ABSTRACT

Reverse Logistics: A Sustainable Option for Indian Pharmaceutical Industry

Sushmita Aghalaya Narayana, Indian Institute of Management (IIMK)

An increased pace of industrialization in developing countries has led to increasing levels of environmental pollution, while wide income disparities continue to exist in society. Researchers and practitioners in the field of management have been motivated to develop sustainable solutions by focusing on development across economic, environmental and social dimensions. Healthcare is an important avenue for sustainable development as it pertains to improving the health of the nation through affordable, yet competitive mechanisms that protect the environment and prevent further proliferation of diseases. In countries like India, industry reports highlight the presence of inequitable access to medicines and poor healthcare financing mechanisms, while product waste (due to expiry) and subsequent disposal further increase economic costs for the industry and environmental pollution. As the pharmaceuticals industry is a vital component of the healthcare system, there is a need to develop sustainable solutions in the Indian pharmaceuticals industry. The research in this thesis attempts to understand the role of reverse logistics in addressing issues of sustainability in the Indian pharmaceuticals industry.

This study has been organized in seven chapters across five sections of this thesis. In Section I, Chapter 1 introduces the concepts of sustainable development and reverse logistics and provides an overview of the pharmaceutical industry and its stakeholders. A detailed review of literature was conducted in Section II (Chapter 2 and Chapter 3) to arrive at the research questions which would be addressed in subsequent chapters. The detailed literature review of managerial research in the pharmaceuticals industry (Chapter 2) indicated that studies on supply chain management are found to be negligible compared to other fields of research. Hence, Chapter 3 attempted a detailed review of managerial research on the pharmaceutical supply chain. It was identified that there is a need for studies that holistically address sustainability in the pharmaceutical supply chain, especially in developing economies.

Through Chapter 4 in Section III an attempt was made to address the first research question, i.e., to understand the current system complexities in pharmaceutical supply chain in India, and the role of reverse logistics in it. Insights from industry reports and preliminary interactions with stakeholders were used to develop a Behaviour-Over-Time (BOT) chart and the problem structure. The BOT chart captures behaviours of important measures relevant to improving sustainability (e.g. quantity of disposable drugs, sales revenues, and effective returns) of the industry. A group model building exercise was conducted and the inputs obtained were used to develop a causal loop model that represents the current system. The exercise indicated that the Indian pharmaceutical market is flooded with drugs/medicines due to the entry of several companies, uneven marketing efforts, inefficiencies in the reverse logistics processes and a negligible presence of reverse logistics processes for redistribution. These features results in higher quantum of product disposals while there are no incentives to carry out redistribution that can provide economic, social and environmental benefits.

Section IV attempted to address the second research question, i.e. exploring if reverse logistics can be utilised to improve sustainability in the Indian pharmaceuticals industry. Chapter 5 utilised system dynamics modelling methodology to model the current system's complexities in the dynamic environment. Relevant equations were developed for the causal loop linkages and simulation was carried out. Through validation tests, it was observed that the system's dynamic behaviour, in the base-case, replicates the trends observed in the BOT chart discussed in Section III. Through a preliminary sensitivity analysis, three significant parameters were identified for further strategic analysis, namely, the impact of market attractiveness on expected market potential, the shelf life of medicines/drugs and the allowable sales loss that is designed into the production process. In order to enhance the sustainability of the industry, structural changes were incorporated to the current system in Chapter 6. These changes included incorporation of the process for product redistribution before expiry (effective returns), the impact of effective returns on brand image, the environmental costs due to disposal and the economic costs associated with forward and reverse logistics. The new model depicted improvement in most of the measures captured in the BOT chart. Robustness of the model was further improved by using Design of Experiments techniques. Using Taguchi's Orthogonal Arrays, attempts were made to identify appropriate levels of control factors that enhance the system's profitability (economic dimension), while also considering social and environmental dimensions of sustainability. The results indicated that, within the identified noise factors, effective returns improve overall system profitability. Additionally, factors having greater impact on the system profitability relate to the design of forward logistics (shelf life and allowable sales loss). In order to address pricing strategies for making redistributed medicines affordable for the needier sections of society, three scenarios with lower product pricing (compared to original price) were assessed. It was observed that price reduction for an alternate market improves economic, social and environmental performances. Thus, it was observed that by incorporating parametric and structural adjustments, reverse logistics can definitely improve sustainability in the Indian pharmaceuticals industry.

Finally, Section V (Chapter 7) presents an overview of the findings in the thesis, contributions to theory, implications for managers and the future research scope. This research substantially improves the understanding of the relatively unexplored domain of sustainability in the pharmaceutical industry. In developing sustainable solutions, the importance of interactions between industry dynamics and logistics activities was recognized through group model building and dynamic modelling. The combined use of system dynamics and design of experiments is a unique approach in developing strategies aimed at enhancing sustainability and perhaps the first attempt to understand complex systems for reverse logistics in the pharmaceutical industry. The findings present significant implications for the various stakeholders involved. Future research scope includes developing reverse logistics networks within dynamic environments to ensure sustainability.