

The Challenge of Closed-Loop Supply Chains

by

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What is a closed loop supply chain and how does it differ from a traditional supply chain?

In a forward loop supply chain, the customer is typically the end of the process. However, in a closed loop supply chain, the returns processes are also considered, with the intent of capturing additional value and providing a more complete integration of all supply chain activities. Therefore, closed-loop supply chains have traditional forward supply chain activities and a set of additional activities required for the reverse supply chain. These additional activities include:

- *product acquisition* – the activities required to obtain the products from the end-users,
- *reverse logistics* – the activities required to move the products from the points of use to a point(s) of disposition,
- *test, sort and disposition* – the activities required to determine the condition of the products, and the most economically attractive reuse option,
- *refurbish* – the activities required to execute the most economically attractive option: direct reuse, repair, remanufacture, recycle, disposal,

- *remarketing* – the activities required to create and exploit markets for refurbished goods and distribution.

A reverse supply chain is an important business process that requires careful design, planning and control. Until the proper context is defined and set, reverse supply chains will be different in nature from forward systems. Although we have been able to establish common activities for reverse supply chains, understanding of these activities in different contexts is far from complete since they vary in complexity and managerial importance from scenario to scenario. The situation is further complicated since products may be returned during the product lifecycle (commercial returns, warranties, repairs), at end-of-use, and at end-of-life. Each returns type requires a reverse supply chain that considers the characteristics of the returned products to optimize the value recovery process.

Forward supply chains are accepted as important processes in business practice; they receive C-level attention and supporting services have created the right context for these processes to be fluid and effective from end-to-end. Forward supply chains have integrated many interdisciplinary elements, including legal issues, governmental policies, environmental concerns, and collaboration (contracts) with partners. There are active, established and rigorous academic research programs dedicated to understanding and improving forward supply chains.

Today, industry and academia rarely consider the reverse supply chain as a business process. Instead, they look at it as a series of relatively independent activities, i.e. they use a silo approach to reverse supply chains. In addition, the focus of both industry and academia is operational or tactical, as opposed to strategic. Both groups assume the larger strategic question of profitability has already been resolved; which is incorrect. In our experience, many firms look at

remanufacturing as the technical operational problem of how to turn a not well-functioning returned product into a functioning product satisfying all quality requirements of a new product.

Companies often passively accept returns from the market or the channel. They do not actively manage the acquisition process, hence returns are uncertain in quality, quantity and timing, and corresponding remanufacturing costs and selling opportunities are not aligned. Similarly, sales and marketing departments are not concerned with remanufacturing. At best, they are neutral, more often they fear remanufactured sales will cannibalize new sales and damage brand image. Additionally, sales persons typically receive lower commissions from the sales of remanufactured products. Sales channels for remanufactured products are ill-developed, and sales are also uncertain in quantities and timing. Finally, design engineers are rarely encouraged to consider product design for disassembly, or easy remanufacturing.

Reverse supply chains researchers and practitioners can learn from the experiences and practices used in forward supply chains, but first they need to adopt a business approach to the entire process. Concentrating on the technical aspects of remanufacturing, passively accepting returns, and spending little effort in developing sales channels for the remanufactured products is not going to make reverse supply chains effective, let alone profitable. For a complete discussion of the business aspects, see Guide and Van Wassenhove 2003.

A silo approach to reverse supply chains also ignores the importance of speed. Fast response time is commonly accepted for forward supply chains, especially in fast clockspeed industries where value erosion of products is considerable. Given the increasing trend in commercial returns from consumers, having a passive silo approach to the reverse process can result in incredibly slow velocity with the consequence that most value in the remanufactured product is lost by the time it hits the market again.

Even if a company has the right business model it has to be carefully operationalized and integrated. Given that the context of reverse supply chains is not as stable and well-defined yet, every key activity in the process (acquisition, reverse logistics, sorting testing and disposition, remanufacturing and remarketing) is a potential showstopper. The activities are interrelated, mutually reinforcing and many of them depend on business functions that typically do not belong to the supply chain like marketing or product design. Given that reverse supply chains are not the core business (an understatement), aligning all of these, getting the right level of resources and a minimum of C-level attention is difficult. This does not necessarily make reverse supply chains different, but the issues and the context are certainly very different with respect to their level of maturity and attention (see Dekker et al. 2003 for a description of quantitative models in reverse logistics).

Previous research and current practice

Reverse and closed-loop supply chains, including remanufacturing, are not new. Industry has been remanufacturing in some industry segments since the 1920s (e.g., automotive parts). Large, expensive assets were originally designed for extended product lives as long ago as the 1800s, e.g., steam locomotives. Aircraft and ships are still designed and maintained for a very long product life. The military has routinely practiced remanufacturing of assets for decades. There has been research on remanufacturing since the early 1980s, including the seminal report for the World Bank by Robert Lund (1983). However, the majority of the research has been published since 1990, and is focused on technical issues of an operational or engineering nature.

There has also been considerable research into ‘green supply chains’ or ‘environmentally responsible manufacturing’. However, no company will rationally invest in environmental issues

to “save the earth”. That’s not what companies are for, and legislation is not going to change that, except perhaps make things worse if we are not careful. Legislation may impose constraints on companies that lead to higher costs and as well as increased environmental impact. Companies will then require others to absorb the costs. In short, they see the environment as a burden, a cost to be minimized, not an opportunity. A viable business model needs to be proposed that marries good business sense with environmental sustainability and allows companies to create value out of returned products.

Of course, there are clear examples where sustainable solutions will never be profitable, no matter how intelligent or innovative the business model. In those cases, legislation may be the only solution. But our general view is that legislation can and should be a “gentle push” to overcome the hurdle, bring things to the attention of business and so on. It should be “flexible”, i.e. give business a chance to organize things themselves, and it should be temporary, i.e. be deleted if business is taking care of things.

Companies have become increasingly interested in reverse supply chains for economic reasons in the United States and in the European Union (EU) because of legislation. Much of remanufacturing until recently was concentrated in limited volume operations for very high value goods. However, companies are now increasingly remanufacturing large volumes of relatively low value items, e.g., mobile telephones and inkjet printers. Companies in the U.S. also have to deal with the problem of commercial product returns during the lifecycle of the product. Commercial product returns are now getting corporate level attention in a few companies because of the high amount of value being lost there (\$100 billion annually).

Future challenges

Increased global competition, shorter lifecycles, environmental legislation and more lenient commercial take back regulations for customers will all lead to increased product returns. Decreasing margins in global markets with overcapacity, together with increased returns that are expensive to handle if they have not been integrated in product designs in the first place, or are not handled as an integrated business process, will lead to losses. Companies will realize that perhaps they need a lifecycle approach to products; that is an approach that integrates all product returns (commercial returns, warranty returns, repairs, end-of-use returns, end-of-life returns) right from the start when the business model for the product is created. Companies must not only design the integrated product/process/supply chain for the forward supply chain (3-dimensional concurrent engineering or 3D-CE), but also the entire reverse supply chain for all types of product returns, including final environmentally friendly disposal. This lifecycle approach goes beyond the current forward supply chain ideas. It is quite possible that the pressure on companies to find better ways to handle returns will lead to exploration of new territory in the field of supply chain management.

Going one step further still, one could argue that concern for product returns of different types during the lifecycle may increasingly lead to business models where product ownership is replaced by creative service offerings. It may accelerate “servicizing” of business. Again, this would lead traditional supply chain research into unexplored territories, or currently insufficiently explored territories. In addition, it may have the great side-benefit of bringing business concerns of value creation closer to industrial ecology concerns for sustainability, and this may help resolve the sometimes perceived, or real, conflict between profit and environment

by showing that sustainable business from an ecological perspective can be sustainable from a profit perspective as well.

We believe the world is changing very rapidly and companies, in cooperation with academics, must quickly develop supply chains that are capable of handling coordinated forward and reverse flows of materials. In order to accomplish this goal, several key items must be in place. First, and perhaps foremost, there must be methods developed that show managers the untapped potential benefits from developing reverse supply chains. If managers cannot quantify the potential financial (and non-financial) benefits, there is very little possibility that return flows will ever be seriously considered as more than a nuisance, where we must minimize the maximum loss. Second, new business models are necessary that show top management how to release the enormous amount of value that is presently unrecognized and unappreciated. Finally, new operational models are required to show how to manage the day-to-day tactical elements so that the business objectives are realized.

The interesting problems for business today are not tactical or operational in nature like most typical OR/OM optimization models. The business problems tend to be strategic and somewhat unstructured. There is a considerable upfront investment for a researcher trying to understand the issues in practice by digging into the details of how companies do things today in reverse supply chains. Then, if a researcher understands several companies, she can generalize some issues in a sector, structure the problem, make abstractions and formulate a model that will lead to nice and clean (i.e. publishable) results. Many researchers in the top-journal publication mode do not have the patience, or the time on their promotion clock to first invest in all of this. Stated differently, it is much easier to take a well-developed and conventional problem area and to derive an extension to an existing body of results.

It may simply be that conventional supply chain researchers, like any other field, are conservative and reluctant to change. It is uncomfortable to acknowledge new issues that challenge existing notions and well-developed jargon. It is much easier to state “there is nothing new under the sun. It is all an extension of forward supply chains”. That reaction is normal, human and intrinsically sound. Science needs to be careful (conservative) but not blind with respect to new things that challenge or enrich the discipline.

Closed-loop supply chains open up a new and interesting set of issues to be addressed by industrial practice. There is also great potential for meaningful academic research that takes into consideration the interdisciplinary nature of the problems and considers the need to develop frameworks and models that take an integrated business process perspective.

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