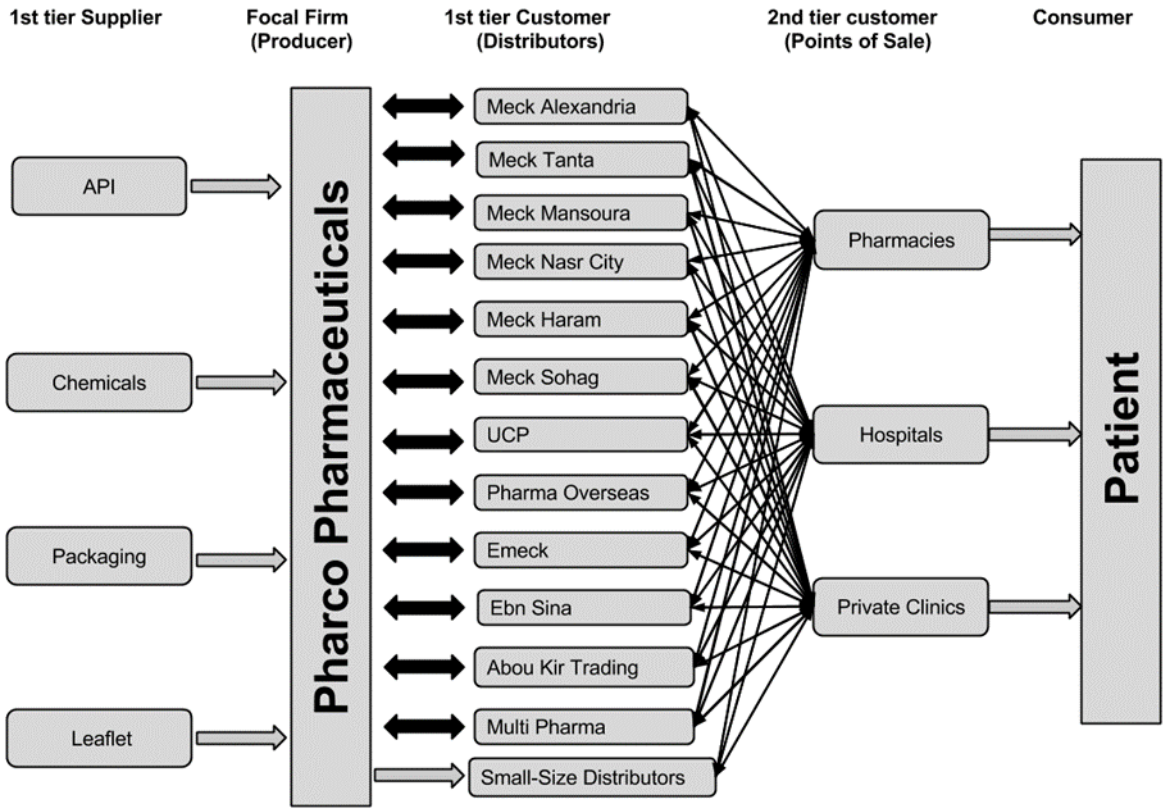

Figure 6 Supply chain of Pharco Pharmaceuticals

Meck Group is the key distributor in Pharco supply chain as it is marketing and selling Pharco products by covering six different regions in Egypt. Also, United Company of Pharmacists (UCP) is one of the important distributors operating through 112 branches covering most of the Egyptian governorates.

The third most important distributor is Pharma Overseas operates through 37 branches, followed by Ebn Sina Pharma operating through 25 branches and Multi Pharma operating through 13 branches. Emeck is also a vital distributor covering Upper Egypt through 12 branches. Abou Kir Trading was acquired by Pharco in 2002, covering 9,000 pharmacies in Egypt through 30 distribution trucks. Small-sized distributors are individual private distribution entities distributing Pharco's products in the Egyptian market.

In 2014, Pharco's annual total sales value was EGP 698,122,200. The share of small-sized distributors with regard to the total sales value was the highest during this year, representing around 40 percent as illustrated below in Figure 7, followed by Meck Group which represented a quarter of the sales value and UCP around 17 percent.

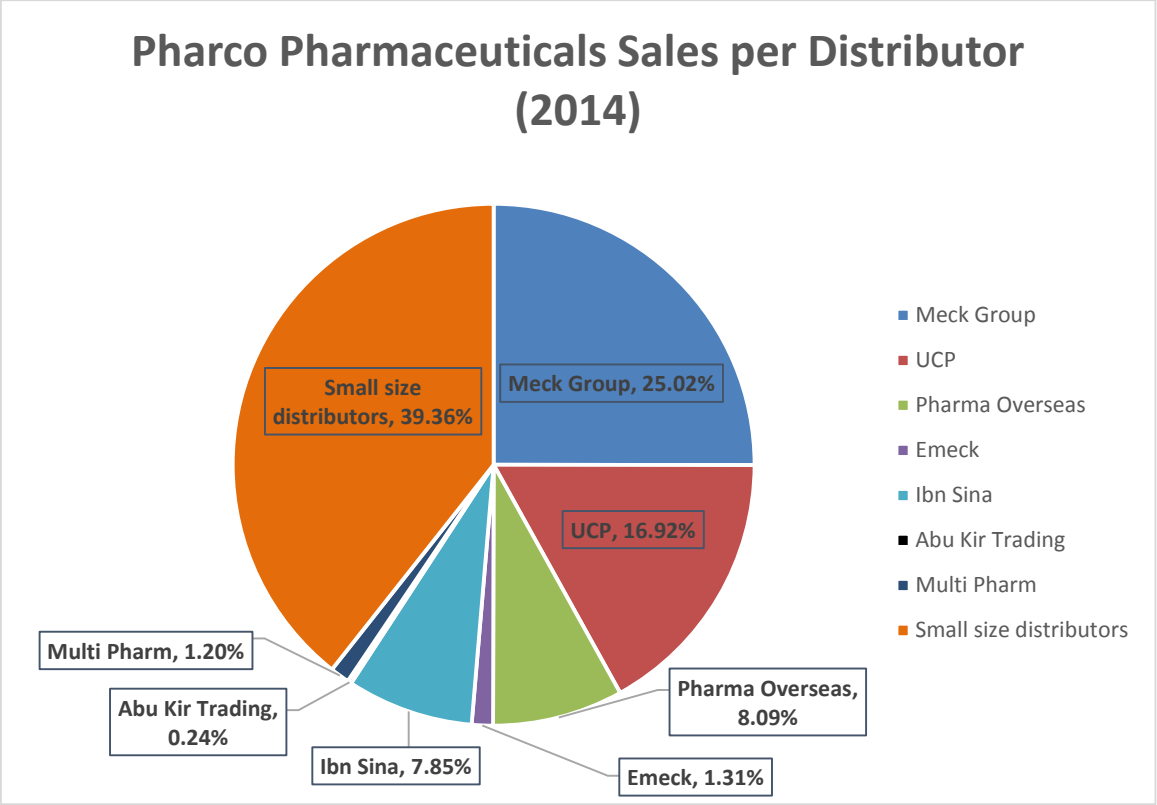

Figure 7 Pharco Pharmaceuticals: Sales per distributor (2014)

The share of Emeck and Multi Pharma in the total sales value did not exceed 1.5 percent during this year, while Abu Kir Trading's share was negligible (0.24%).

Regarding reverse logistics, Pharco depends on the same forward distribution channel partners for reverse functions—the 12 authorized distributors are responsible for collecting the expired, damaged, or recalled products from points of sales. However, neither points of sales nor small-sized distributors have the authority to return products directly to the company. In 2014, the total returned products value from all distributors was EGP 6,569,751, representing 0.94 percent of the total sales value.

4.3.2 Pharco Supply Chain Downstream Information Flow

Despite the distributors' important role in the forward and reverse product flows, the fragmentation of Pharco supply chain as well as the lack of visibility and transparency between the downstream partners make it difficult to share and transmit timely and precise information to effectively manage the reverse flow. Especially because, neither Pharco nor its downstream partners rely on advanced information systems.

In the forward flow, Pharco's access to its product information, after the products get transferred to distributors, is very limited as distributors control the carried inventory in the

chain pipeline. The last information recorded by Pharco regarding its products in the forward flow is the values and volumes of products transferred to each distributor in accordance with their sales orders. Therefore, it becomes very difficult for Pharco to track the amount of inventory carried by distributors on a real-time basis. Moreover, Pharco's control and visibility over the inventory becomes more difficult and complex after the products get distributed to thousands of pharmacies, hospitals, and clinics in Egypt. Consequently, Pharco remains uncertain about the amount of returns until the distributors send them back to the company.

4.4 Reverse Logistics Drivers in Pharco Supply Chain

The driving forces stimulating Pharco's implementation of reverse logistics are mainly legislative and regulatory-driven. However, other reasons for product returns from Pharco's downstream partners influence Pharco reverse logistics processes and activities.

4.4.1 The Receiving Party's Perspective: Pharco Pharmaceuticals

Reverse logistics drivers from Pharco's perspective are legislative in nature, as explained by the Returned Products Supervisor (personal communication, December 24, 2014). This is due to the legal responsibility imposed by MOH and EDA over the company. In this regard, Pharco follows MOH and EDA regulations regarding the collection and disposal of the returned pharmaceuticals. However, there are no standard rules or regulations governing the relationship between the company and its downstream partners, or a decree specifying boundaries for the acceptable percentage of returns.

Thus, Pharco specifies its acceptable percentage of returns and determines the preferable compensation method. The company accepts *partial returns with full credit* from its 12 authorized distributors—i.e., Pharco's distributors can return up to 2 percent of expired or damaged products from their purchase order value and will be compensated by the full wholesale price in the form of credits for future purchases. It is worth mentioning that this percentage is not final and there are exceptions, depending on the distributor's power in the distribution channel. Regarding the small-sized distributors, Pharco applies the "*no returns*" policy—i.e., these distributors are not allowed to return expired or damaged products.

The economic driver is not significant at Pharco because the high degree of product complexity limits the company's ability for extracting the active ingredients from the returned products in pharmaceuticals production, thereby making it difficult to capture direct

economic value. However, the Returned Products Supervisor (personal communication, December 24, 2014) explained two activities that are performed on an irregular basis. Those activities enable the company to capture economic benefits by decreasing the volume of the destructed returns and hence reduce the disposal costs.

The first activity is relabeling the valid returned products with less than one year of shelf-life as "free medical sample" and using them for marketing purposes. The reason behind the inability of redistributing those valid returns back to the market and capturing their full market value is that distributors are not willing to distribute products with less than one year of shelf-life.

The second activity is donating the returned products with valid expiry date but damaged packages to charitable organizations. The Returned Products Supervisor (personal communication, December 24, 2014) declared that when Pharco gets involved in such activities, the company is exempted from sales taxes over the amounts of donated and free medical samples. He also mentioned that such activities do not generate a significant financial reward for the company, for most products returned by the distributors are past their sell-by dates and only negligible amounts are within valid expiry dates.

4.4.2 The Returning Party's Perspective: Return Reasons

There are several reasons for pharmaceutical returns in Pharco—the most common being product expiration, followed by damaged packaging and product recalls. One of the uncommon reasons of product returns is the distributor's financial deficit.

According to the pharmaceuticals market standards, Pharco is responsible for accepting returns from the distributors if the product is expired or the remaining shelf-life is two months or less.

Pharco is also responsible for collecting products with damaged packaging during transportation or due to storage activity. Even though the product with damaged packaging remains valid and suitable for consumption, the company does not redistribute them in the market after being returned.

A less frequent reason for return—but when occurring, it is urgent and requires an immediate action—is product recall. When a production batch is defective due to quality issues, Pharco should recall it from POS through its distributors. In such cases, Pharco distributors are responsible for executing the recall and collection of the defective products from the chain pipeline based on Pharco and CAPA requests. The recall process is executed under CAPA's

supervision and it promptly notifies all distributors with the required information to execute the recall—for example, the defective product's batch number, its manufacturing date, and expiration date. Pharco's responsibility is to receive the recalled amount from the distributors and dispose of it in a proper way under CAPA's supervision.

Another uncommon reason for return is the distributor's financial deficit, as some distributors may face a deficit to pay for the purchased orders. In this regard, the distributor will return the purchased products to Pharco. Since the product's remaining shelf-life is longer than one year and the package is not damaged, the company can resell it again to other distributors.

4.5 Pharco Reverse Logistics Practices: Processes and Activities

The scope of reverse logistics activities at Pharco depends on the return reasons from downstream partners. Since most of the return reasons take place due to product expiration, the dominant reverse logistics activity at Pharco is disposal by incineration. However, other reverse logistics activities— such as donation to charitable organizations, free medical samples, and redistribution—are practiced but to a lesser extent. Figure 8 maps the process of product return—it is clearly illustrated that the return process is complex as multiple activities and different parties are involved.

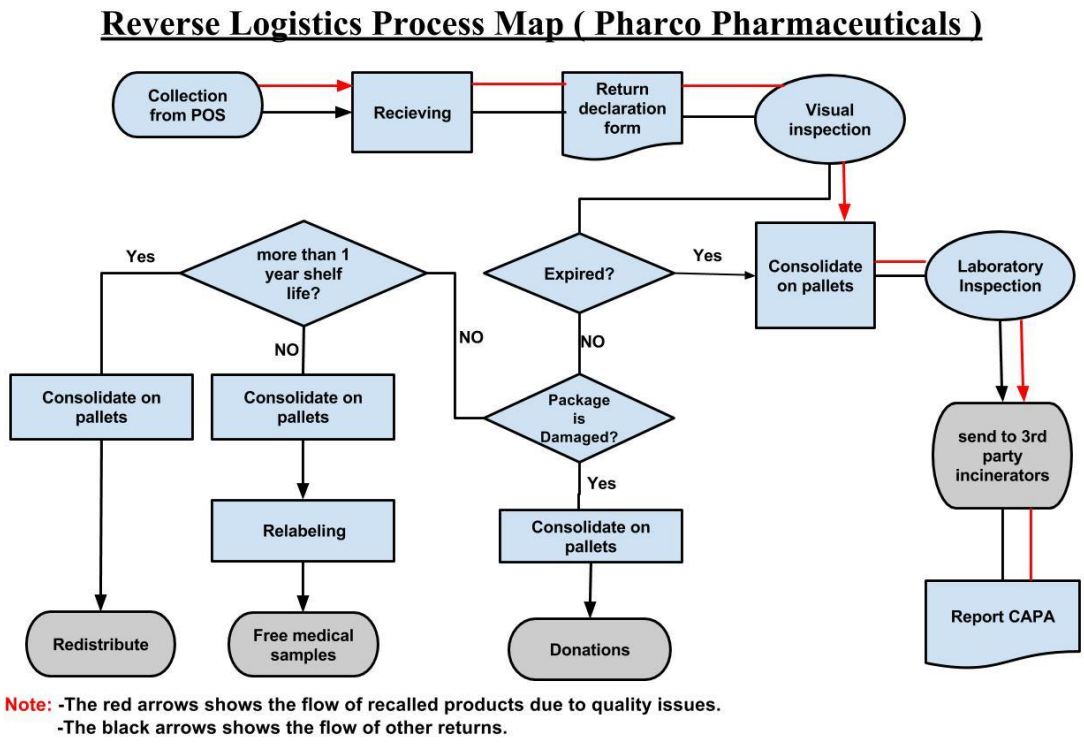

Figure 8 Reverse logistics process map of Pharco Pharmaceuticals

4.5.1 Collection, Receiving, and Inspection

The product return process starts with the **collection** activity, as illustrated in Figure 8. The responsible party for collecting returns or recalls from the chain pipeline and POS are Pharco's authorized distributors. Their main task is to collect the returned and recalled products from their central branch warehouses and to transport them back to the Pharco headquarters is in Alexandria.

Then, Pharco **receives** the returned or recalled products in the finished goods returns warehouse. After receiving, the distributors should manually **fill out a standard return declaration form** in which they should declare the returned product information by clarifying the returned product's name, returned quantities per product, expiry date, and the main reason for return. After the distributor fills out the declaration form, the company checks the received shipment in correspondence with the document by **visual inspection** to ensure that the returned products are same as declared in the form. After ensuring that the received products are as declared, the company will **check the expiration date** in order to determine whether the products are expired and will be disposed of by incineration, or whether they still have a shelf-life and can be donated to charitable organizations or relabeled as free medical samples or redistributed to other distributors for resale. However, the decision to dispose of recalled products by incineration is predetermined due to quality issues, regardless of their expiration dates.

4.5.2 Disposal by Incineration

If the received products are expired, the company does not have any other option than to destroy them by incineration. Accordingly, the company will consolidate those expired products on pallets along with any recalled products, and **the laboratory will randomly check the consolidated shipment** before sending them to third-party incinerator companies. The health and safety department is responsible for arranging the disposal activity with incinerator companies and also for **reporting the amount disposed of to CAPA**.

The disposal of expired and recalled products includes those products' internal and external packaging as well as the product leaflet. Hence, the packaged materials are not separated from those products before the final disposal, as the separation activity is rather time-consuming. Furthermore, according to the Returned Products Supervisor (personal communication, December 24, 2014), it is not economically feasible to separate and resell

the packaged materials because they constitute only a small fraction of the returned product value.

The Health and Safety Manager (personal communication, January 10, 2015) explained that the company disposes of around 17 tons of pharmaceutical waste every month. Expired products are the major source of pharmaceutical waste at Pharco, which account for around 70 percent of the total pharmaceutical wastes generated. As illustrated in Figure 9, Pharco disposes of all the recalled and expired returned products as well as other pharmaceutical wastes generated during production stages and product stability testing by incineration at three disposal sites in Egypt.

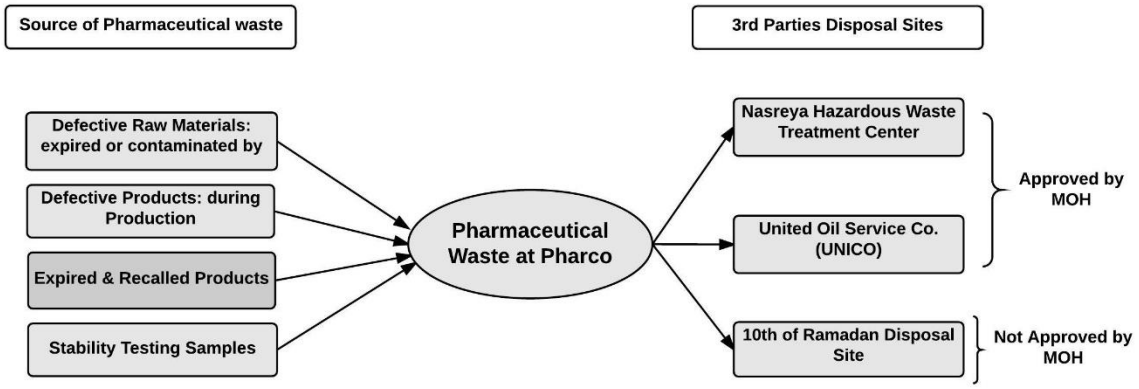

Figure 9 Disposal activity for pharmaceutical waste of Pharco Pharmaceuticals

Two of these sites, namely the Nasreya Hazardous Waste Treatment Center and the United Oil Services (UNICO), are approved by MOH for disposal of pharmaceutical waste. However, the 10th of Ramadan Disposal site is not approved by MOH. Pharco relies on the non-approved disposal site for the disposal of around 90 percent of the total pharmaceutical wastes generated, as the disposal cost is less than half of the cost of the approved sites (Health and Safety Supervisor, personal communication, January 10, 2015).

4.5.3 Donation to Charitable Organizations

If the received products are of valid expiry dates, the company will **check whether the product packages are damaged**. If damaged, the company will consolidate those products to be donated through charitable organizations in Egypt. Pharco organizes the donation activity in cooperation with the Faculty of Pharmacy Asyut University and the Rotary Club of Alexandria.

4.5.4 Free Medical Samples

If a product package is in its original form (i.e., not damaged), the company will check the remaining shelf-life of the product—**if less than one year is remaining**, the company will consolidate the products and re-label them as free medical samples to be used for marketing purposes. Such products are directed free of charge to private clinics to induce medical practitioners to prescribe Pharco products for their patients. The reason behind the inability to redistribute those valid returns back to the market and capture their full market value is that distributors refuse to distribute products with less than one year remaining in shelf-life, as explained before.

4.5.5 Redistribution

If a product package is not damaged and there is more than one year remaining in the returned product's shelf-life, the product will be **redistributed back to the market** through distributors and hence the company can capture the full market value from the returned product. However, this activity is rarely performed, as a distributor virtually never returns products with more than one year of shelf-lives (Returned Products Supervisor, personal communication, December 24, 2014).

4.6 Reverse Logistics Barriers at Pharco

The following section describes the identified barriers that hinder Pharco in applying their reverse logistics activities and processes and how such barriers are affecting the implementation of reverse logistics.

4.6.1 Lack of Strategic Planning Resulting in Contradicting Objectives

In Pharco, the sales department is responsible for sales planning and products return planning. The combination of both responsibilities in one department creates a conflict of interest due to the contradicting objectives of each responsibility. The sales department's objective is to achieve the monthly sales targets by selling more units to distributors and by having high product availability in the market. In contrast, the objective of reverse logistics is to accept returned products from distributors, capture economic value from such products, or proper disposal.

Practically, the sales department is interested in enhancing their sales activities as it increases the company's profitability. However, when it comes to returned products, less attention is

paid as such products are considered to be an extra cost that is better to avoid (Sales Manager, personal communication, December 24, 2014).

4.6.2 The Non-existence of Logistics Department in Pharco

Pharco does not have a logistics department responsible for coordinating its logistics activities, and each department works in isolation (Sales Manager, personal communication, December 24, 2014). Consequently, the company neither efficiently nor effectively plans reverse logistics activities, as the real cost of reverse logistics processes and activities is very difficult to estimate due to the lack of awareness regarding the importance of the total logistics cost, including the inbound and outbound transportation, warehousing, handling, storage, and the returned inventory-carrying cost.

4.6.3 Lack of Advanced Information System

The company does not rely on a database management system and the use of information technology is very limited between Pharco's functional departments. In addition, the sales department does not rely on barcode scanners for counting and sorting returned products.

Consequently, the sales department has to do a lot of paper work regarding products returns, while the manual counting and sorting of returned products are also time-consuming and subject to human error. Moreover, the return declaration form and all the related documents are filled out and transmitted manually by distributors after Pharco receives the returned shipment. This results in several process delays due to manual counting, sorting, and checking (Returned Products Supervisor, personal communication, December 24, 2014).

4.6.4 Insufficient Performance Metrics

Pharco develops no key performance indicators (KPIs) for measuring reverse logistics performance. The sales department prepares a monthly report showing the percentage of returned products' value from sales by distributors, which is used for internal reporting to the company's top management. However, there are neither performance metrics showing the returned quantities per product groups nor per product type (Sales Manager, personal communication, December 24, 2014).

4.6.5 Lack of Dedicated Workers and Facilities for Handling Returns

One of the identified barriers confronting Pharco in handling product returns is constituted by limited workers and a small dedicated warehouse for handling returns that prevents

Pharco from receiving simultaneous returns from its distributors. Thus, the company is scheduling returns from distributors at separate time intervals in order to avoid creating a buffer of unprocessed returns in the return warehouse.

According to the Returned Products Supervisor (Personal communication, December 24, 2014), some distributors return the expired pharmaceuticals on a quarterly basis rather than a monthly basis. The postponement of returns from one distributor affects the overall receiving plan. This is because when the returned amounts are larger than the usual amount, they requires more processing time and more human efforts due to the limited number of workers handling returns.

4.6.6 Financial Constraints

As explained by the Sales Manager (personal communication, December 24, 2014), Pharco is facing financial pressure due to three main reasons. First, the cost of reverse logistics activities represents a direct hit on Pharco's profitability since capturing economic benefits from expired products is infeasible. Second, the devaluation of the Egyptian currency relative to the raw materials supplier's currencies during previous years affects the purchasing price of raw materials. As a result, the currency devaluation puts more financial pressure over Pharco, as the company is highly dependent on international suppliers for sourcing the active pharmaceutical ingredients that constitute the greatest portion from the final product total cost. In addition, the retail price of pharmaceuticals is fixed by the Egyptian government, and the application for modifying the existing retail price is a lengthy and complex process.

4.6.7 Management Did Not Consider Reverse Logistics as a Priority

Reverse logistics at Pharco lacks importance relative to other issues such as production and sales. Pharco's top management perceives reverse logistics as the "cost of doing business." Therefore, they do not take serious actions in order to improve their reverse logistics capabilities and are reactive rather than proactive in solving problems related to product returns (Returned Products Supervisor, personal communication, December 24, 2014).

However, the Sales Manager (personal communication, December 24, 2014) indicated that Pharco's top management is willing to consider any project that would decrease costs, increase revenues, or boost sales.

4.6.8 Restrictive Return Policy

Although the monthly generated sales by an individual, small-sized distributor was not significant in 2014, the aggregate sales value per month of all small-sized distributors was extremely high compared with any of the other distributors, as shown in Figure 10 below.

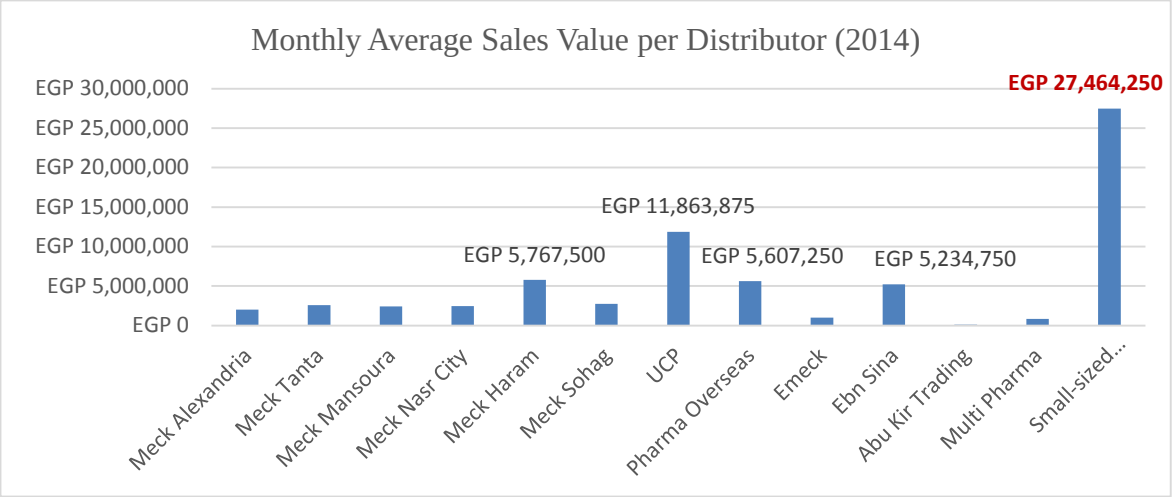

Figure 10 Monthly average sales value per distributor (2014)

However, Pharco did not accept returns from small-sized distributors in order to minimize the returned products quantities. This is clearly evident from Figure 11 that shows the monthly average product returns as a percentage of the sales value per distributor in 2014. Apart from "Abu Kir Trading", which is acquired by Pharco, the average returns from the rest of distributors was around 2 percent of their total monthly sales. Therefore, Pharco's return policy is restrictive in order to limit product returns from all distributors in general and from small-sized distributors in particular.

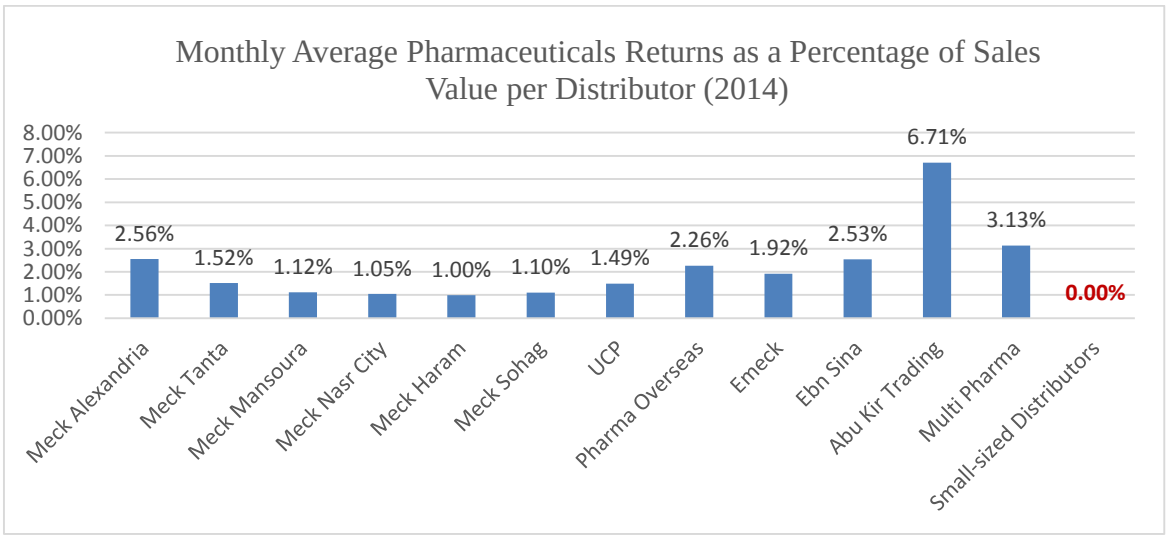

Figure 11 Monthly average pharmaceuticals returns as a percentage of sales value per distributor (2014)

Although Pharco did not explicitly specify in formal agreements with distributors the terms and conditions for returns, the Returned Products Supervisor (personal communication, December 24, 2014) declared that it is very important for the top management that product returns do not exceed 2 percent of the company's monthly sales.

4.6.9 Lack of Workers' Support and Personnel Training

In the sales department the majority of workers resist changes by discouraging their direct manager from modifying their tasks or work standard procedures, as mentioned by the Sales Manager (personal communication, December 24, 2014), and they would like to perform the same task "as it is." Therefore, when the management proposes a modification in the process of handling returns, most of them consider the proposed change as overload and do not support the change. In addition, there is a lack of skilled and trained workers employed in handling returns, as most of training opportunities are dedicated to personnel working in the production and marketing of pharmaceuticals.

4.6.10 Lack of Information Sharing across the Supply Chain

Pharco is relying on a basic information system that is not capable of integrating the company's internal functional departments or being integrated with the downstream partners for transmitting or sharing information. Similarly, most of its distributors and large chain pharmacies are relying on their own internal information systems which are utilized only for coordinating and planning their sales activities between their own branches (Sales Manager, personal communication, December 24, 2014). Therefore, it is very difficult to share POS data across the supply chain as neither Pharco nor its downstream partners depend on adequate information systems suitable for transmitting the actual sales data or the current valid and expired inventory in the chain pipeline. Consequently, this lack of visibility limits Pharco's ability to estimate returns or to pre-plan for handling returns.

4.6.11 Lack of Regulation Enforcement

Although the pharmaceutical industry is regulated by MOH and EDA, it is plagued by poor enforcement of regulations (Sales Manager, personal communication, December 24, 2014). According to EDA regulations, it is illegal for pharmacies to purchase pharmaceutical products without a valid invoice, while the production batch number, the expiry date, and the distributor's name are shown clearly on the sales invoice. However, in reality, a number of pharmacies accept shipments without a valid invoice from unauthorized distributors in

order to get higher volume discounts than the normal discounts provided by the authorized distributors. Consequently, they face difficulties in returning expired pharmaceuticals, as expired returns without a valid sales invoice are not accepted by most authorized distributors (Sales Manager, personal communication, December 24, 2014).

Moreover, the EDA's role is only supervisory and limited to periodic inspection of the manufacturer's disposal activities, and there is no concrete regulations enforcing Pharco to accept a predefined amount of the expired and damaged products from distributors. In this regard, there is always a debate between Pharco and its distributors over the permissible percentage of expired and damaged returns. At the same time, this debate escalates between distributors and pharmacies, resulting in distributors' reluctance to accept returns from pharmacies (Sales Manager, personal communication, December 24, 2014).

Also, the disposal supervision by CAPA is poor, as the Health and Safety Manager (personal communication, January 10, 2015) declared that the company disposes of on average 17 tons of pharmaceutical waste on a monthly basis. As many as 15 tons of such wastes (around 90 percent) are disposed of in a non-approved disposal site by MOH in order to cut down the disposal cost.

4.6.12 Lack of Economic Support from Government

The Egyptian government represented in MOH did not provide any economic support to Pharco for handling the returned pharmaceuticals in a better manner. Also, Pharco bears the full responsibility as well as the associated costs of the disposal activity for the expired returns (Returned Products Supervisor, personal communication, December 24, 2014). Therefore, Pharco is unwilling to accept large quantities of expired pharmaceuticals from distributors, as the disposal activity is considered as an extra cost affecting the company's profitability and especially because the company does not capture any economic benefits from the expired returns.

4.6.13 Lack of Public Awareness Regarding the Importance of Reverse Logistics

The Returned Products Supervisor (personal communication, December 24, 2014) mentioned that patients in Egypt, who can be termed as Pharco's end consumers, are not fully aware of the importance of reverse logistics in protecting the public health and the environment, as their main driver in buying medicines is mainly the price.

In this respect, Pharco is not considering reverse logistics as a source to create a good corporate image. The main objective of Pharco is to provide a pharmaceutical product with an affordable price in the Egyptian market, and this is the main source of its strength in the Egyptian pharmaceutical industry.

4.6.14 Differences in Supply Chain Partners' Objectives

One of the barriers faced by Pharco is the different goals and objectives of its supply chain partners in reverse logistics, as explained by the Returned Products Supervisor (personal communication, December 24, 2014). Pharco as a producer tries to reduce the amount of returned products and the credits to its distributors over the returned products. Also, the top management will not be satisfied if they figure out that a high percentage from sales is being returned to the company. Accordingly, Pharco has adjusted its return policy to act as an incentive to boost sales volumes through distributors by linking the amount of permissible returned products to the distributors' purchase order value. Consequently, the distributors order unnecessary high volumes from Pharco in order to get volume discounts and to return the most possible amount of expired products based on their purchase order value, without taking into account the actual demand from pharmacies.

Most problems occur when distributors distribute the products to pharmacies. The distributors' objective is to sell large quantities of products to pharmacies and hence they link the credit duration to the quantities purchased—i.e., if the total purchased amount during a month is greater in value than EGP 5000, the credit duration will be 75 days and cash discount 2.75 percent. Consequently, pharmacies are motivated to order larger than needed amounts, while the distributors' return policies are restrictive in order to minimize returns from pharmacies.

Pharmacies aim to minimize their purchase order quantities because they already have unnecessary stock from their acceptance of the distributors' volume discounts offered during previous periods, which will expire in a short time. In spite of this, the only legal solution to return the expired products is by purchasing large volumes of products from the distributors, which simply exaggerates the problem. Such contradicting objectives put pressure on pharmacies to deal with unauthorized intermediaries in order to return their expired products with a deduction from the initial wholesale price. Those unauthorized intermediaries open the gate for counterfeited products in the market, as they modify the expiry date printed on the expired products and redistribute them back to pharmacies as valid.

4.6.15 Opportunistic Behavior

Some of the distributors are trying to take advantage of Pharco due to the lack of formal return agreements. They are striving to return large amounts of expired products while getting more compensation credits than they should receive, as they have purchased those products based on a volume discount price. Pharco is counteracting such opportunistic behavior by restricting its return policy to safeguard its profits. According to the Returned Products Supervisor (personal communication, December 24, 2014), the traditional standard in the Egyptian pharmaceutical industry for returning expired products is no more than two months prior to the expiration date. However, Pharco is tightening its return policy with all distributors by accepting only products which either will expire at the current month or have already expired.

Furthermore, the supervisor of returned products mentioned that the difference in power between distributors and small-size pharmacies allows the former to behave opportunistically toward pharmacies by being reluctant to accept expired or damaged products.

4.6.16 Long Processing Cycle Time of Returned Products

Another barrier facing Pharco is the long processing cycle time of returned products—i.e., from receiving returns until final disposal or recovery activity—as the manual preparation of return documents as well as the manual counting, sorting, and inspection of returns require a substantial amount of time and human resources. Moreover, returns might remain unprocessed in Pharco's warehouse for several working days or weeks, in case of conflicts between Pharco and its distributors over the returned quantities, and as a result, the overall receiving plan of returns might be interrupted or delayed (Returned Products Supervisor, personal communication, December 24, 2014).

4.6.17 Unknown Total Cost of Return Process

According to the Sales Manager (personal communication, December 24, 2014), the total cost of returns at Pharco is composed of the following:

- → Value of returned products.
- → Transportation cost from POS to warehouses at distributor's branches.
- → Transportation cost from distributor's branches to distributor's central warehouse.

- → Transportation cost from distributor's central warehouse to Pharco finished goods returns warehouse.
- → Returned inventory-carrying cost (warehousing, utilities, and salaries).
- → Transportation cost from Pharco finished goods returns warehouse to disposal sites.
- → Incineration cost.

As Pharco's responsibility is limited to certain activities in the return process, the company's knowledge about the cost of returns is limited to the value of returned products, transportation cost from their warehouse to the disposal sites, and the incineration cost. However, the cost documentations are only prepared for accounting issues and they are not utilized for the purpose of process improvement or cost reduction (Sales Manager, personal communication, December 24, 2014).

5. ANALYSIS AND DISCUSSION

In the previous chapter "empirical case description", numerous barriers facing Pharco in implementing reverse logistics were listed and discussed individually. In this chapter, these barriers will be analyzed by using the ISM methodology, in order to visualize the interrelationships and different levels of the identified barriers. In addition, a categorization of those barriers based on their driving and dependence power with respect to each other will be provided. In this regard, the main objectives of the analysis is to first identify and rank the barriers of reverse logistics in Pharco Pharmaceuticals, second, to determine the interaction between the identified barriers and to discuss the managerial implication based on the analysis results.

5.1 Interpretive Structural Modeling Analysis

The ISM analysis in the following sections follows the ISM methodology steps, as described in the third section of the methodology chapter.

5.1.1 Identification of Barriers Affecting Pharco's Reverse Logistics

A preliminary list of 17 barriers that hinder Pharco's implementation of reverse logistics practices have been generated by a literature review and semi-structured interviews with Pharco management. These are summarized in Table 4 below.

Table 4 Identified barriers of reverse logistics at Pharco Pharmaceuticals

Barriers facing Pharco in implementing reverse logistics
1. Lack of strategic planning resulting in contradicting objectives.
2. The non-existence of a logistics department at Pharco.
3. Lack of advanced information system.
4. Insufficient performance metrics.
5. Lack of dedicated workers and facilities for handling returns.
6. Financial constraints.
7. Management did not consider reverse logistics as a priority.
8. Restrictive return policy.
9. Lack of workers' support and personnel training.
10. Lack of information sharing across the supply chain.
11. Lack of regulation enforcement.
12. Lack of economic support from the government.
13. Lack of public awareness regarding the importance of reverse logistics.
14. Difference in the supply chain partners' objectives.
15. Opportunistic behavior.
16. Long processing cycle time of returned products.
17. Unknown total cost of return process.

5.1.2 Structural Self-interaction Matrix

To develop the Structural Self Interaction Matrix (SSIM) with contextual relationships of types "leads to" across the barriers, a set of closed-ended questions were answered by the company managers. The following four symbols are applied to denote the direction of the relationship between the factors (*i* and *j*):

- **V:** barrier *i* will lead to barrier *j*;
- **A:** barrier *j* will lead to barrier *i*;
- **X:** barriers *i* and *j* will lead to each other; and
- **O:** barriers *i* and *j* are unrelated.

Table 5 illustrates the SSIM matrix, with the contextual relationship between the 17 barriers.

Table 5 Structural self-interaction matrix (SSIM)

Barriers	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1. Lack of strategic planning resulting in contradicting objectives.	O	O	O	O	A	A	A	O	V	V	A	A	V	V	O	V
2. The non-existence of a logistics department in Pharco.	V	O	O	O	O	O	O	O	V	O	V	A	V	V	O	
3. Lack of advanced information system.	V	V	O	O	O	O	O	V	O	O	A	A	V	V		
4. Insufficient performance metrics.	A	V	O	O	O	A	O	A	V	O	A	O	O			
5. Lack of dedicated workers and facilities for handling returns.	O	V	O	O	O	O	A	O	O	A	A	A				
6. Financial constraints.	O	O	V	O	O	A	O	V	V	V	V					
7. Management did not consider reverse logistics as a priority.	O	O	V	O	A	A	A	V	V	V						
8. Restrictive return policy.	O	V	X	A	A	A	A	O	O							
9. Lack of workers' support and personnel training.	O	V	O	O	O	A	A	O								
10. Lack of information sharing across the supply chain.	V	V	X	A	O	O	O									
11. Lack of regulation enforcement.	O	O	V	V	A	O										
12. Lack of economic support from the government.	O	O	V	V	A											
13. Lack of public awareness regarding the importance of reverse logistics.	O	O	V	O												
14. Difference in the supply chain partners objectives.	O	V	V													
15. Opportunistic behavior.	O	V														
16. Long processing cycle time of returned products.	O															
17. Unknown total cost of return process.																

The use of the symbols V, A, X, and O in the SSIM are exemplified below:

→ Barrier 14 *leads to* Barrier 15. This means that the differences in Pharco's supply chain partners' objectives lead to opportunistic behavior. Thus, the relationship between Barriers 14 and 15 is denoted by **'V'** in the SSIM.

→ Barrier 13 *leads to* Barrier 12. This means that the lack of public awareness regarding the importance of reverse logistics (Barrier 13) leads to lack of economic support from the government (Barrier 12), but the opposite relationship—i.e., Barrier 12 leads to Barrier 13—is not assumed. Thus, the relationship between the two barriers is denoted by **'A'**.

→ Barrier 8, "restrictive return policy," and Barrier 15, "opportunistic behavior," *lead to* each other. Thus, the restrictive return policy adopted by Pharco leads to opportunistic behavior in the chain and the opportunistic behavior of the chain partners' influences Pharco's adoption of a restrictive return policy. Thus, the relationship between Barriers 8 and 15 is denoted by **'X'**.

→ No direct relationship exists between the lack of information sharing across the supply chain (Barrier 10) and the lack of regulation enforcement (Barrier 11). Therefore, the relationship between the two barriers is denoted by **'O'**.

5.1.3 Reachability Matrix

In this step, the SSIM is converted into a binary matrix (called the initial reachability matrix) by substituting V, A, X, and O by 1 or 0. The rules of substitution of 1s and 0s are as follows:

→ If the *(i, j)* entry in the SSIM is **V**, then the *(i, j)* entry in the reachability matrix becomes 1 and the *(j, i)* entry becomes 0.

→ If the *(i, j)* entry in the SSIM is **A**, then the *(i, j)* entry in the reachability matrix becomes 0 and the *(j, i)* entry becomes 1.

→ If the *(i, j)* entry in the SSIM is **X**, then the *(i, j)* entry in the reachability matrix becomes 1 and the *(j, i)* entry becomes 1.

→ If the *(i, j)* entry in the SSIM is **O**, then the *(i, j)* entry in the reachability matrix becomes 0 and the *(j, i)* entry becomes 0.

According to these rules, the initial reachability matrix for the barriers is shown in Table 6.

Table 6 Initial reachability matrix

Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	1	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0
2	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	0	1
3	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1
4	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
6	1	1	1	0	1	1	1	1	1	1	0	0	0	0	1	0	0
7	1	0	1	1	1	0	1	1	1	1	0	0	0	0	1	0	0
8	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0
9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
10	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	1
11	1	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	0
12	1	0	0	1	0	1	1	1	1	0	0	1	0	1	1	0	0
13	1	0	0	0	0	0	1	1	0	0	1	1	1	0	1	0	0
14	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	0
15	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1

The final reachability matrix in Table 7 is obtained by adding transitivity[1], as explained in step four of the ISM methodology. The driving power and dependence of each barrier are also shown.

Table 7 Final reachability matrix

Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Driving Power
1	1	1	**1^t**	1	1	0	**1^t**	1	1	**1^t**	0	0	0	0	**1^t**	**1^t**	**1^t**	**12**
2	**1^t**	1	**1^t**	1	1	0	1	**1^t**	1	**1^t**	0	0	0	0	**1^t**	**1^t**	1	**12**
3	0	0	1	1	1	0	0	**1^t**	**1^t**	1	0	0	0	0	**1^t**	1	1	**9**
4	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	**3**
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	**2**
6	1	1	1	**1^t**	1	1	1	1	1	1	0	0	0	0	1	**1^t**	**1^t**	**13**
7	1	**1^t**	1	1	1	0	1	1	1	1	0	0	0	0	1	**1^t**	**1^t**	**12**
8	0	0	0	**1^t**	1	0	0	1	**1^t**	**1^t**	0	0	0	0	1	1	**1^t**	**8**
9	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	**2**
10	0	0	0	1	**1^t**	0	0	**1^t**	**1^t**	1	0	0	0	0	1	1	1	**8**
11	1	**1^t**	**1^t**	**1^t**	1	**1^t**	1	1	1	**1^t**	1	**1^t**	1	1	1	**1^t**	**1^t**	**17**
12	1	**1^t**	**1^t**	1	**1^t**	1	1	1	1	**1^t**	0	1	0	1	1	**1^t**	**1^t**	**15**
13	1	**1^t**	**1^t**	**1^t**	**1^t**	**1^t**	1	1	**1^t**	**1^t**	1	1	1	**1^t**	1	**1^t**	**1^t**	**17**
14	0	0	0	**1^t**	**1^t**	0	0	1	**1^t**	1	0	0	0	1	1	1	**1^t**	**9**
15	0	0	0	**1^t**	**1^t**	0	0	1	**1^t**	1	0	0	0	0	1	1	**1^t**	**8**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
17	0	0	0	1	0	0	0	0	**1^t**	0	0	0	0	0	0	**1^t**	1	**4**
Dependence Power	**7**	**7**	**8**	**14**	**13**	**4**	**7**	**12**	**15**	**12**	**2**	**3**	**2**	**4**	**12**	**17**	**13**	**152/152**

The *Driving power* of a particular barrier is the total number of barriers, including itself, which it influences. The *dependence* of a particular barrier is the total number of barriers, including itself, which may influence it.

Those driving power and dependencies shown in Table 7 will be used later to classify barriers into four groups of autonomous, dependent, linkage and independent (driver) barriers in the Driver-Dependence diagram.

5.1.4 Level Partitions

Based on the final reachability matrix, the reachability set and the antecedent set for each barrier is found. The *reachability set* for a barrier comprises the barrier itself and the other barriers influenced by it. The *antecedent set* consists of the barrier itself and other barriers that may influence it. The intersection between the reachability and antecedent sets for all barriers determines the *intersection set*.

The barrier for which the reachability and intersection sets overlap is assigned as a top-level barrier in the ISM hierarchy or Level 1, as shown in Table 8.

[1] (1^t) means value after applying transitivity.
Transtivity was calculated by using the web-based program
http://www.cs.nmsu.edu/~ipivkina/TransClosure/ .

Table 8 Iterations summary result 1–10

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	Level 7
2	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	Level 7
3	3,4,5,8,9,10,15,16,17	1,2,3,6,7,11,12,13	3	Level 6
4	4,9,16	1,2,3,4,6,7,8,10,11,12,13,14,15,17	4	Level 3
5	5,16	1,2,3,5,6,7,8,10,11,12,13,14,15	5	Level 2
6	1,2,3,4,5,6,7,8,9,10,15,16,17	6,11,12,13	6	Level 8
7	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	Level 7
8	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5
9	9,16	1,2,3,4,6,7,8,9,10,11,12,13,14,15,17	9	Level 2
10	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	11,13	11,13	Level 10
12	1,2,3,4,5,6,7,8,9,10,12,14,15,16,17	11,12,13	12	Level 9
13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	11,13	11,13	level 10
14	4,5,8,9,10,14,15,16,17	11,12,13,14	14	Level 6
15	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5
16	16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	16	Level 1
17	4,9,16,17	1,2,3,6,7,8,10,11,12,13,14,15,17	17	Level 4

Level 1 is then, discarded from the other remaining barriers and the iterative procedure is continued until further levels are identified. For complete iterations, see Appendix (B1). The 10 identified levels in Table 8 helps to build the ISM model.

The conical matrix in Table 9 is built on the basis of the partitioned reachability matrix by rearranging the factors in accordance with their levels, which means that factors having the same levels are clustered together.

Table 9 Conical Matrix

Clustered levels	Barriers	16	5	9	4	17	8	10	15	3	14	1	2	7	6	12	11	13
Level 1	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Level 2	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Level 3	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Level 4	17	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Level 5	8	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	10	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	15	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Level 6	3	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	14	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0
Level 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
	2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
	7	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0
Level 8	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Level 9	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Level 10	11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

5.1.5 ISM-based Model

The conical matrix helps to generate the structural model from the initial direct relation graph (digraph, Appendix B2). Hence, after removing the transitive links, as described in the ISM methodology, the diagraph is finally converted into the ISM model by replacing nodes with statements, as shown in Figure 12 below.

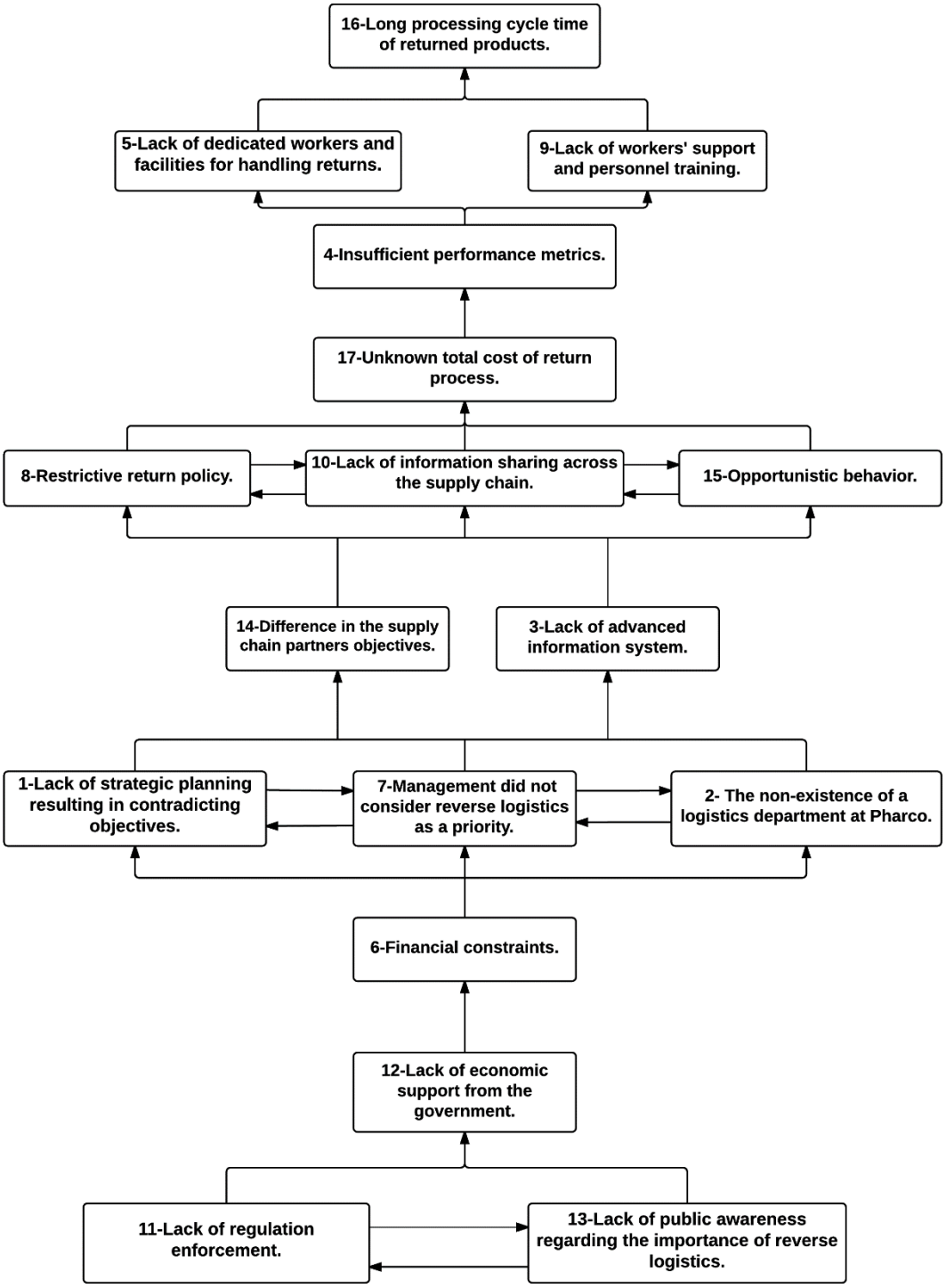

Figure 12 ISM-based model for barriers of reverse logistics at Pharco Pharmaceuticals.

The ISM-based model indicates that Barrier 16 – on **level 1** – *long processing cycle time of returned products* has the lowest driving power, and it is strongly dependent on the rest of barriers.

The rest of the barriers are clustered into different levels as follows:

Level 2 consists of two barriers: Lack of dedicated workers and facilities for handling returns (Barrier 5); and Lack of workers' support and personnel training (Barrier 9).

Level 3 consists of one barrier: Insufficient performance metrics (barrier 4).

Level 4 consists of the barrier 17: Unknown total cost of return process.

Level 5 consists of three barriers: Restrictive return policy (Barrier 8); Lack of information sharing across Pharco's supply chain (Barrier 10); and Opportunistic behavior (Barrier 15). In addition, these three barriers interact with each other.

Level 6 consists of two barriers: Lack of advanced information system (Barrier 3); and Differences in the supply chain partners' objectives (Barrier 14).

Level 7 Three barriers interacting with each other are found in this level—the lack of strategic planning resulting in contradicting objective (Barrier 1); the non-existence of a logistics department in Pharco's organizational structure (Barrier 2); and the fact that Pharco's management does not consider reverse logistics as a priority (Barrier 7).

Level 8 consists of barrier 6: The financial constraint.

Level 9 consists of barrier 12: The lack of economic support from the government.

The lack of regulation enforcement from the government (Barrier 11) and the lack of public awareness regarding the importance of reverse logistics (Barrier 13) are very significant barriers hindering the application of reverse logistics at Pharco. These two barriers form the bottom **Level 10** of the model, as they have the highest driving power and the lowest dependence on the rest of the barriers.

5.1.6 Classification of Barriers: MICMAC Analysis

The purpose of the cross-impact matrix multiplication applied to classification, which is known as (MICMAC)[2], is to analyze the drive power and dependence power of barriers. The analysis principle is based on the multiplication properties of matrices.

[2]MICMAC software access http://en.laprospective.fr/methods-of-prospective/softwares/59-micmac.html.

Based on the driving power and dependence power, the barriers have been classified into four categories (Attri et al., 2013, p. 7).

- **Autonomous Barriers:** These barriers have weak driving power as well as week dependence.
- **Linkage Barriers:** These barriers have strong driving power as well as strong dependence. They are considered as unstable because any action on these barriers will affect other barriers and result in a feedback effect on themselves.
- **Dependent Barriers:** These barriers have weak driving power but strong dependence.
- **Driver Barriers:** These barriers have strong driving power but weak dependence.

The drive-dependence diagram presented in Figure 13 gives a clear picture of the relative importance as well as the interdependencies among the different barriers. The vertical axis reflects the driving power of factors; the horizontal axis reflects their dependence power.

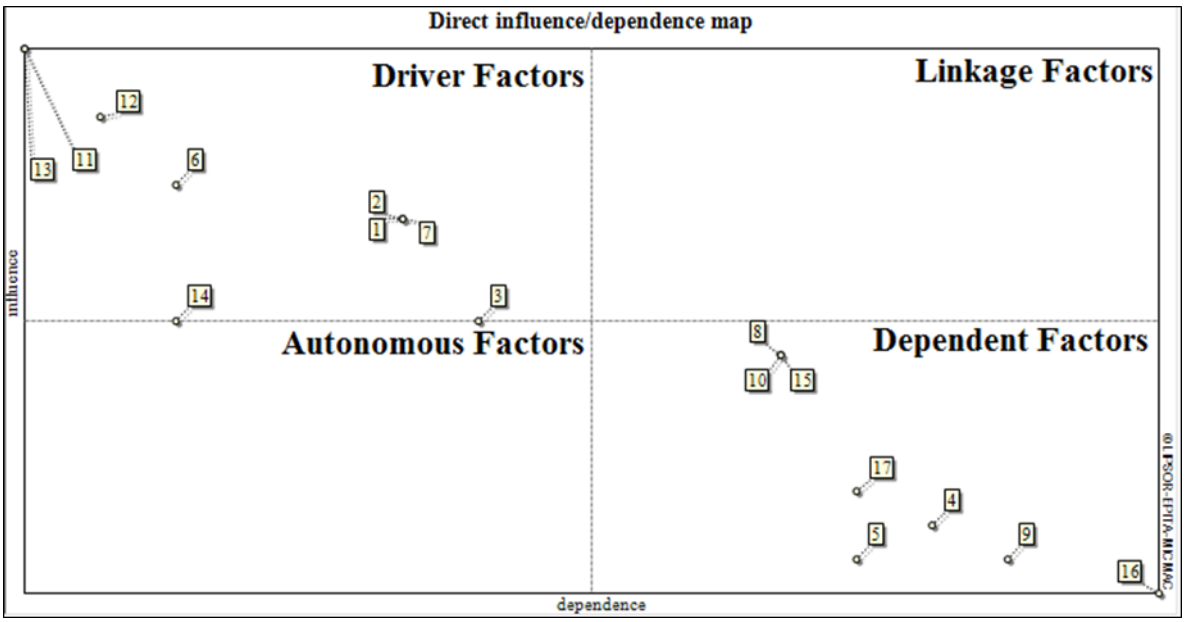

Figure 13 Drive-dependence diagram

In the MICMAC analysis Figure 13, neither autonomous nor linkage barriers are found. The non-existence of autonomous barriers implies that all the identified barriers affect the reverse logistics application in Pharco and that all of them are relevant. In addition, the absence of linkage factors under the linkage group implies that no barriers are considered unstable and all of them are either driving or dependent barriers. The dependent barriers have week driving power, but they are highly dependent on the driving barriers. According to the

analysis, eight barriers are dependent and represent the undesirable outcome of the nine driving barriers.

5.2 Discussion

The final results of the ISM can be seen in Figure 12, which depicts the series of influences between the barriers affecting the application of reverse logistics at Pharco. The MICMAC analysis presented in Figure 13 offers directions for dealing with such barriers.

The ISM model should be interpreted as a tool to understand and visualize the interrelation between the barriers (Lendaris, 1980, pp. 809–812; Malone, 1975, pp. 397–404). It should not be interpreted as a flowchart and it should not be taken for granted that once the barrier at the base of the model is addressed, Pharco can shift to the next barrier in the model.

Also, the ISM model provides no information about the size of the barriers or how easy is it to alleviate them. In-depth internal organizational knowledge is necessary to correctly interpret and follow up the results from the ISM analysis. In addition, the ISM model results must be interpreted on the basis of the explanations of the barriers, as provided in the research literature, and also in accordance with the case descriptions.

5.2.1 Driving Barriers

The lower side of the ISM model consists of driving barriers which have very strong driving power and significant influence over the other barriers. These barriers are located in the driver factors' quadrant in the drive-dependence diagram.

Based on the performed analysis, the lack of regulation enforcement and the lack of public awareness regarding the importance of reverse logistics are the most significant barriers hindering reverse logistics application at Pharco. Also, the ISM model shows that the lack of regulation enforcement and the lack of public awareness regarding the importance of reverse logistics are interrelated, which is similar to the research findings of Donald F. Blumberg (1999, p. 147) and Ismail et al. (2010, p. 51). Their findings indicate that the creation of public awareness is derived from the imposed legislation. In addition, Grabara, Man, and Kolcun (2014, p. 13) state that consumer awareness as well as the imposed legislation are key factors for a successful implementation of reverse logistics, and that the consumer awareness creates legislation which, in turn, leads to a change in consumer behavior.

Therefore, the absence of regulation enforcement negatively affects the application of reverse logistics at Pharco since the company's main driver in adopting reverse logistics is the imposed regulations by MOH, as explained earlier. On the other hand, it becomes difficult for Pharco to make use of reverse logistics in creating a green image if their final consumers lack awareness regarding the importance of reverse logistics in protecting their health as well as the environment.

The absence of economic support from the government is one of the powerful barriers hindering Pharco's implementation of reverse logistics practices, as shown in the power-dependence diagram. The economic support provided by the Egyptian government is essential for Pharco in order to alleviate the financial pressure resulting from the cost associated with reverse logistics activities. This is especially required when the company cannot capture direct economic value by recycling the expired products that represent a significant amount of returns. The financial constraint has a significant influence on the application of reverse logistics and derives Pharco's managers' inattention to the importance of reverse logistics relative to other issues such as sales, marketing, and production activities.

Also, the lack of strategic planning in reverse logistics practices is derived from the financial constraint and is also influenced by the non-existence of a logistics department at Pharco. This is because the combination of sales and returns activities in the sales department creates a conflict of interest due to the contradicting objectives of each responsibility. Consequently, Pharco's management gives less priority to returned products and reverse logistics activities compared with sales activities. Therefore, the existence of a logistics department for coordinating the multiple reverse logistics activities between the various responsible departments is important for a better application of reverse logistics.

The presence of the previously-mentioned barriers also result in Pharco's reliance on an outdated information system for handling returns. This is because the developed information system to support reverse logistics requires huge funds (Ravi & Shankar, 2005, p. 1016).

On the fifth level of the ISM model, where the lack of advanced information system is located, the differences in supply chain partners' objectives are located. The presence of the differences in supply chain partners' objectives as a barrier in this position in the ISM model implies that the internal strategic planning and the company's own objectives in handling returns influence the objectives of other chain partners. Thus, Pharco's setting up of a good internal strategic plan and clear objectives for handling returns might help to align the chain partners' objectives.

The discussed driving barriers are considered key barriers as they have very strong driving power and significant influence over the other barriers. In this regard, Pharco's management should devote considerable efforts to address such barriers first, as they heavily affect the company's success in implementing reverse logistics.

5.2.2 Dependent Barriers

The upper side of the ISM model consists of barriers which are strongly dependent on the discussed driving barriers. These barriers are located in the dependent factors' quadrant in the drive-dependence diagram.

The appearance of the *long processing cycle time of returned products* on the top of the ISM model implies that this barrier is derived from the rest of the model barriers. Despite the fact that the lack of dedicated workers and facilities for handling return and also the lack of workers' support and personnel training is a dependent barrier, they have an influence on the processing time of returned products.

Since Pharco's knowledge about the total cost of return process is limited, the unknown total cost of return process is one of the dependent barriers which limits the company from measuring their reverse logistics performance by establishing performance metrics. Therefore, information sharing between Pharco and its downstream partners is essential in order to acquire knowledge about the total cost of return process, and develop performance metrics and cost-related KPIs. This is similar to the research findings of Hazen, Overstreet, Hall, Huscroft, and Hanna (2015, p. 7), as they suggest that setting up of clear, specific goals for reverse logistics, combined with information system capabilities (i.e., the ability to receive information within and between organizations) are antecedents to establishing reverse logistics performance metrics.

Opportunistic behavior and restrictive return policy fall in the same sixth level with lack of information sharing in the ISM model. In addition, these three barriers have the same dependence and driving power on the drive-dependence diagram, and they influence each other. Therefore, addressing the three barriers together will be beneficial for Pharco. The lack of information sharing between Pharco's partners results in asymmetric information. Togar M Simatupang and Sridharan (2001, p. 4) explain that asymmetric information results from a situation where different supply chain partners have different information regarding resources, cost data, chain operations, performance status, and market condition. Therefore,

information asymmetry results in a situation where one partner has private information that other partners in the chain do not possess to make a good decision.

As explained by Togar M. Simatupang and Sridharan (2002, p. 17), supply chain members do not prefer to share private information with each other due to the economic value of that information. Consequently, the supply chain suffers from opportunistic behavior as the existence of asymmetric information allows supply chain partners to hide their private information and increase their willingness to reduce the effort levels by offering incomplete or distorted information. Such behavior was defined by Oliver E. Williamson (1985, p. 47) as opportunism—"self-interest seeking with guile", which includes apparent behaviors such as lying, cheating, and stealing. It also refers to the offering of incomplete and distorted information for the purpose to mislead, confuse, or blind for one's own benefit.

The above clarification for the relationship between information sharing and opportunistic behavior helps to understand the interaction between those two barriers in the ISM model. Therefore, Pharco's supply chain is vulnerable to opportunism in a situation where each of the supply chain partners tries to maximize individual benefits and avoid reverse logistics costs. This is clearly illustrated in the ISM model as the differences in supply chain partners' objectives leads to the lack of information sharing between partners, thereby paving the way for opportunistic behavior. As a result, Pharco is adopting a restrictive return policy, known as "zero returns," for small distributors in order to safeguard itself from such opportunistic behavior, as well as a partial return policy (2 percent) of the purchased amount with full credit for the rest of distributors.

Finally, the dependent barriers are heavily influenced by the previously discussed driving barriers, and as the ISM model depicts the influence between barriers and does not provide a road map, the model remains useful even in case where a driving barrier cannot be totally alleviated or is difficult to overcome. It should also be noted that the model analyzes these barriers based on a case study from a single partner's perspective—i.e. Pharco Pharmaceuticals. Therefore, this model focuses on the barriers only from one perspective and does not reflect the downstream partners' perspectives.

5.2.3 Potential Actions to Reduce Barriers

This section discusses potential actions to reduce or control barriers' intensities. The discussion is based on established practices and relevant literature.

5.2.3.1 Creating Public Awareness Campaigns

Since the lack of public awareness regarding the importance of reverse logistics is one of the most driving barriers hindering the implementation of reverse logistics at Pharco, thus the creation of public awareness is very important. The benefits of creating public awareness toward the importance of reverse logistics in the pharmaceutical industry are expected to result in a positive effect not only on Pharco as a pharmaceutical producer but also on public health and the environment.

One way to create public awareness is through public communication campaigns by using the media and organizing a set of communication activities to generate desirable social outcomes by shaping individual and organizational behavior. The ultimate goal of such campaigns is to attain specific policy results that lead to better outcomes for individuals and communities by coordinating media efforts with a mix of other interpersonal and community-based communication channels (Coffman, 2002, pp. 2-5).

One type of such campaigns, as mentioned by Coffman (2002, p. 6), is the public education campaign or public awareness campaign which strives to change the behaviors that lead to social problems or to promote the behaviors that would improve social well-being. Most of public education and awareness campaigns are usually sponsored by non-profit organizations.

Therefore, interest or pressure groups in Egypt and also voluntary and non-profit organizations such as The Egyptian Center to Protect the Right for Medicine (ECPRM) should implement effective public awareness campaigns involving a focused message to the public regarding the importance of reverse logistics at the pharmaceutical industry to protect the environment and public health by ensuring proper disposal of pharmaceutical waste and expired products. Such campaigns are expected to yield multiple benefits. First, the result from creating public awareness might motivate Pharco's top management to consider reverse logistics as a priority. In turn, the raised awareness might lead Pharco's management to realize that reverse logistics can create a good corporate image and they might consider it as an essential element in their social responsibility programs. Moreover, the raised public awareness might result in motivating the regulatory authorities to strictly enforce the existing environmental and health-related rules and regulations, thereby contributing to the emergence of more rigid regulations. In addition, the Egyptian government might economically support manufacturers in their disposal activities due to the created awareness and increasing public pressure from the media as well as interest or pressure groups.

5.2.3.2 Regulation Enforcement and Stringent Sanctions

Heyes (2000, p. 108) explains that companies treat fines for law breaking as any other cost of doing business and that they aim to minimize the sum of the expected compliance costs plus expected penalties. In this respect, companies will choose to comply with regulations if and only if the expected penalty from non-compliance is greater than the cost of compliance. Similarly, Winter and May (2001, p. 676) explain that regulated entities comply with a given regulation while concluding that the benefits of compliance, including fines or other sanctions avoidance, exceed the costs of compliance.

In this regard, depending on how entities calculate the benefits and costs of compliance, they will select the option that yields the higher net return. This could be the reason why Pharco is disposing of around 90 percent of its pharmaceutical waste in a non-approved disposal site by MOH in order to cut down the disposal cost. Moreover, the above explanation illustrates why pharmacies might illegally accept shipments from unauthorized distributors without a valid invoice in order to benefit from the higher than normal quantity discounts offered by those unauthorized distributors.

Two proposed actions might be appropriate when we consider the seriousness of the potential damage that would result from the improper disposal of pharmaceutical waste on the environment and the negative effect on consumer health from the existence of unauthorized pharmaceutical distributors facilitating the redistribution of expired pharmaceuticals after modifying their expiry dates. First, EDA and CAPA should play more than just supervisory roles, as the need for enforcing MOH regulations as well as applying stringent sanctions for entities that violate rules and regulations is substantial. In addition, sanctions applied by regulatory bodies should be proportionate with the seriousness of the potential risk or the damage caused to the public health and environment. Hence, if sanctions are not sufficiently deterrent, the probability of violation of rules and regulations by an organization or a firm would be high (OECD, 2014, pp. 29, 34).

5.2.3.3 Risks, Costs, and Rewards Sharing

The differences in Pharco's downstream partners' objectives are determined by one of the barriers which limits the implementation of reverse logistics at Pharco. Therefore, it is crucial to align their objectives in reverse logistics. The objective of such alignment can be achieved by establishing incentives for supply chain partners to improve the overall performance of the chain. One way for Pharco to align its partners' objective with its own

interest is by redefining the terms of their relationships so that firms share risks, costs, and rewards equitably, as suggested by H. Lee (2004, p. 9).

Togar M. Simatupang and Sridharan (2002, p. 26) provide a similar mechanism, known as *equitable compensation*, to motivate different partners to align their behavior with the overall chain goal. Using equitable compensation mechanism, supply chain partners jointly agree on a gain sharing formula that they perceive as equitable; they also share risks and fairly assess the actual performance in order to equitably distribute gains. Such mechanism is consistent to the type of return policy proposed by Pasternack (2008, p. 132) which allows for "*full returns with partial credit*" as explained earlier in the theoretical framework chapter. Using such policy, the downstream partners share the risk of returns as the manufacturers provide a partial returns policy by deducting only a small amount of the whole price of the returned items. Consequently, the partial risk will motivates the downstream partners to place order conservatively and create incentives for all partners to do their tasks. Therefore, if Pharco and its downstream partners share the risks and costs of returned pharmaceuticals, they will tend to make the best possible decisions for maximizing their overall benefits.

In order to align Pharco's goals and objectives to its downstream partners, an integrated return policy could be jointly achieved by substituting the individual policies that attempt to maximize only individual benefits and prevent supply chain members from achieving overall profitability.

5.2.3.4 Controlling Opportunism

Various researchers—Contractor and Lorange (2002); Das and Rahman (2010); Niesten and Jolink (2012); Wathne and Heide (2000); Yaqub (2011)—provided numerous actions as control mechanisms to opportunistic behavior in business relationships. Accordingly, some of the relevant actions that might control the opportunistic behavior exercised by Pharco and its downstream partners are briefly described below.

Owing to the opportunistic behavior of distributors, as explained earlier, Pharco is safeguarding itself by adopting a restrictive return policy with small-sized distributors and by tightening its return policy with all authorized distributors. Such reaction is facilitated through Pharco's use of informal return agreements with the distributors.

Oliver E Williamson (1991, p. 273) refers to such behavior as "lawful opportunism" in which contracting parties breach informal agreements by ignoring obligations that are not clearly stated in a formal contract to maximize their self-interests.

One way to control opportunism, as explained by Yaqub (2011, p. 23), is by using explicit contracts as a protective device against possible opportunistic behavior by providing formal rules and procedures to govern the relationship between partners.

Establishment of detailed and formal contracts between Pharco and its downstream partners regarding the returned products and explicit specification of the responsibilities, obligations, and rights of each partner is expected to control the opportunistic behavior exercised. Thus, use of formalized contracts in which Pharco specifies clearly the terms and conditions of its return policy—the condition by which returned products are subject to credit or refund as well as the condition by which returned products are not—will act as a protective device and safeguard against possible opportunistic behavior that might be exercised by any of the partners.

In addition to explicit contracts, effective monitoring can facilitate the detection of opportunistic behavior between partners, as it becomes possible for a party to act opportunistically without being detected when information asymmetry exists in a relationship (Wathne & Heide, 2000, p. 43). For example, attempts made by partners to withhold or distort key information can be detected by formal reporting between partners, as their roles and responsibilities are clearly defined and hence the opportunistic partners would face legal corrective actions (Das & Rahman, 2010, p. 107). Therefore, effective monitoring may result in pressure on parties to increase compliance.

In order to control opportunism, Pharco should effectively monitor its downstream partners' performance and compliance to their roles and responsibilities in accordance with formal reporting procedures. In this way, the previously mentioned opportunistic behavior which distributors might exercise toward pharmacies by restricting their return policies is expected to diminish. Also, the supervisory role of the EDA is essential in monitoring the compliance of all partners.

Another way to control opportunism is by aligning goals and incentives between contracting parties, because firms perceive their partners' actions as opportunistic when goals are incompatible and hence conflict may arise. Incompatible goals—when the pursuit of one party hinders the pursuit of the other partner —may result in self-interest seeking, as each partner will try to attain its own goal in an uncooperative manner (Das & Rahman, 2010, p.

66). On the other hand, when goals are compatible, each partner can pursue its own interests without affecting those of the rest. In that case, mutual self-interest seeking becomes possible as the alignment of partners' goals mitigates the impact of opportunism in contractual relations (Niesten & Jolink, 2012, p. 3).

In addition to goal alignment, incentives alignment may also reduce the chance of opportunistic behavior between partners, as parties align their incentives when they are able to increase their benefits and none of them hinders the ability of another to increase its benefits (Niesten & Jolink, 2012, p. 3).

Accordingly, it is beneficial for Pharco and its downstream partners to align their goals and to find a win-win solution based on collaborative conflict resolution and joint value maximization. Moreover, it is more advantageous for Pharco to resolve conflicts with its downstream partners by adopting a generous return policy, instead of wining conflicts by adopting a restrictive return policy. As the full return policy with partial credit proves that it would result in improving the channel profits by sharing the risk between partners, it consequently creates incentives for all partners to do their tasks (Padmanabhan & Png, 1995, p. 70; Pasternack, 2008, p. 132).

Also, Contractor and Lorange (2002, p. 108) propose participatory decision-making as a mechanism that mitigates problems generated from goal incompatibilities by enhancing transparency between partners and hence make it easier for companies to detect partner opportunism. Since participatory decision-making requires close interaction and detailed communication between partners, it discourages partners to behave opportunistically. In this way, participatory decision-making can facilitate efficient conflict resolution in partnership by creating relational ties and by bringing harmony into the relationship (Contractor & Lorange, 2002, p. 109). Based on the previous explanation, it is more effective for Pharco to make its decisions related to product returns along with its downstream partners to avoid problems arising out of incompatible goals, which might result in opportunism and also raise transparency between Pharco and its partners.

6. CONCLUSION

The research presented in this thesis aimed to investigate the driving forces behind Pharco's implementation of reverse logistics and the reasons for product returns from its downstream partners. It also attempted to understand the interrelation between the different reverse logistics barriers facing Pharco in implementing its reverse logistics practices. In this regard, the research sought to find answers to a set of research questions, of which the first was **"Why Pharco implements reverse logistics practices?"**

The research revealed that the application of reverse logistics at Pharco is mainly regulatory-driven. However, the interviews with the company management showed a lack of full compliance to the imposed regulations, as around 90 percent of the total pharmaceutical waste is destructed in a non-approved disposal site by MOH.

From the economic point of view, the economic driver is practically unattainable due to the complex nature of pharmaceutical products and the difficulty in extracting direct economic value from returns. The main reasons for returns from Pharco's downstream partners are product expiration, followed by damaged packaging during transportation or storage. Product recalls due to quality issues is a less frequent reason than the previously stated reasons, but when it occurs it is important that the company, its distributors, and also CAPA should respond immediately to execute the recall.

The second research question "**What are the reverse logistics practices implemented by Pharco?"** was addressed by mapping the process of product return. Multiple parties are involved in the return process. The company's 12 authorized distributors are responsible for the collection activity from thousands points of sale—i.e., pharmacies, hospitals, and private clinics. Pharco is responsible for receiving and inspecting the returned products, as well as for selecting suitable reverse logistics activities in accordance with the returned products' conditions and expiration dates.

In cases where the returned product has not expired or the product package is not damaged, the company will either redistribute those products in the market or will re-label them as free medical samples—the choice depends on the product's remaining shelf-life. Also, in cases where the returned product has not expired but packaging is damaged, the company donates such returns through charitable organizations.

For recalled and expired returns, disposal by incineration through third-party disposal companies is the only suitable activity, and since the most common reason for returns is

expired returns, the disposal by incineration is the dominant reverse logistics activity. The only possibility to capture economic value is by separating and reselling the expired or recalled products packaging materials before final disposal. However, such activity is not economically attractive for Pharco and is perceived to be time-consuming, rather than being considered as a source of income.

The last research question was "**What are the barriers hindering Pharco in implementing reverse logistics?"**

The methodological approach of ISM was applied to study the mutual influences across barriers listed by a preliminary case analysis, and to identify the "driving" barriers which may lead to other barriers, and "dependent" barriers influenced by the driving barriers. Thus, the systematic analysis using ISM approach contributed to a more realistic representation of the complex problem in a visualized and simplified manner and also has provided a deeper understanding of the situation than observing individual barriers in isolation.

A key finding of the analysis is that the "lack of regulation enforcement," "lack of public awareness regarding the importance of reverse logistics," and "lack of economic support from government" form the bottom levels of the ISM model. Thus, those barriers imply high driving power and should be treated as the root cause of the remaining barriers. It was also observed that the "long processing cycle time of returned products," "lack of dedicated workers and facilities for handling returns," and "lack of worker support and personnel training" form the top levels of the model. Those barriers imply high dependence and represent the undesirable outcome of the driving barriers.

Finally, for some of the model barriers, potential actions to alleviate their intensities were discussed. For example, creating effective public awareness campaigns by interest groups and voluntary organizations in Egypt, might raise the public awareness regarding the importance of reverse logistics and yield other benefits, while the imposition of sufficiently deterrent and stringent sanctions by regulatory bodies in Egypt might take steps toward better compliance to reverse logistics regulations. Also, sharing risks and costs of returns equitably between Pharco and its downstream partners might help in aligning their objectives in reverse logistics. Finally, by aligning goals and incentives between Pharco and its downstream partners as well as using explicit and formalized return policy and effective monitoring can facilitate the detection of opportunistic behavior between partners and might help to control opportunism in the Pharco supply chain.

6.1 Limitations of the Research

This research has been limited by the absence of Pharco's key downstream partners' perspectives. Their incorporation would have added more value to the research to understand the problem from a more holistic view. This research used only the ISM approach. However, since the relation among the identified reverse logistics barriers depends on the respondent's knowledge and familiarity with the supply chain of Pharco Pharmaceuticals, its reverse logistics operations, and the pharmaceutical industry in Egypt, there might be a subjective bias affecting the final model due to their judgment. In this regard, the applied ISM methodology should be evaluated in connection with its utility in the research context.

Also, even though the application of ISM approach provides a much better visualization of the complex problem, with directed linkages between the identified reverse logistics barriers, the ISM output is not statistically valid.

6.2 Future Research

This research was carried out within the context of a single case. Hence, further research could extend the investigation to a wider range of companies in the Egyptian pharmaceutical industry. Also, it would be interesting to incorporate the other downstream parties involved in application of reverse logistics in the pharmaceutical industry.

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APPENDICES

Appendix A

Semi-structured Interview Guide

The questions mentioned below are guidelines for the semi-structured interviews conducted face-to-face with the following interviewees:

Participant's position	Date of the interview	Approximate length of the interview
Sales Manager	24 December 2014	2 hours
Returned Products Supervisor	24 December 2014	2 hours
Health and Safety Manager	10 January 2015	1 hour
Health and Safety Supervisor	10 January 2015	1 hour

This interview guide provides only the outline of those aspects that were intended to be addressed, but other aspects came up during the interviews and were also addressed.

Set 1: Questions Related to RL Drivers

- As reverse logistics drivers differ from your company's perspective (receiver) and your downstream partners' (returning) perspectives, what are the motives and incentives for your company (i.e., economic, legislative, or corporate citizenship) to implement reverse logistics?
- In what manner your downstream partners influence your company's implementation of reverse logistics processes and activities?
- What are the possibilities of capturing direct or indirect economic value from the returned products? Is it possible to recycle the returned or expired products?
- Was/Is your company previously or currently involved in any environmental or social program in order to create social awareness for the importance of returns, which, in turn, helps your company to handle the returned products?

Set 2: Questions Related to RL Activities and Processes

- What are the types of wastes generated from expired and returned products of your company?
- What are the reverse logistics activities adopted by your company for handling returns, and how does the company implement such activities (the process)?

- Who are the main parties involved in the return process of your products? Are returns handled and processed by a third party or internally, and how? (The question aims to map the process of returns and the roles of the parties involved).
- What types of information are transmitted to your chain partners to facilitate handling returns? How the POS (pharmacies) information is transmitted to your company?
- What are the current regulations imposed by the government to enforce your company to handle returns? What are the contracting and legal issues that determine the responsibilities of the partners involved in the return process?

Set 3: Questions Related to RL Barriers

- What are the internal barriers that currently limit your company in implementing reverse logistics? Examples: Lack of awareness, restrictive firm policies, management inattention, lack of personnel support, system inadequacy, and financial constraints.
- What are the external barriers that limit your company in implementing reverse logistics? Examples: Legal, regulatory, and public issues.
- Is there any preferential tax policies or economic support from the government to help your company to compensate the costs of reverse logistics? If yes, what are those policies and how they are implemented?
- How do the imposed regulations affect the application of reverse logistics at your company? Do they act as a barrier for implementing reverse logistics practices? If yes, how exactly?
- What are the challenges faced by your company in managing returns, and how the company deals with such challenges? Example: Conflicts in the channel, opportunism, and uncertainty about return causes.
- There are general symptoms which, when discovered, indicate a problem in the return process—for example, large amounts of returns held in the warehouse, unauthorized returns, lengthy processing cycle times, and unknown total cost of the returns process. Does your company identify any of these symptoms? If yes, how the company reacts to such symptoms upon discovery?

Appendix B

B1 - Iterative Procedures for ISM Level Partitions

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	
3	3,4,5,8,9,10,15,16,17	1,2,3,6,7,11,12,13	3	
4	4,9,16	1,2,3,4,6,7,8,10,11,12,13,14,15,17	4	
5	5,16	1,2,3,5,6,7,8,10,11,12,13,14,15	5	
6	1,2,3,4,5,6,7,8,9,10,15,16,17	6,11,12,13	6	
7	1,2,3,4,5,7,8,9,10,15,16,17	1,2,6,7,11,12,13	1,2,7	
8	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
9	9,16	1,2,3,4,6,7,8,9,10,11,12,13,14,15,17	9	
10	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	11,13	11,13	
12	1,2,3,4,5,6,7,8,9,10,12,14,15,16,17	11,12,13	12	
13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	11,13	11,13	
14	4,5,8,9,10,14,15,16,17	11,12,13,14	14	
15	4,5,8,9,10,15,16,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
16	16	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	16	Level 1
17	4,9,16,17	1,2,3,6,7,8,10,11,12,13,14,15,17	17	

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,5,7,8,9,10,15,17	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,4,5,7,8,9,10,15,17	1,2,6,7,11,12,13	1,2,7	
3	3,4,5,8,9,10,15,17	1,2,3,6,7,11,12,13	3	
4	4,9	1,2,3,4,6,7,8,10,11,12,13,14,15,17	4	
5	5	1,2,3,5,6,7,8,10,11,12,13,14,15	5	Level 2
6	1,2,3,4,5,6,7,8,9,10,15,17	6,11,12,13	6	
7	1,2,3,4,5,7,8,9,10,15,17	1,2,6,7,11,12,13	1,2,7	
8	4,5,8,9,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
9	9	1,2,3,4,6,7,8,9,10,11,12,13,14,15,17	9	Level 2
10	4,5,8,9,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17	11,13	11,13	
12	1,2,3,4,5,6,7,8,9,10,12,14,15,17	11,12,13	12	
13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17	11,13	11,13	
14	4,5,8,9,10,14,15,17	11,12,13,14	14	
15	4,5,8,9,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
17	4,9,17	1,2,3,6,7,8,10,11,12,13,14,15,17	17	

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,4,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,4,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
3	3,4,8,10,15,17	1,2,3,6,7,11,12,13	3	
4	4	1,2,3,4,6,7,8,10,11,12,13,14,15,17	4	Level 3
6	1,2,3,4,6,7,8,10,15,17	6,11,12,13	6	
7	1,2,3,4,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
8	4,8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
10	4,8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
11	1,2,3,4,6,7,8,10,11,12,13,14,15,17	11,13	11,13	
12	1,2,3,4,6,7,8,10,12,14,15,17	11,12,13	12	
13	1,2,3,4,6,7,8,10,11,12,13,14,15,17	11,13	11,13	
14	4,8,10,14,15,17	11,12,13,14	14	
15	4,8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
17	4,17	1,2,3,6,7,8,10,11,12,13,14,15,17	17	

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
3	3,8,10,15,17	1,2,3,6,7,11,12,13	3	
6	1,2,3,6,7,8,10,15,17	6,11,12,13	6	
7	1,2,3,7,8,10,15,17	1,2,6,7,11,12,13	1,2,7	
8	8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
10	8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
11	1,2,3,6,7,8,10,11,12,13,14,15,17	11,13	11,13	
12	1,2,3,6,7,8,10,12,14,15,17	11,12,13	12	
13	1,2,3,6,7,8,10,11,12,13,14,15,17	11,13	11,13	
14	8,10,14,15,17	11,12,13,14	14	
15	8,10,15,17	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	
17	17	1,2,3,6,7,8,10,11,12,13,14,15,17	17	Level 4

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,7,8,10,15	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,7,8,10,15	1,2,6,7,11,12,13	1,2,7	
3	3,8,10,15	1,2,3,6,7,11,12,13	3	
6	1,2,3,6,7,8,10,15	6,11,12,13	6	
7	1,2,3,7,8,10,15	1,2,6,7,11,12,13	1,2,7	
8	8,10,15	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5
10	8,10,15	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5
11	1,2,3,6,7,8,10,11,12,13,14,15	11,13	11,13	
12	1,2,3,6,7,8,10,12,14,15	11,12,13	12	
13	1,2,3,6,7,8,10,11,12,13,14,15	11,13	11,13	
14	8,10,14,15	11,12,13,14	14	
15	8,10,15	1,2,3,6,7,8,10,11,12,13,14,15	8,10,15	Level 5

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,3,7	1,2,6,7,11,12,13	1,2,7	
2	1,2,3,7	1,2,6,7,11,12,13	1,2,7	
3	3	1,2,3,6,7,11,12,13	3	Level 6
6	1,2,3,6,7	6,11,12,13	6	
7	1,2,3,7	1,2,6,7,11,12,13	1,2,7	
11	1,2,3,6,7,11,12,13,14	11,13	11,13	
12	1,2,3,6,7,12,14	11,12,13	12	
13	1,2,3,6,7,11,12,13,14	11,13	11,13	
14	14	11,12,13,14	14	Level 6

Barriers	Reachability set	Antecedent set	Intersection set	Level
1	1,2,7	1,2,6,7,11,12,13	1,2,7	Level 7
2	1,2,7	1,2,6,7,11,12,13	1,2,7	Level 7
6	1,2,6,7	6,11,12,13	6	
7	1,2,7	1,2,6,7,11,12,13	1,2,7	Level 7
11	1,2,6,7,11,12,13	11,13	11,13	
12	1,2,6,7,12	11,12,13	12	
13	1,2,6,7,11,12,13	11,13	11,13	

Barriers	Reachability set	Antecedent set	Intersection set	Level
6	6	6,11,12,13	6	Level 8
11	6,11,12,13	11,13	11,13	
12	6,12	11,12,13	12	
13	6,11,12,13	11,13	11,13	

Barriers	Reachability set	Antecedent set	Intersection set	Level
11	11,12,13	11,13	11,13	
12	12	11,12,13	12	Level 9
13	11,12,13	11,13	11,13	

Barriers	Reachability set	Antecedent set	Intersection set	Level
11	11,13	11,13	11,13	Level 10
13	11,13	11,13	11,13	Level 10

B2 – Direct Influence Graph among the Barriers affecting Pharco's Reverse Logistics Application