A Process Re-engineering Framework for Reverse Logistics based on a Case Study

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Abstract: *Reverse logistics has gained increasing attention in recent years as a channel for companies to achieve operational excellence. The process involves manipulation of returned materials, or even products, which forms a pivotal role in sustainable development throughout the whole supply chains. To make reverse logistics possible, process re-engineering may need to be carried out. However, the processes involved in re-engineering are practically complicated. Objectives, benefits, and applicability of any process re-engineering require a careful and detailed strategic planning. This paper aims to propose an easy-to-follow step-by-step framework for practitioners to perform process re-engineering, to learn and identify the critical issues in each step, and to be successful in applying process re-engineering in order to enhance reverse logistics performance. A learner-centred approach is adopted based on a case study of process re-engineering, which is demonstrated in the paper for explanation.*
Keywords: *Process reengineering; Reverse logistics; Learner-centred; Framework*

1. Introduction

Practicing reverse logistics is a substantial trend in the last decade. More specifically, Brockmann (1999) defines reverse logistics as "the processes of receiving returned goods, determining product status (i.e., resale, repair, remanufacture, parts, scrap), and crediting customers before either processing the material or taking back the product and its packaging to deliver recyclable or reusable material to the manufacturer". Obviously, it is related to the movement of materials in the opposite direction as compared to forward logistics (Kiesmüller, 2003). Fleischmann *et al.* (2001) further extended the definition of reverse logistics to a boarder sense that reverse logistics can also be defined as the reverse activities of product flow. In some cases, products are flow back from the customers to the upstream members for no reason (Autry *et al.*, 2001). As the environmental awareness has been increasing over the last decade, however, companies are attempting to reuse, remanufacture and recycle more end-of-life or returned products in order to reduce the negative impact on environment (Chung and Wee, 2008).

Reverse logistics can be categorized into product- and packaging-centric (Rogers and Tibben-Lembke, 2001). The former could be reused or remanufactured, or sometimes it is returned by customers for no reason; while the latter presents in the reverse system because it is reusable, or its disposal is restricted by regulations (Rogers and Tibben-Lembke, 2001). Nevertheless, the complexity of logistics systems have increased as organizations moved from domestic purchasing to international purchasing. In this connection, integration of logistics activities among organizations becomes important. Furthermore, reverse logistics cannot share the network for forward logistics directly, as the latter focus on efficient use of resources in order to lower cost (Chan *et al.*, 2010). Therefore, process reengineering plays a noteworthy role in deploying a reverse logistics system from its existing counterpart. As a matter of fact, process reengineering has been employed in a number of studies for a variety of applications (e.g., Gao and Li, 2006).

Process re-engineering (more specifically for reverse logistics systems in this paper) involves designing a new process by integrating technology to knowledge. An example is to consider material properties in relation to different processes. In this connection, it is a scientific-based subject, and one possible way to manifest such technological-based design process is through activity (Ankiewicz et al. 2006). Durán et al. (2007) advocate the learner-centred approach which concerns "how people learn" by placing them as the main actor of the learning process. They proved their concept with some industrial engineering and chemical engineering people through a series of experiments. Based on this philosophy, the proposed framework in this study aims to stimulate practitioners or students to think the critical issues in process re-engineering based on a real-life case study. The following section presents the details of the proposed framework.

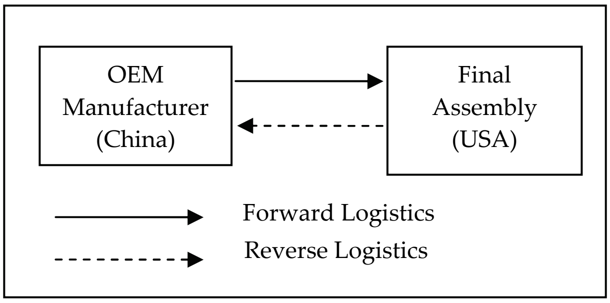

Fig. 1. Illustration of the case

2. Framework for Process Re-Engineering of Reverse Logistics Systems

Returnable packaging can be utilized in a new process, or in an existing process, although some processes or designs have to be changed prior to actual implementation in the latter case. In fact, the former can be regarded as a deviation of the latter. Therefore, the main focus of this section, as suggested by the title, is on reengineering of existing processes. However, the same principle may also be applied to any new design. A framework for re-engineering existing process by incorporating returnable packaging will be proposed in this section.

In fact, the framework is originated from a case study which consists of two companies, namely a supplier and a manufacturer (Chan, 2007). The supplier sends electronic modules (a complete product from the supplier's point of view) to the manufacturer for final assembly of an industrial product. Original packaging design made use of paper pulps as storing trays, and cardboard cartons, which are not reusable. Both companies agreed to adopt a collaborative approach to using returnable packaging material by re-engineering of the processes in both companies so that reverse logistics is possible. This is illustrated in Fig. 1. The solid arrow represents the original design, while the new design incorporates the dashed arrow, which refers to the reverse logistics channel.

Chan (2007) reported all the technical details of the case, including cost analysis, life-cycle assessment of the new design as compared with the old design from environmental protection point of view. Based on this case, a step-by-step approach in reengineering the business process for the enhancement of reverse logistics is demonstrated. The procedure involves six steps. At the end of each step, a set of questions will be given. Its idea is to help people realize the critical issues in each step and ensure that the requirements are fulfilled before they move on.

Step 1. Define the objectives of the reengineering project;
Step 2. Identify potential improvements areas;
Step 3. Understand the whole logistics process and view it from a process point of view;
Step 4. Develop manageable solutions for the potential improvement;
Step 5. Evaluate the alternatives from the whole process point of view and finalize the decision; and
Step 6. Implement the new design.

The above steps are illustrated in Fig. 2 below.

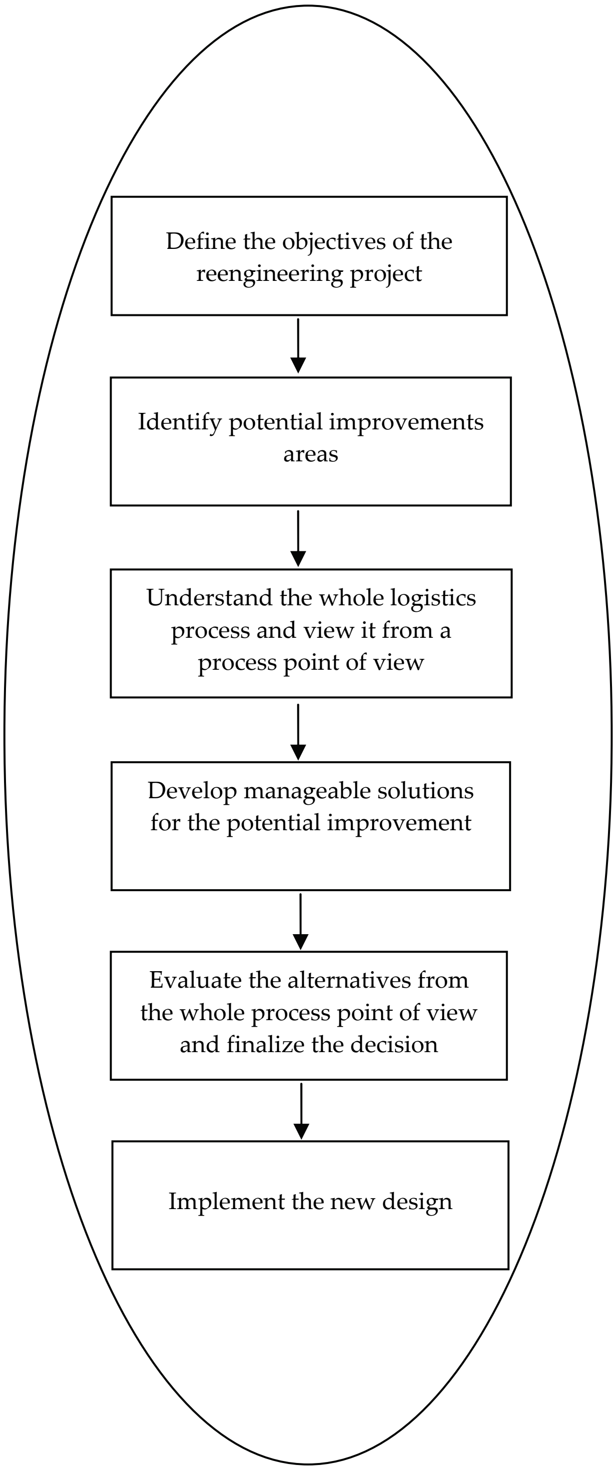

Fig. 2. Flowchart of the proposed framework

2.1 Define the objectives of the reengineering project

The reason to utilize returnable packaging may be motivated by different factors. One could be driven by government regulation (González-Torre et al. 2004); the others may be due to the initiative to commit for sustainable development. The objectives of a project will vary depending on the driving force behind. Therefore, it is very important to define the objectives of the returnable packaging design, and assign proper performance measurements (e.g. cost, process time, etc.) in order to demonstrate the usefulness and cost-effectiveness of the new design as compared to the existing one. If this is a reengineering program, measurements can be employed as a benchmark to the existing design. On the other hand, if this is a new design program, the aforementioned measurements can still be used as selection criteria for alternatives. More importantly, the objectives should be in line with the corporate objectives or strategic directions. Otherwise, any potential conflicts may easily result in a failure in the reengineering process. However, it should be emphasized that defining the measurements does not mean that they can be quantified directly during this phase.

This initial definition of project objectives involves the participation of all appropriate managers or senior staff. It is not uncommon that different opinions exist even among the people who agreed to the reengineering initiative. Consensus can only be obtained by gathering information and comments from all these people. Although monetary performance like return on investment or cost saving is of vital importance to any business, it is not advised to focus on the discussions from this perspective at this stage. It is because, when the scope of the reengineering project has not yet been defined clearly, it is meaningless to talk about returns, in whatever forms.

Taking the case study as an example, top management of the supplier and the manufacturer decided to introduce returnable material is because they had committed to adopt lean production philosophy. They believed that the lean approach would beneficial to both companies in terms of cost and lead time. Therefore, they selected returnable packaging as one of the candidates as improvement areas. They set out this objective first, and then feasibility and cost analysis are carried out in later stage, as discussed later. In other words, a reasonable high level objective should be defined at this stage.

In short, at the end of this phase, the following questions should be answered clearly:

- Why should we use returnable packaging?
- How can we know the benefits if the returnable packaging design has been phased in?

In other words, this phase is the initial evaluation of requests for using returnable packaging, along with a definition of the objectives and performance measurements.

2.2 Identify potential improvement areas

Any projects that passed through phase one should be regarded as having a sound potential for acceptance. However, the impact of these projects on the existing processes should be reviewed in this phase against the existing solution. The departments that will be involved, and the potential improvement areas, can be identified in this phase. The team should think innovatively in the application of the returnable packaging. Taking the case study as an example again, related departments, including marketing, R&D engineering, production engineering, and purchasing, should not only consider returnable packaging as a protective agent. They tried to come up with a design that could facilitate production in both companies as a handling device and storage device. In other words, the functionality of the original design has been extended. As a consequence, the overall production cost can be reduced because of the adaption of the process in relation to the change. In addition, the overall environment impacts can be reduced as well as less materials (papers in this case) can be reduced, despite of the high cost of the plastic packaging material. Of course, this extension may inevitably involve in redesigning existing processes before such benefits can be capitalised.

During this phase, the project team should attempt to quantify the benefits of the projects, even a rough estimation. An initial rough cost-benefit estimate can also be provided for management to understand the magnitude of the effort and gauge the differential between cost and benefit. For example, even if the final design is yet to be confirmed, an initial (new) unit cost regarding the new methods could be estimated and hence a decision on screening out infeasible solutions, at least from the cost perspective, can be made. In addition, investigation on the interrelationships between the list of departments and potential improvement areas is required. A quick evaluation will be made on how the processes of the involved department will be affected. Then, the scope of the reengineering project can be easily identified.

The output of this stage is in fact the scope of the reengineering project by using returnable packaging for later phases, including the potential benefits that such adoption can bring out.

2.3 Understand the whole logistics process and view it from a process point of view

Above phases aim at selecting the correct areas to be reengineered, and defining the scope of the project. This involves innovative thinking in applications of the returnable material in order to either save costs, or add value into potential processes, etc. The whole process is broken down into segments in order to ease benefits analysis.

In the case study, most of the supplier's front end production processes are not related to the packaging design. However, by considering the whole logistics process, extra saving may be generated from hidden processes. For example, a returnable packaging should be durable enough so that it should have no problem to go through the manufacturing processes as a storage device. If the same packaging material can be employed as handling materials within a manufacturer plant, and can be returned for reuse, extra value can then be added.

In the case study, the factory of the manufacturer involves heavy machining, which implies selection of the materials for the returnable packaging is restricted. Eventually, a durable engineering plastic material was selected. Although the unit cost of each packaging unit is thus increased, they are basically fixed cost because of the returnable nature. Therefore, the cost impact is in fact not too significant and it is counted towards the initial investment for consideration. In addition, storage space is not a problem for both companies so that a relatively large single unit of the packaging design could be used. All these concerns should be done by a careful examination of the existing processes, and the new processes after re-engineering.

As suggested by the title of this section, at the end of this phase, the detailed analysis of the processes to be reengineered is the basic output. The knowledge obtained in these phases lays the solid foundation for the creation of new designs and processes in later phases. After steps 2.1 to 2.3, the layout of the re-engineering project is almost done. Following steps are more general "follow-up" procedures in any projects.

2.4 Develop manageable solutions for the potential improvement

After the whole logistics processes have been analyzed, certain improvement areas should be identified, and later development should be focused on these areas. It is not easy to design a single method to cover all of the improvements. Too large a development scale may result in unmanageable project. This phase uses the information collected and studied in the previous steps. New process or new design of the returnable packaging material is the main output of this phase. These may involve redesign of the appropriate processes, or redesign of job work flows, etc. Quantified benefits could be derived at a higher accuracy at this phase. An implementation schedule should be defined in this phase as well.

In the case study, the major consideration is to determine the most economic size of the returnable packaging materials with respect to different business processes, like storage, handling limitation of the processes at the manufacturing plant, etc. The material of the new packaging design as mentioned in the above section is also a critical decision to be fixed at this stage. This is a compromise between cost and technical performance.

At the end of this stage, different design alternatives with strength in different performance aspects should be formulated.

2.5 Evaluate the alternatives from the whole process point of view and finalize the decision

After the target areas and potential solutions have been defined, the next step is to evaluate them according to the said objectives and measurements. Therefore, the initial phase is not only important to screen the possibility of applications of returnable packaging material. It also defines the framework for selection of alternative in this stage. The costs and benefits must now be specifically defined before a conclusion can be made such that which alternative should be implemented.

2.6 Implement the new design

After the best method amongst different alternatives is selected, the proposed methodology should be tested or evaluated through some prototype systems. Actual applications can be carried out as pilots but it may not be applicable if customized tooling is involved. The design is subject to minor adjustment in this phase. The major objective is to adjust the design in order to suit for actual applications, or to tackle unforeseen problems during above processes. After that, the new design or process can be migrated to replace old design or process. In the case study, the initial returnable design had been shipped in parallel with the original design as pilots. A number of modifications had been made in order to improve the design before it was actually phased in.

At the end of this phase, the new process or design will be put into operating and giving increased benefits to the company. However, human factors cannot be overlooked at this point. Training and education should be conducted to related personnel so that the new design is fully understood by related parties. Adjustments are still possible to be done as a continuous improvement cycle.

3. Conclusion

Process reengineering is not a new initiative. The paper, however, reveals a process reengineering case in reverse logistics, and outlines the associated framework which can be used for designing such reverse logistics systems. Main concerns of different phases of the framework are summarized in Table 1.

During the course of development of this framework, it is found that getting a process reengineering project done is not difficult. However, getting all the parties who get involved with additional benefit after completing the project is not as easy as expected. Without participating in the design activities, one cannot be inspired literally. Innovative thinking of the applications, sometime may involve radical change of the existing processes, is necessary in order to accomplish the objectives. In light of

Phases	Key considerations
Define the objectives of the reengineering project	• Why should we use returnable packaging? • How can we know the benefits if the returnable packaging design has been phased in?
Identify potential improvement areas	• Which parties are involved? • What are the new applications or functionalities of the new design? • What are the rough benefits?
Understand the whole logistics process and view it from a process point of view	• How to divide the processes into segments? • Which processes are affected by the new design? • What design criteria are needed in respect to those processes?
Develop manageable solutions for the potential improvement	• What alternatives are possible, and what are the associated benefits?
Evaluate the alternatives from the whole process point of view and finalize the decision	• What is the best evaluation method?
Implement the new design	• How to carry out the testing and pilot? • How to make modifications accordingly?

Table 1. The Proposed Framework

this, an activity-based framework is proposed so that practitioners or students are encouraged to think critically when they are designing a new reverse logistics system from the process reengineering perspective.

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