THEORETICAL FRAMES FOR DESIGNING REVERSE LOGISTICS PROCESSES

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Abstract

Logistics processes of return flow became more and more important in present business practice. Because of better customer satisfaction, environmental and financial aspects many enterprises deal with reverse logistics performance. The paper is a literature review focused on the design principles of reverse logistics processes.

Keywords: reverse logistics, designing.

1. Introduction

Over the past few years increasing volumes of return flows, varying from end-of- life returns to marketing or commercial returns, has reinforced interest in the effective management of such flows. In the literature various approaches describing reverse logistics flow can be found. The systematic study of return flows and environmental aspects (Corbett, C., van Wassenhove, L.N., 1993,) were the main topic in early literature. Later literature has studied decisions in remanufacturing of returned products (Thierry, M., Salomon, M., van Nunen, J.A.E.E., van Wassenhove, L.N., 1995) and inventory strategies with a remanufacturing option (Van der Laan, E.A., Salomon, M., Dekker, R., van Wassenhove, L.N., 1999). Besides that, there is relevant literature scanning the general issues / problems in reverse logistics (Kopicky, R.J., Berg, M.J., Legg, L., Dasappa, V., Maggioni, C., 1993). Hardly any attention has been paid to operational and financial aspects of return storage, handling and transportation. Strategic aspects of distribution network structures were discussed by Bloemhof-Ruwaard et al (Bloemhof-Ruwaard, J.M., Fleischmann, M., van

Nunen, J.A.E.E., 1999). Autry et al. (Autry, C.W., Daugherty, P.J., Richey R.G., 2000), deal with the bond between reverse logistics performance and satisfaction.

Fleischmann et al. (Fleischmann, M., Krikke, H.R., Dekker, R., Flapper, S.D.P., 2000) be described reverse logistics management as the process of planning, implementing and controlling the efficient and effective inbound flow and storage of secondary goods and related information opposite to the traditional supply chain, for the purpose of recovering value or proper disposal. Typically, this comprehends a set of processes such as collection, inspection/separation, reprocessing (including disassembly), disposal and redistribution. Closed loop supply chain management goes beyond that (Quariguasi Frota Neto J., Walther G., Bloemhof J., van Nunen J.A.E.E., Spengler, T., 2007). It comprehends all business functions and hence decisions regarding the adaptation of business strategy, marketing, quality management, information systems, logistics and so on in view of closing material flows, thereby limiting emission and residual waste, but also providing customer service at low cost. Both the forward and reverse chain are considered, since there is a strong interaction between the two.

It is essential to analyze in what respect reverse logistics fundamentally differ from forward logistics, and how this affects design principles. Reverse logistics is different on the following aspects:

- in addition to cost and service there are environmental drivers, complicating the objective function;
- higher system complexity, in particular in reverse logistics processes due to increased number of - and interaction between goods flows. Uncertainty on the supply (collection) side of the system regarding volumes, quality, composition and timing;
- push-pull nature. There is often a mismatch between supply and demand. “Production” (i.e. supply of used products) is not coupled with “demand” (i.e. producer’s requirements);
- numerous “suppliers”/ few “customers”. Used products are the raw materials for the reverse chain. Unlike the forward chain, there are a lot more sources of raw materials and they enter the reverse chain at small cost or at no cost at all. However, although obtained for “free”, the value of return flows is low and may be limited to a small fraction of the flow;
- unexplored market opportunities. Environmental requirements can be the basis of the creation of new markets or result in the reorganization of existing ones for by-products of the production process. With such reorganization, materials that would otherwise end as wastes would turn into useful products.

2. Design principles for reverse logistics

From reverse logistics point of view, we are able to following important rules Impose sustainability standards on suppliers. Selecting sustainable suppliers requires additional selection criteria. One of the issues to be solved is the supplier paradox: the one supplying reusable parts may loose most business. This needs to be compensated, for example by outsourcing repair to the original supplier, who as a bonus also has most knowledge and dedicated equipment. Also, suppliers may co-design the product to enable modularization and design for recycling (Tsoulfas, G.T., Pappis, C.P., Minner, S., 2000).

Make use of accounting systems that account for the full life-cycle costing of a product or service, and the environmental impacts it creates. Based on this, develop and design recoverable products, which should be technically durable, repeatedly usable, harmlessly recoverable after use and environmentally compatible in disposal (Gotzel, C., Weidling, J.G., Heisig, G., Inderfurth, K., 1999). Extending service and function, especially at the usage phase, improves eco-efficiency and reusability. Modularity and standardization also improves opportunities for repair and (cross-supply chain) reuse of components and materials.

Make use of management tools, such as ISO 9000-14000, life cycle analysis, environmental accounting methods, that may help business to identify and select opportunities for improvement. For example, using less energy is obviously good for the environment. It is also self-evidently good for business because it cuts companies' costs, and eventually avoids potential environmental liabilities. It is, therefore, a prerequisite to the long-term sustainability of business. To replace non-renewable and polluting technologies, it is crucial to support the use of solar, wind, water and geothermal energy (among others), as well as reduction in energy consumption.

Create new markets. The environment can be at the basis of the creation of new markets or of the reorganization of existing ones for certain (material) flows resulting from the production process. With such a technical reorganization, materials that would formerly have ended as wastes are turned into useful by-products (Faucheux, S., Nicolai, I., 1998). Facilities should be located close to possible end-users. Such a policy would ease the direct delivery of used products from end-users (Angell, L.C., Klassen, R.D., 1999). Furthermore, companies can also offer waste disposal services (Corbett, C., van Wassenhove, L.N., 1993).

Manage additional uncertainty. In recovery situations only a part of the flow is valuable, but it is hard to say beforehand which part. This means that sorting and initial testing should be decentralized to separate junk from valuable returns. The same goes for sorting and volume reduction in e.g. plastics recycling. Intrinsic to the push-pull nature of reverse channels, there will often be a mismatch between supply and demand for recyclable products and choice of the right recovery channels, even in situations with perfect information. E-market places provide a good support tool. Companies that manipulate materials and energy should be organized in such a way that they can respond rapidly to changes in management and processes. Changing demands for goods and services will also push design changes. The study of alternative plans is necessary in order to achieve eco-optimization. "Do the same but do it better or try to do something different" (Angell, L.C., Klassen, R.D., 1999). Pro-activeness, especially to intended legislation, has proven to be effective in many situations. Match network design with recovery option. Regarding cost and service driven network design, (Fleischmann, M., Krikke, H.R., Dekker, R., Flapper, S.D.P., 2000) give an overview of case studies. They conclude that compared to traditional forward logistics, reverse logistics has some distinguishing common characteristics, in particular in terms of processes to be carried out. Typical characteristics of product recovery networks include a convergent part concerned with collection and transportation from a disposer market to recovery facilities, a divergent part for distribution to a re-use market, and an intermediate part related with the recovery processing steps required. Moreover, they derive typical types of networks per recovery option, where they distinguish networks for material recycling, remanufacturing, reusable components, reusable packaging, warranty and commercial returns. These network types generally differ in terms of network topology, the role of and cooperation between actors and the collection and routing system used.

Environmental aspects may influence network topology, the role and cooperation between actors and the collection and routing system used, and they also raise the issue of product design as a critical element (Tsoulfas, G.T., Pappis, C.P., Minner, S., 2000). Decisions to be taken concern modularity, kind of materials, involvement of suppliers (co-design), disassemblability, life cycle considerations, type of equipment used and standardization of modules/components in the product. Parameters affecting the decision include pollution generated, energy use, residual waste, life cycle cost, production technology, secondary materials, by-products, recyclability, product complexity, product function, and so on.

Enhance quality and rate of return. In a multicriteria model presented by Krikke at all (Krikke, H.R., Bloemhof-Ruwaard, J. M., Van Wassenhove, L.N., 2000) that optimizes the supply chain of refrigerators on both economic and environmental (LCA based) criteria. The model is run for different scenarios using different parameter settings such as centralized versus decentralized operations, alternative product designs, varying recovery feasibility and return quantity, and potential EU legislation. The most important conclusion of the project is that, next to efficient logistics combined with optimal product design, system optimality depends on return quality and rate of return. In fact, in this case study these effects outperform the impact of product design and logistics network structure.

3. Conclusions

Generally it is well known that sustainability is costly and the domain of environmental idealists. Few companies have established reverse logistics in form of closed loop supply chains and the ones that have usually implemented end-of-pipe solutions are enforced by law. Present results on the state of the art of "reverse logistics" and conclude - amongst other things- that "the state of development" of "reverse logistics" is analogous to that of inbound logistics of 10-20 years ago.

Although one case is insufficient to draw generic conclusions, that the most eminent mistakes made by business companies are:

Life cycle approach is missing. Many troubles in recovery phase are caused by bad product design. Reverse logistics process should be designed in concert with the forward logistics. Sometimes this requires a partial redesign of the forward logistics as well. Existing supply chains thus strongly affect the design of reverse logistics but may also be affected themselves. Extend service and enhance function, especially at the usage phase, to improve eco-efficiency and reusability.

Optimization on out-of-pocket costs only. In the reverse logistics, next to out-of-pocket costs we must also include obsolescence costs and service related criteria must be included. This is in fact a very old principle. The importance of lead time effects both on costs and service level has been extensively reported in classic logistics literature. However, there is a danger that reverse logistics is going to reinvent the wheel at this point.

Neglect of sustainability as an optimization issue. It is necessary to develop and design recoverable products, which should be technically durable, repeatedly usable, harmlessly recoverable after use and environmentally compatible in disposal. Very important is to add energy use of the entire system as an optimization criterion. Using less energy's obviously good for the environment. It is also self-evidently good for business because it cuts companies' costs, and eventually avoids potential environmental liabilities. It is, therefore, a prerequisite to the long-term sustainability of business. To replace or reduce the use of non-renewable and polluting technologies, it is crucial to support the use of solar, wind, water and geothermal energy (among others), as well as to reduce energy consumption. A number of management tools, such as environmental assessment, life cycle analysis, environmental accounting methods, but also "simple" logistics principles can help business identify and select opportunities for improvement.

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