4th International Conference on Industrial Engineering and Industrial Management
XIV Congreso de Ingeniería de Organización
Donostia- San Sebastián , September 8th -10th 2010

A management model for closed-loop supply chains of reusable articles: defining the issues

Ruth Carrasco-Gallego, Eva Ponce-Cueto

Escuela Técnica Superior de Ingenieros Industriales. Universidad Politécnica de Madrid (UPM). C/ José Gutiérrez Abascal, 2. 28006 Madrid, Spain. ruth.carrasco@upm.es, eva.ponce@upm.es

Abstract

In this paper a conceptual model for the management of closed-loop supply chains of reusable articles is put forward. This framework condenses the more relevant managerial issues arising when reuse is carried out in industrial practice. The model intends to be a guideline for practitioners dealing with this type of challenges and constitutes a first step towards the mitigation of the problematic issues involved in reuse. In further developments of this research, we propose solutions to some of the issues identified here.

Keywords: reverse logistics, closed-loop supply chains, reuse, sustainable SCM.

1. Introduction

In the last few years, many industrial companies have realized that product reuse can be an interesting practice to achieve a more environmentally friendly supply chain. Many items involved in sourcing, production and distribution processes in the extended enterprise can be designed for durability and be used multiple times by different supply chain partners along the product value chain. We refer, for instance, to:

– Returnable Transport Items (RTI), such as pallets, crates, railcars or maritime containers,

– Reusable Packaging Materials (RPM), such as glass bottles, gas cylinders, beer kegs or barrels for chemicals,

– Reusable Products (RP), where the article reused is not a packaging element but the product itself. Examples for this last category are for instance durable tools and instruments required for maintenance operations in manufacturing processes.

Management of reuse closed-loop supply chains is not straightforward. Many companies that have turned into reusable packaging from disposable packaging materials have encountered difficulties in managing their fleets of reusable articles. In the automotive industry -a sector widely recognized for the excellence of their logistics procedures- many assemblers have

This work stems from the participation of the authors in a research project funded by Plan Nacional de I+D+i, reference DPI2007-65524, title DOLI "Análisis y desarrollo de técnicas para el Diseño y la Operación de sistemas de Logística Inversa".

decided to finally outsource the ownership and management of the reusable packaging they use (crates, racks, etc.) to a third party, given the problems encountered when substituting disposable packaging elements for reusable ones (Roseneau et al., 1996). Other industries where reuse has been practiced for a long time, such as beer brewers, report similar management difficulties (Breen, 2006; Wyld, 2009). Reusable articles constitute a shared resource in the supply network: they travel beyond the boundaries of the organization and their control involves several actors (suppliers, manufacturers, distributors, end customers) having different objectives and incentives. Their management requires a good amount of coordination and incentives alignment.

2. Objectives and methodology

In this paper we intend to contribute to academic knowledge and to industrial practice by providing a conceptual model for the management of closed-loop supply chains (CLSC) of reusable articles (RA). This framework intends to be a guideline for practitioners in order to identify the more relevant management issues in which they have to focus on. In future developments of this manuscript, we intend to propose several solutions for helping managers to deal with these issues.

The model we propose is based on (a) our experience about the managerial concerns involved in reusable articles CLSC and, on (b) our review of the related literature. Our empirical experience has been acquired through our past professional practice and through our involvement in six case studies we have conducted in real industrial settings. Besides, we also support our statements throughout the text on the results from other researchers appearing in published sources.

Table 1 provides a brief description of the six case studies that empirically support our results. More detailed information about them can be found in Carrasco-Gallego et al. (2009).

Table 1. Six industrial case studies (own development).

Nb.	Name	Brief Description	Reusable article type
1	MedGas	Multinational company producing and distributing medical oxygen in cylinders.	RPM Oxygen cylinders
2	LPG	Multinational oil company distributing Liquified Petroleum Gases in cylinders to households.	RPM LPG cylinders
3	Erasmus MC	Hospital in the Netherlands. Reusable surgical instruments are sent to sterilization to a Central Sterilization Department.	RP Surgical tools
4	Service tools	Equipment manufacturer holding local inventories of service tools for customers' equipment maintenance purposes. Service engineers borrow tools from the warehouse when needed.	RP Service tools
5	Shopping carts	Retailing surfaces in the Netherlands.	RTI Shopping Carts
6	Stapelwagen	Global flower broker using roll cages specially designed for the horticultural supply chain.	RTI Flower roll cages

The reminder of the paper is organized as follows. In section 3, we identify and describe the three common problems found in reuse CLSC. Next, in section 4 we present the basic information required to manage a CLSC of reusable articles. The main issues in which managers have to focus on in order to achieve more efficient operations in reuse CLSC are listed and explained in section 5. Finally, in section 6 we present our conclusions and future research lines, which include the proposal of some solutions to the management issues identified in this manuscript.

3. Common problems found in reuse closed-loop supply chains

3.1. Fleet shrinkage

Typically, in reuse CLSC the fraction of articles returning to the system (the yield) is high when compared with other types of CLSC, such as those involving commercial returns or remanufacturing. A very high return rate (close to 100%) is one of the particular characteristics that make reuse CLSC different from other CLSC. However, even if most demand is fulfilled with used products, not all the RA sent to the market will return to the system in order to enter in a new reuse cycle. Some articles will be irreparably damaged, misplaced or stolen. The fact that there are “leakages” in the fleet of reusable articles has been widely recognized either in academic and practitioners-oriented literature (Kelle and Silver, 1989a,b; Roseneau et al., 1996; Breen, 2005; Wyld, 2009).

3.2. Significant investment

Generally, individual units of reusable articles are relatively inexpensive. However, it is also typical that enormous amounts of units are required to run operations. Therefore, if the system is considered as whole, the amount of capital immobilized in the form of a fleet of reusable articles can become really significant. For instance, Roseneau et al. (1996) reported of investments in reusable containers for a single automotive assembly plant of up to $35 million, where each container was $100-$600 worth.

Given the impressive amounts invested in the whole fleet, reusable articles should be considered as corporate assets. However, the fact that each individual article is relatively inexpensive leads them to be considered many times as expensed items. Supply chain partners often do not realize of reusable articles’ intrinsic value and tend to neglect their caring and quick return. Even internally, as the investment in reusable articles is usually phased, making many little purchases over a long period of time, reusable articles are not considered as the valuable asset they are.

3.3. Limited visibility

Reusable articles are not kept in a single location. They constitute a shared resource that can be located in the sites of different supply chain partners. During this “customer-use” stage, articles remain out of the control of their owner. However, given the low unitary value of each individual reusable article, it has been difficult to justify a tight monitoring over each unit in the past. Neither big administrative efforts nor important IT investments (Kelle and Silver, 1989a) seem to have been justified in the past. The value of the information that could have been obtained about the “customer-use” phase did not overcome in many cases the costs of obtaining such information.

As a result, historically, in many businesses reusable articles were not serialized and were only controlled based on account management. Item-level tracking was rare and, therefore the management of RA CLSC was carried out with very limited visibility in the customer use stage of RA life cycle (unobservable part of the supply chain). It was difficult to obtain accurate information about how many articles are lost in the unobservable part of the supply chain, how long does it take for a reusable article to return to a depot and be ready for reuse again or how many articles are available in each location of the supply chain.

In the last few years, however, the cost of tracking technologies (RFID, bar codes, associated software) has steadily decreased. Many companies have started to experiment with RFID technology by launching pilot applications in their reusable articles fleets. As a result, the number of item-level tracking applications for medium value reusable articles has been increasingly growing in the last few years. Some recent case studies include Hellström

(2009), Ilic et al. (2009) or Carrasco-Gallego and Ponce-Cueto (2009). In all these experiences, authors coincide to highlight that enhanced visibility over the customer-use stage of RA lifecycle, accompanied by proper actions and continuous management attention, results in a reduction in the number of units in circulation (fleet size reduction) and in a reduction of fleet shrinkage rates.

4. Basic parameters

Three parameters have been identified as the basic information (metrics) required for managing a CLSC of reusable articles. These three parameters are return rate, cycle time and on-hand inventory in each location. We discuss them in turn.

Return rate is defined as the percentage of RA that eventually return to the depot after having been issued to the market.

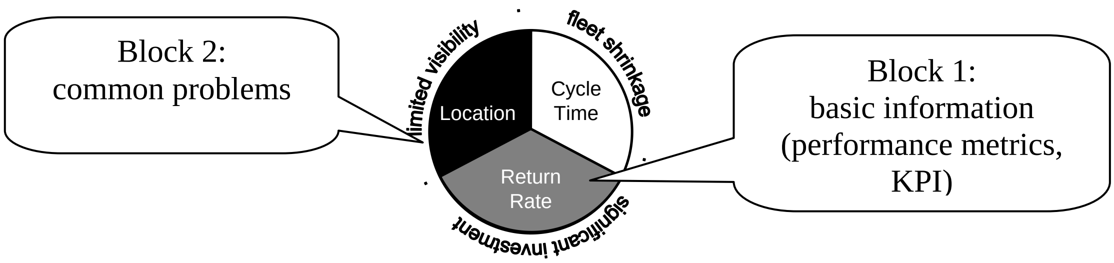
Cycle time is defined as the time elapsed between the issue of an article and its return to the depot to be reused again. Cycle time comprises the storage times in all the stages of the supply chain (manufacturer, distributor, etc.), the transportation times between locations, the time required in the use stage at the customer and also the time required for putting the RA in condition to be reused again (small repairs, filling, sterilization, etc. - reconditioning).

Cycle time may be described by a statistical distribution, although a non stationary description may be necessary. Cycle time distribution includes a finite probability that the article is never returned (infinite cycle time) that corresponds with the return rate.

The *on-hand inventory in each location* (how much RA inventory is available in each stage of the supply chain) is sometimes difficult to quantify, due to the lack of visibility. When item-level tracking is not available or not economically justified, the inventory associated with a given location can also be obtained through registration of the incoming and outgoing quantities (account management), although this approach is not exempt of some shortcomings.

Figure 1 depicts the two first building blocks of our conceptual model: common problems in reuse CLSC and a nucleus with the basic information required to tackle these problems. This basic information can also be interpreted as the set of performance metrics or key performance indicators (KPI) that can be used to monitor a continuous improvement program in a system of reusable articles.

Figure 1. A management model for reuse CLSC: common problems and basic information (own development).



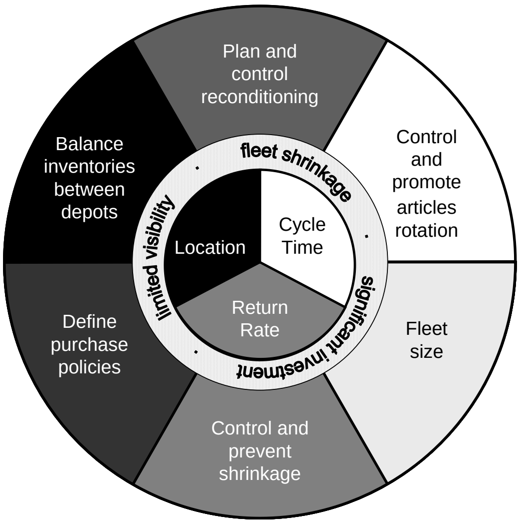
5. Management issues

Management of closed-loop systems of reusable articles is not a simplistic task. Depots need to assure that they are able to fulfil demand depending heavily on returned articles (return volumes are typically over 90% and most demand is fulfilled with reused articles). However, returns are subject to a high degree of uncertainty in their timing, quantity and quality.

In order to match demand and returns, firms deal with the challenges depicted in Figure 2. The following six management issues constitute the third building block in our framework.

Note that our focus is on the management aspects (tactical and operational issues) in a system that is already in place. Design aspects of the system, such as network design, actors involved in the supply chain, relations and cost allocation between these agents, etc. remain out of the scope of this framework.

Figure 2. A management model for reuse CLSC (own development).



5.1. Issue 1: Define the fleet size dimension

One of the first questions managers need to deal with when implementing a system of reusable articles is the number of units in circulation required to keep operations running smoothly (Goh and Varaprasad, 1986; Fleischmann et al., 2000). As noted in 3.2, the purchase of the initial RA fleet generally constitutes an important initial investment. An overdimensioned RA fleet unnecessarily ties up capital and adds holding costs. On the other hand, an undersized RA fleet will cause unsatisfied demands and costly stockouts.

We use the term "fleet size" to refer to the total number of RA that are in circulation in the whole supply chain, including reusable articles inventory levels at supply chain partners and RA in transit (forward and reverse) between locations. There is not a standard term in literature to refer to this variable. In the beer business, practitioners use the term "float" (Bryson, 2005; Wyld, 2009). However, in other practitioners' oriented papers with a more general scope (Aberdeen, 2004) and in academic papers (Roseneau et al., 1996, Johansson and Hellström, 2007), the term "fleet" is mostly used and is the one we adopt in this paper.

The number of articles needed in circulation in the whole system depends on the demand for RA and the time a RA requires for completing the whole logistics cycle (from its issue to the moment in which it is ready for reuse again). Long cycle times require larger fleet sizes. Surprisingly, our own case studies and the review of literature have shown that there is not a clear methodology in industry for calculating the fleet size. Investments in RA are usually based in experience and simple calculations (van Dalen et al., 2005, Hellström, 2009). For instance, in the beer industry, the "rule-of-thumb" is that for every keg on tap in the customer another extra seven kegs are required to cover kegs in transit, in maintenance, in stock in the wholesalers, distributors, etc (Bryson, 2005; Wyld, 2009). Therefore, for every pouring tap, eight kegs are required. Similar rules of thumb are used in the oxygen (Case #1) and LPG industries (Case #2). Of course, such simple criteria vary with the particular characteristics of the supply chain: number of middlemen (echelons), average time spent in each stock location, average time articles are in use at the customer, geographical distances, etc.

To be noted that the typical safety stock formula for gaussian approximations of demand ($\mu + k\sigma$, μ is the expected demand for RA, σ represents RA demand dispersion and k represents the service level; Johansson and Hellström, 2007) is not valid for determining the required system-wide fleet size. The issue here is not determining how much stock must be kept in a given location for satisfying a prestablished service level but to decide the total number of units that need to be circulating in the whole supply chain (multiple locations) in order to guarantee that given service level (avoid stockouts). The above formulation only takes into account the demand for RA, but ignores the fact that the same unit of RA can be used for satisfying a set of demands during the time horizon of analysis.

This situation calls for clarifying which are the variables involved in fleet size calculations and for proposing a methodology for its computation, as we will do in further developments of this manuscript.

5.2. Issue 2: Control and improve return rate

The economical efficiency of the RA system directly depends on the velocity with which RA travel around the supply chain. The faster articles circulate in the system, the smaller is the required fleet to fulfil a given demand with a given service level. A short cycle time renders a high number of article uses per time unit. As far as cycle time is concerned, managers have to deal with two main challenges. First, how can cycle time metric be measured and controlled. Second, which managerial actions can be implemented in order to reduce cycle time (encourage as much as possible the turnover (rotation) of RA in the system).

The first challenge (metric measurement) is related with the limited visibility available in the customer use stage of the CLSC. Unless some type of item-level tracking is put in place, accurate information about the average cycle time, a measure of its dispersion and the cycle time distribution shape would be at least complicated to obtain. However, as noted in 3.3, most closed-loop systems of reusable articles have been traditionally managed without item-level tracking. At best, only account management (aggregate issues and returns in a period of time) information has typically been available. With no serialization of RA it is not possible to obtain empirical observations of the turnaround process of RA and its cycle time. Nevertheless, academic literature cover a few applications of statistical methods in order to draw from models relevant cycle time distribution parameters, such the ones described in Goh and Varaprasad (1986) and Toktay et al. (2000). In both applications, a dynamic regression is established between aggregate issues and returns time series. Cycle time distribution parameters are drawn from the dynamic regression model estimation. However, both cases assume a stationary cycle time distribution, while empirical observations show that the turnaround process duration may also depend on the season, if product (RA) demand show seasonality (Van Dalen et al., 2005, Van Dalen and Van Nunen, 2009; Carrasco-Gallego and Ponce-Cueto, 2009, Case #1 (Medgas) and Case #2 (LPG)). Then, when a non-stationary description of cycle time distribution is necessary (which is the case of articles with seasonal demand), item-level tracking seem to be the only realistic option to obtain information about the turnaround process. For these purposes, item level tracking does not need to be implemented in the whole fleet. Serialization can only be carried out on a sample of articles. The resulting cycle times and other turnaround process parameters empirically observed in the sample can be inferred (if experiments are well designed) to the reusable articles population.

Once the cycle time distribution has been estimated (cycle time metric is measured), the second challenge introduced at the beginning of this subsection can be dealt with: which managerial actions can be undertaken in order to reduce cycle time metric? While managers will have direct control over some stages contributing to the total cycle time, in the unobservable part of the supply chain, the return velocity depends on supply chain partners' behaviour. The desired behaviour can be induced through recovery incentives (different types of incentives will be analyzed in further development of this study). In the stages under our direct control, we can adopt different courses of action in order to reduce long cycle times, such as accelerating reconditioning lead times or delivering/collecting more frequently at distributors and customers. For this purposes, keeping in mind some factors that contribute to increasing the cycle time in RA CLSC can be useful:

large stock quantities of used and reconditioned articles at depots,

long reconditioning lead times (for filling, repair, sterilize, etc.),

long transportation distances,

infrequent deliveries and collections at distributors and/or customers,

long supply chains with a high number of intermediaries,

excessive customer holding time.

5.3. Issue 3: Control and improve cycle time

Regarding return rate, two analogous challenges arise. First issue is how to determine a metric for measuring the current return rate in system. Once the current return rate is known, the next step is to determine which management controls can be introduced for preventing loss and increasing returns (Fleischmann et al., 2000). The economical efficiency of the system improves if less RA have to be purchased in order to replace the lost or irreparably damaged articles.

As far as return rate control is concerned, quality losses (due to RA deterioration) can be much more easily measured because damaged articles are rejected in the part of the supply chain which is under depots' control. On the contrary, losses due to fortuitous misplacement or deliberate fraud (incidental or structural losses) are more difficult to monitor because they happen in the unobservable part of the supply chain.

As a result, obtaining the overall return rate (including the three types of losses origins: quality, incidental and structural) is not straightforward. The six case studies we conducted in the field and the results published by other researchers show that most firms dealing with reusable articles are not able to quantify with precision their current return rates. In a further article, we will compile the different methods used in practice for estimating the return rate under different informational levels: account management and item-level tracking.

Once the current return rate of the system is measured, managers can focus in the courses of action that can be launched in order to obtain higher return rates. Recovery incentives are powerful tools in order to discourage article leakage. Visibility in the unobservable part of the CLSC, at least to a extent that enables to know where in the system there are more leakages, can also provide good results.

5.4. Issue 4: Define purchase policies for new articles.

Fleet shrinkage has consequences both in the finance and operations functions. Lost assets have to be written off from the balance sheet. In addition, even in the case of a level demand pattern, new reusable articles (assets) will have to be purchased from time to time in order to substitute the irreparably damaged, lost or theft articles. In this "replacement" situation, managers need to determine the optimal procurement policies (for new articles) and their optimal control parameters. For this purposes, some inventory control models proposed in the body of CLSC literature can be useful. For instance, Kelle and Silver (1989b) develop a model for calculating the optimal purchasing lot-sizes considering the trade off between purchasing and expected holding costs over a finite time horizon using a traditional Wagner-Within approach.

Procurement of new articles not only takes place in a steady-state replacement situation. Besides the initial acquisition of the fleet, new articles (assets) also have to be purchased when the fleet size has to be redefined due to structural changes in demand or cycle time: a sudden increase in RA demand (because of, for instance, the addition of new markets to be served from the same plant) or an enlargement of cycle time motivated, for instance, by longer travelling distances, require more units of RA in circulation. This type of situations requires a redesign of the fleet size that is not to be addressed through “replacement” inventory control models but through a review of the reusable articles system design (re-calculate the fleet size dimension).

5.5. Issue 5: Plan and control reconditioning activities

Even if the number of RA in circulation in the network is accurate, depots need to assure that articles are returned and reconditioned at the right time in order to fulfil demand. In real industrial settings, the reconditioning capacity is not infinite (Kelle and Silver, 1989a) and therefore, “reconditioning” plans (similar to manufacturing plans) have to be carried out for the necessary activities that put the article into a usable condition again. This planning involves forecasting the expected demand and the expected returns in a given time period. If the reconditioning capacity is not enough to match the forecasted demand and returns then some course of action has to be undertaken, such as buying new reusable articles or searching for extra reconditioning capacity.

Using the available capacity for reconditioning activities was found to be a management issue in several of our case studies (Case #1: MedGas, Case #2: LPG, Case #3: Erasmus MC). Giuntini and Andel (1994) also remark this aspect:

“In most organizations, fewer than 50% of returnable containers are available for use at any one time. The rest are floating around customer sites or stacked in the warehouse in some unusable condition”.

5.6. Issue 6: Balance inventory between depots

This challenge only concerns multi-depot networks, where RA do not have to return to the originally issuing depot (in multi-depot networks, RA physical flows follow a many-to many configuration). In this case, periodical rebalancing of the number of RA among facilities is required, so that the inventory in each depot is sufficient to cope with the demand for RA it faces (note that demand in each depot is dynamic – changes over the time – and uncertain). Rebalancing involves transhipments between depots from time to time in order to relocate RA from locations with an excess of inventory to locations that can eventually experience a stockout.

Network flow models are typically for inventory rebalancing between depots at the minimum costs. The use of this type of models has been widely reported in the transport sector (railcars, trucking operations, maritime container systems). Models were firstly formulated within the classical transportation construction (Misra, 1972). Next, the transportation models were extended into the transhipment formulation in order to include the dynamic characteristics of demand using time space networks (White, 1972). Later on, stochastic demands were included as well (Jordan and Turnquist, 1983). More recent references on the same topic include Crainic et al. (1993) or Erera et al. (2009).

6. Conclusions and further research

Durable products that are used multiple times reduce the amount of materials and energy required to carry out operations in the supply chain. However, even if reusable articles contribute to the environmental sustainability of supply chains, their management poses a variety of challenges and issues that may hinder a more extensive adoption of reuse practices. The conceptual model (framework) we propose in this manuscript identifies and condenses these challenges in three building blocks (common problems, basic information and management issues) and intends to constitute a first step towards the mitigation of the problematic issues involved in reuse.

This conceptual model will be further developed by proposing several solutions to the management issues presented in this manuscript. The set of solutions include a series of incentives aiming at prevention of loss and rotation promotion and also a methodology for determining the fleet size required in the system. This methodology is based in the yardstick existing between demand, cycle time and fleet size dimension.

References

Aberdeen Group, Inc. (2004). RFID-enabled logistics asset management. Boston, Mass.

Bryson, L. (2005). Brewers, do you know where your kegs are? Solving the problem of disappearing cooperage. The New Brewer, September-October, pp.30-35.

Breen, L. (2006). Give me back my empties or else! A preliminary analysis of customer compliance in reverse logistics practices (UK). Management Research News, 29(9):532–551.

Crainic, T.G., Gendreau, M., and Dejax, P. (1993). Dynamic and stochastic models for the allocation of empty containers. *Operations Research*, 41(1):102-126.

Carrasco-Gallego, R., Ponce-Cueto, E., Dekker, R. (2009). A framework for closed-loop supply chains of reusable articles. Econometric Institute Report EI2009-21. [Available on-line]: http://publishing.eur.nl/ir/repub/asset/16707/EI2009-21.pdf

Carrasco-Gallego, R., Ponce-Cueto, E. (2009). Forecasting the returns in reusable containers' closed-loop supply chains: a case in the LPG industry. Proceedings of the 3rd International Conference on Industrial Engineering and Industrial Management, CIO 2009. Barcelona-Terrassa, September 2-4, pp. 311-320.

Carrasco-Gallego, R., Ponce-Cueto, E. (2009), Case studies on the adoption of radiofrequency identification (RFID) systems in Spanish companies. In: 16th International Annual EurOMA Conference. 14-17 June, Göteborg, Sweden.

Erera, A.L., Morales, J.C., and Savelsbergh, M. (2009). Robust optimization for empty repositioning problems. Operations Research, 57(2):468-483.

Fleischmann, M. Krikke, H.R., Dekker, R., Flapper, S.D.P. (2000). A characterisation of logistics networks for product recovery. Omega, 28(6):653–666.

Guintini, R., Andel, T. (1994) Track the coming, goings and costs of returnables. Transportation & Distribution, 35 (7): 55-60.

Hellström, D. (2009). The cost and process of implementing RFID technology to manage and control returnable transport items. International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management, 12(1):1–21.

Ilic, A., Ng, J., Bowman, P., and Staake, T. (2009). The value of RFID for RTI management. Electronic Markets, 19(2):125–135.

Johansson, O. and Hellström, D. (2007). The effect of asset visibility on managing returnable transport items. International Journal of Physical Distribution & Logistics Management, 37(10):799–815.

Jordan, W.C. and Turnquist, M.A. (1983). A stochastic, dynamic network model for railroad car distribution. *Transportation Science*, 17(2):123-145.

Kelle, P. and Silver, E. (1989a). Forecasting the returns of reusable containers. Journal of Operations Management, 8(1):17–35.

Kelle, P. and Silver, E. (1989b). Purchasing policy of new containers considering the random returns of previously issued containers. IIE Transactions, 21(4):349–354.

Misra., S. (1972). Linear programming of empty wagon disposition, Rail Int., 3, pp. 151-158.

Rosenau,W.V., Twede, D., Mazzeo, M.A., Singh, S.P. (1996). Returnable/reusable logistical packaging: a capital budgeting investment decision framework. Journal of Business Logistics, 17(2):139–165.

Toktay, L.B., Wein, L.M., and Zenios, S.A. (2000). Inventory management of remanufacturable products. Management Science, 46(11):1412–1426.

Van Dalen, J., van Nunen, J.A.E.E; Wilens, C.M. (2005). The chip in crate: the Heineken case. In: Flapper, S.D.P.; van Nunen, J.A.E.E.; van Wassenhove, L.N. (eds). Managing Closed-Loop Supply Chains. Berlin: Springer.

Van Dalen, J., van Nunen, J.A.E.E. (2009) Modeling the turnaround behavior of product carriers in the presence of highly-frequent information. Working paper. Erasmus University of Rotterdam.

White, W.W. (1972). Dynamic transshipment networks: An algorithm and its application to the distribution of empty containers. Networks, 2(3):211-236.

Wyld, D.C. (2009). The reverse logistics of beer: combating keg theft by better managing the “float” in the very unique supply chain for draft beer. Reverse Logistics Magazine, 17: 16-19.