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Evaluation of Different Types of Risks in Pharmaceutical Supply-Chain

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ABSTRACT

Pharmaceutical supply chain has always been a point of great interest in academic research as well as in industrial practice. However this popular buzzword still remains an ill-defined and poorly understood concept and this will provide a better understanding of the different levels of pharmaceutical supply chain issues and the terms regarding supply chain for pharmaceuticals. Though the pharmaceutical industry has grown by leaps and bounds the risk affecting it has also increased proportionately. Furthermore this addresses the issues of risk mitigation in pharmaceutical supply chain by providing quantified empirical results. Based on the available literature four major risks affecting the pharmaceutical supply chain were identified as regulatory risk, inventory risk, counterfeit risk and financial risk. Ranking and management strategies of these are based on Analytical Hierarchy Process model. Also solutions to these risks are provided based on the results of the survey questionnaires and literature study which would be best suited for the industry to flourish and survive in today's competitive global marketplace.

Keywords: Supply chain, Analytical Hierarchy Process Model, Risk management

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INTRODUCTION

Supply chain in India presents major challenges to manage and maintain effectively. Due to poor infrastructure, overstretched capacity, a highly fragmented supplier base, the lack of traditional retail channels and point-of-sales, ineffective usage of information technologies and communication, a very complex system of taxes and restrictive government regulations, are just some of the challenges that can make the sourcing and retailing opportunities in India seem unattainable. Consequently, many logistics and distribution models that have proven their value in developed economies, doesn't often work when applied to India. This represents a major challenge for multinational firms, since they either have to adapt their existing strategies to the peculiarities of the Indian landscape or design new strategies from scratch, that are entirely adapted to the local conditions. On top of that, the concept of supply chain management is still nascent in India. Except for the industry leaders, many Indian corporations are still reluctant to sharing information and to engaging in collaborative relationships with suppliers, third-party logistics providers, distributors and retailers.[2][5][12]

Evaluation of the Pharmaceutical Supply Chain is an important issue for both academic research and industrial practice. However, this popular buzzword still remains an ill-defined and poorly understood concept and the findings of this project will provide us better understanding of the issues in local existing pharmaceutical supply chain and help us to bridge the information gap and provide a better control of standards through evaluation of existing supply chain management.

The study evaluates the risks in pharmaceutical supply chain and provides solutions to these through risk prioritization and management using Analytical Hierarchy Process model.

MATERIALS AND METHODS

Initial work was extensively on gathering of data on specific as well as generalized pharmaceutical supply chains in order to identify the critical points for further more detailed investigation.

In addition, an evaluation has been made on pharmaceutical supply chain risks. The method adopted was to gather data from a questionnaire with a sample population of manufacturers, intermediaries and dispensing pharmacists. The outputs from these were then combined, compared, analyzed and conclusion was drawn.

Analytical Hierarchy Process (AHP) is type of evaluation and management of pharmaceutical supply chain risks developed by Thomas L Saaty which helps in complex decision making in

Multi Criteria Decision Making (MCDM). AHP is selected because it allows decision-makers to model a complex problem in a hierarchical structure portraying the relationships of the overall goal, criteria (objectives), sub-criteria (sub-objectives), and alternatives. Research that have used AHP include supplier selection, project selection and management, international business management, operations and logistics/supply chain management, marketing, pharmaceutical marketing and management, and accounting.

Following hierarchy structure modelling for risk management in pharmaceutical supply chain is shown in **Figure 1** can be achieved as follows.

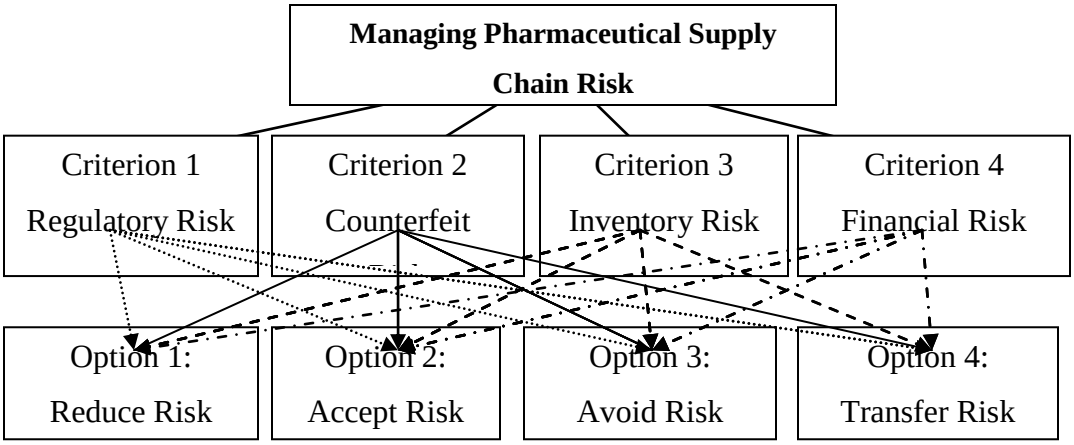

Figure 1. **Hierarchy Structure of Pharmaceutical Supply Chain Risks**

- Define an unstructured problem and determine the overall goal. The overall goal is to manage risk in pharmaceutical supply chain.
- Build the hierarchy from the top through the intermediate levels to the lowest level which usually contains the list of alternatives. The major decision criteria occupy the second level of the hierarchy, while the sub-criteria occupy the third level of the hierarchy. The decision maker defines the criteria that will be used to judge the alternative policy options. The defined decision criteria are Inventory Risk, Regulatory Risk, Financial Risk and Counterfeit risk. The alternative policy options proposed to manage the pharmaceutical supply chain risk are risk reduction, risk acceptance, risk avoidance, and risk transfer. The factor with the maximum local priority is selected from each category to represent the category and the relative priorities of the scaling factors computed. The derived priorities are used for final rating of the alternative policy options and selecting the most important and satisfactory policy option.
- Construction of pair-wise comparison matrix: Build a set of pair-wise comparison matrices for each level of the hierarchy and then conduct all the pair-wise comparisons.

Importance was measured on an integer-valued 1-9 scale reported in **Table 1**. It is the relative scale measurement developed by Saaty for pair wise comparisons. It allows the transformation of qualitative judgments or intangible attributes into preference weights (level of importance) or numerical values. The nine-point scale seeks to know the dependence criteria, which one will influence the common criteria more and if so how much more. According to Saaty, a value of 1 between two criteria indicates that both equally influence the affected node, while a value of 9 indicates that the influence of one criterion is extremely more important than the other.[8]

Table 1. The AHP pair-wise comparison values or scale of preference between two elements.

Preference weights or level of importance	Definition of Verbal Scale	Explanation
1	If the two objectives are equally (equal) preferred (importance)	Two activities or elements contribute equally to the objective
3	If objective (i) is moderately preferred or moderately more important than objective (ii)	Experience and judgment slightly favour activity or element over another.
5	If objective (i) is strongly preferred or strongly more important than objective (ii)	Experience and judgment strongly or essentially favour one activity over another
7	If objective (i) is very strongly preferred or very strongly more important than objective (ii)	An activity is strongly favoured over another and its dominance demonstrated in practice
9	If objective (i) is extremely preferred or extremely more important than objective (ii)	The evidence favouring one activity over another is of the highest degree possible of affirmation
2,4,6,8	Intermediate values	Used to represent compromise between the preferences listed above or used to compromise between two judgments.
1/3	If objective (ii) is weakly more important than objective (i).	

Data Collection

A survey questionnaire approach was used for gathering relational data to assess the order of importance of the pharmaceutical supply chain risks. Thus, from the hierarchy tree, a questionnaire was developed to enable pair-wise comparisons between all the factors at each level in the hierarchy. The pair-wise comparison process elicits qualitative judgments or opinions that indicate the strength of the experts preference in a specific comparison according to 1-9 scale. The experts were requested to respond to several pair-wise comparisons where two categories at a time are compared with respect to the goal. The result of the survey questionnaire technique was then used as input for the AHP. The pair-wise comparison matrix is shown in **Table 2.** [8]

Empirical Results

The pair-wise comparison of the major criteria shown in Table 2 as well as in the Figure 1 below indicate that the regulatory risk is the most important risk to manage with a priority of 0.383 followed by financial right risk(0.342), inventory risk(0.168) and counterfeit risk(0.107)(Table3).

Table 2. Pair-wise Comparison Matrix for the Four Criteria:

Criteria	Regulatory Risk	Counterfeit Risk	Inventory Risk	Financial Risk
Regulatory Risk	1	3	3	1
Counterfeit Risk	1/3	1	2	3
Inventory Risk	1	2	1	2
Financial Risk	1	1/3	2	1

Table 3. Pair-wise Comparison Matrix for Risk objectives with respect to the Goal

Goal	Priority	Rank
Regulatory Risk	0.383	1
Counterfeit Risk	0.107	4
Inventory Risk	0.168	3
Financial Risk	0.342	2

RISK MANAGEMENT STRATEGIES

Tables 4 to 7 report the risk management strategies for the four major decision criteria including regulatory risk, counterfeit risk, inventory risk and financial risk. For both regulatory and financial risk, the best strategy is risk transfer such as outsourcing and insurance respectively. However, for both counterfeit risk and inventory risk, the preference is to reduce risk that is by incorporating anti-counterfeiting strategies and inventory management.[5]

Table 4. Pair-wise Comparison Matrix for Policy Option with respect to Regulatory Risk

Regulatory Risk	Reduce Risk	Accept Risk	Avoid Risk	Transfer Risk	Priority	Rank
Reduce Risk	1	2	2	2	0.261	2
Accept Risk	2	1	2	3	0.169	3
Avoid Risk	2	2	1	3	0.119	4
Transfer Risk	2	1/3	1	1	0.451	1

Table 5. Pair-wise Comparison Matrix for Policy Option with respect to Counterfeit Risk

Counterfeit Risk	Reduce Risk	Accept Risk	Avoid Risk	Transfer Risk	Priority	Rank
Reduce Risk	1	5	3	5	0.560	1
Accept Risk	5	1	3	1	0.095	3
Avoid Risk	1/3	1/3	1	3	0.249	2
Transfer Risk	5	1	1/3	1	0.095	3

Table 6. Pair-wise Comparison Matrix for Policy Option with respect to Inventory Risk

Inventory Risk	Reduce Risk	Accept Risk	Avoid Risk	Transfer Risk	Priority	Rank
Reduce Risk	1	5	3	3	0.527	1
Accept Risk	5	1	3	1	0.102	4
Avoid Risk	1/3	1/3	1	2	0.241	2
Transfer Risk	1/3	1	2	1	0.129	3

Table 7. Pair-wise Comparison Matrix for Policy Option with respect to Financial Risk

Financial Risk	Reduce Risk	Accept Risk	Avoid Risk	Transfer Risk	Priority	Rank
Reduce Risk	1	5	1	3	0.226	2
Accept Risk	5	1	3	5	0.068	4
Avoid Risk	1	1/3	1	3	0.193	3
Transfer Risk	1/3	5	3	1	0.513	1

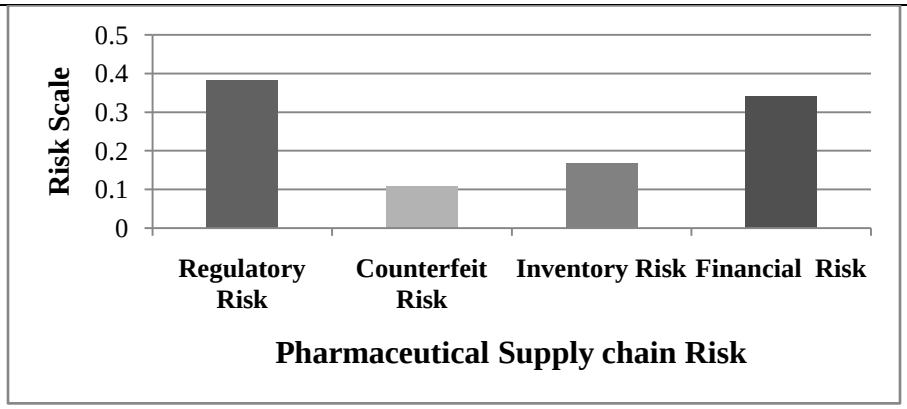

Figure 2. Comparison of risk affecting pharmaceutical supply chain.

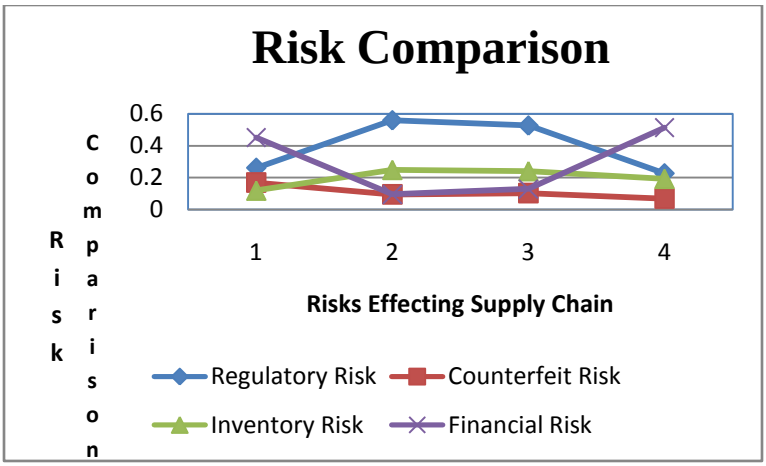

Figure 3. Comparison Chart of Policy Options for Pharmaceutical Supply Chain Risks

CONCLUSION

In this atmosphere of high competition and increasing business targets pharmaceutical industry faces an array of risk ranging from regulatory failure, counterfeiting, inventory mis-management, financial loss. The pharmaceutical companies should incorporate appropriate risk management strategies to counter these risks. Outsourcing of key regulatory activities to external agencies improves cost efficiencies by fewer hiring of expertise personnel, training costs, facility requirement and refocusing employees on other essential activities though it has its own share of issues and hurdles which includes data security, increased compliance risk, loss of control, sharing of internal responsibilities and trust. Issues regarding counterfeiting can be managed by incorporating latest anti-counterfeiting technologies such as hologram, mass

encoding systems, bar-codes and RFID systems. Inventory management logistics planning and good warehousing practises help in coping with inventory risks. Major financial risks can be mitigated using insurance of products and facilities, mergers and acquisitions to gain marketing access into newer markets. Thus proper risk management strategies help in building shareholder's trust and improve performance and profit margins.

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