On the attractiveness of product recovery:

The forces that shape reverse markets

Abstract
Product recovery is a major contributor for implementing sustainable business practices. Within such operations, which are either driven by legislation or economic rationales, practitioners face strategic issues concerning reverse market entry and positioning. Although the complexity of acting on reverse markets is widely acknowledged, a comprehensive framework to facilitate decision-making in this area is lacking. In an attempt to fill that gap, we develop a model that supports Original Equipment Manufacturers’ (OEMs’) assessment of the attractiveness of reverse markets. We identify, from a comprehensive literature analysis, in-depth interviews, and engagement with a dozen companies from different countries, factors that influence key characteristics of reverse markets, and consolidate this lengthy list into a comprehensive model intuitively applicable to business practice. The model combines five forces that drive reverse markets: Access to recoverable products, Threat of independent recovery companies’ (IRCs’) market entry, Rivalry for recoverable products, Adverse effects on core business, and Remarketing opportunities. We propose for each a set of attributes that influences its power and direction. To demonstrate the efficacy of the model, we apply it in two industry settings, recovery of white goods in the United Kingdom and paper recycling in Germany. The present research enables OEMs to understand the structure and forces that drive reverse markets, identify levers to influence those markets, anticipate market developments, and formulate resilient strategies for product recovery.

Keywords: Reverse logistics; Closed-loop supply chain management; Strategy development; Market analysis; Sustainability; Case studies
<heading level 1> Introduction

Product take-back and recovery have been shown, in numerous implementations of sustainable business operations, to generate significant revenue streams (Maslennikova and Foley 2000). Original Equipment Manufacturers (OEMs) that extend their core business through product recovery operations are usually seeking either to generate profits from replacement of primary inputs (recycling, retrieval) or to enter new market segments with reprocessed products (reuse, remanufacturing, refurbishing) (Stindt and Sahamie 2014). On the downside, product backflows increase the complexity of supply chains (Kapetanopoulou and Tagaras 2011), posing management challenges associated with, among other things, acquisition of collectable goods in sufficient volume and of suitable quality, peculiarities of the secondary market, and interplay with the marketing of new products (Nuss et al. 2015). The uncertainties that attend such considerations frequently discourage OEMs’ active involvement in markets for recoverable goods, which we term reverse markets.

Informed decision-making on the part of OEMs regarding entry and repositioning in reverse markets would benefit greatly from a structured assessment of the attractiveness of reverse markets, yet prior research has paid scant attention to the development of relevant models. Absence of this knowledge is posited as one reason “many companies are unwilling to enter the reverse logistics” arena (Krumwiede and Sheu 2002, 325) and thus miss profitable business opportunities (Geyer and Jackson 2004) that could enhance their competitiveness (Toffel 2003).

The present article attempts to fill this knowledge gap by systematically identifying, analyzing, and integrating, from the perspective of the OEM, the forces that shape the attractiveness of reverse markets. This research is informed by existing literature and by interviews and information gathered in industry projects conducted over the past decade.
involving a dozen companies in diverse industry sectors located in different countries. The fundamental strategic decisions being evaluated are whether an OEM should generally engage in product recovery and how it should position itself on respective reverse markets. These decisions are strongly connected to the attractiveness of a reverse market, which in turn is a function of influencing factors that shape these markets. The research process was guided throughout by the following research question:

*How can an OEM evaluate the attractiveness of a reverse market to support strategic decision-making?*

Specifically:

*Question 1 (Q1): What factors influence the attractiveness of a reverse market?*

*Question 2 (Q2): How can these factors be integrated into a comprehensive model?*

*Question 3 (Q3): How can such a model be integrated into a strategic decision-making process that considers both market knowledge and corporate capabilities?*

These questions, which drove our development of what we have termed the “Reverse Five Forces” (R5F) model for assessing the attractiveness of reverse markets, are addressed successively in the article. The factors (Q1) are identified at the beginning of the section headed “Forces in Reverse Markets” and are subsequently developed into the R5F model (Q2) in the remainder of that section. The model’s value for strategic decision-making with respect to reverse market positioning is demonstrated in the section headed “Empirical Validation: Case Studies,” and insights into its integration into a holistic corporate decision-making process
informed by a thorough understanding of target markets and corporate capabilities (Q3) related in the section headed “Discussion.”

<heading level 1> Assessing the Attractiveness of Reverse Markets – Review and Outlook

A well-established model for analyzing the attractiveness of markets in the traditional “forward-oriented” supply chain exists. “Porter’s Five Forces” model (Porter 1979; Porter 2008) characterizes a market’s attractiveness in terms of five forces—threat of new entrants, threat of substitute products or services, rivalry among existing competitors, bargaining power of suppliers, and bargaining power of buyers—that can be further subdivided into different factors. This model can help a company match core competencies and capabilities with market characteristics to reveal business opportunities and lay the foundation for strategic (re-)positioning as well as generate insights into how these forces can be influenced to actively reshape the market. But although widely accepted for traditional markets, the model cannot be directly applied to markets for recoverable products, as we explain below.

Within a closed-loop supply chain (CLSC) system, supplier, primary, and secondary markets are all perceived as traditional markets that follow similar principles (figure 1). Reverse markets exhibit substantially different characteristics (Wu and Cheng 2006), as shown below (see also table 1).

In reverse markets, both business-to-business (B2B) and business-to-consumer (B2C) customers offer recoverable goods, such as end-of-use products, to recovery companies, including OEMs and independent recovery companies (IRCs). The actors’ roles are thus reversed, the consumers of traditional markets becoming suppliers to corporations, which effectively become the consumers. In contrast to traditional supply chains, however, consumers
do not perceive themselves as suppliers and often do not actively participate in such markets. This presents increased difficulties for OEMs with regard to both identification of potential suppliers and relationship management in the reverse market. Common procurement measures like contracting are hardly applicable in reverse markets characterized by large numbers of diversified suppliers, few demanding actors (Fleischmann et al. 2000), and limited goods availability. Moreover, “[t]he collection of goods from the marketplace is a supply-driven flow, rather than a demand-driven flow” (Guide et al. 2000, 137), the quality of returned products is non-uniform, mostly unknown, and dependent on both initial product design and utilization patterns, and some obsolete products do not enter the market at all due to dissipations such as export or improper disposal. As well, the definition of market scope differs. Traditional markets are commonly defined by a distinct function provided with specific products. For instance, the market for portable music entertainment comprises all devices that satisfy the respective demand of customers, including MP3 players, smartphones, and iPods. In this sense, traditional markets are functionality- or customer-oriented. Contrastingly, reverse markets are defined by the focal product or material that is targeted for recovery. A metal smelting company may choose a broad market definition that encompasses all materials that contain significant amounts of steel, while a computer OEM may consider a much smaller market focusing on its own end-of-life products.

These differences in key characteristics between traditional and reverse markets lead us to conclude that models for assessing the former, especially Porter’s Five Forces, will be more useful for OEMs considering product take-back if tailored to the reverse market. Nor do specific models exist, prior research on strategic decision-making in product recovery having focused almost exclusively on frameworks that support company-specific analyses (e.g., de Brito and
Dekker 2004; Geyer and Jackson 2004; Nuss et al. 2015; Subramoniam et al. 2010), and the broader field of sustainable supply chain management as well being devoid of models or frameworks that address the focal challenge (Brandenburg et al. 2014; Carter and Easton 2011; Carter and Rogers 2008; Seuring and Müller 2008). To the best of our knowledge, the only attempt to evaluate the profitability of remanufacturing industries is presented in a book chapter by Ferguson et al. (2010). The authors list a set of descriptive categories motivated by three existing frameworks including Porter’s Five Forces. We extend previous research in developing, from close examination of what constitutes and shapes reverse markets, a tool, amenable to integration in OEMs’ corporate decision-making processes, for making structured assessments of forces that shape such markets.

**Methodological Approach**

Our exploratory research follows an inductive approach that progresses through three stages (figure 2). We ensure academic rigor in the first and second stages by applying Strauss and Corbin’s (1990) proposed methodology for qualitative research, which requires open, axial, and selective coding of information.

The first stage involves two parallel analyses that identify relevant factors that influence the attractiveness of a reverse market. We review the literature on obstacles to, and drivers and dynamics of, reverse markets. For this purpose an archival research (Searcy and Mentzer 2003) following the structured approach presented by vom Brocke et al. (2009) is implemented. In a first step, we conduct a keyword search in Google Scholar and Web of Science limited to peer-reviewed management science journals. The initial selection process encompasses a review of title and abstract. Afterwards, a content analysis was conducted with at least two of the involved
researchers evaluating each article. In parallel, we adopt a mix of case study approach, using the interview method, and action research. This way, we combine what Coughlan and Coghlan (2002) define as research ‘in action’ with research ‘about’ action. We employed theoretical sampling to select studies that span multiple types of reverse market players that differ with respect to industry sector, organizational structure, and business model. The rationale for such an approach is to strengthen the validity of the findings, as asserted in Voss et al. (2002) and Boyer and Swink (2008). It is worth noting that our approach is qualitative in nature, as defined by Ketokivi and Choi (2014), i.e. our intention is not to quantify each of the forces described in this paper, but rather to outline the factors that affect the attractiveness of the reverse market.

The first source of industry experience involved four, 4- to 16-month projects, transformational in nature, in which at least one of the authors participated. Eight semi-structured interviews with corporate decision-makers involved in product recovery comprised the second source. The 12 companies from which we drew experience were divided between OEMs (8) and IRCs (4), the latter included because they provide perspectives on reverse markets that are relevant but commonly not recognized by the former. An anonymized overview of the participant companies along with key information, involved roles and implemented method is provided in table 2.

Having compiled the factors identified in the literature and case studies (open coding), we commenced the second stage of developing the model, through consolidation of the insights generated. We first classified, after eliminating redundant and merging similar, factors into logical groups that affect similar areas of reverse markets (axial coding). We then developed a
two-level hierarchical order to represent interrelations between these factors (selective coding),
the top level, the forces that shape the market, the lower level the underlying attributes.

Validation of the R5F model through observational field cases in two reverse markets,
white goods and paper and pulp, was performed in the third stage.

We accounted for both scientific and multiple case perspectives to assure the
development of a generalizable model adaptable to manifold applications, and employed an
international and interdisciplinary research team in order to account for common patterns across
industry sectors, business models, and regional peculiarities.

<heading level 1> Forces in Reverse Markets

We elaborate here the first and second stages of our research methodology (figure 2).
Please note that our arguments are backed up by either prior research, our case studies and
industrial collaborations, or both. To improve readability, we refer to the companies as C1 to
C12 (table 2).

In the first stage, we identify factors that influence the attractiveness of reverse markets.
For this, we supplemented with industry insights and interviews analyses of frameworks for
company-specific strategic decision-making and further studies of CLSC decision-making that
casually mention relevant factors. The lengthy list of factors generated by these activities yielded
the attributes we aggregated into the forces that shape reverse markets (table 3).

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In the second step, we build on the insights gathered in the first stage and consolidate the
identified factors, which results in five forces—Access to recoverable products, Threat of IRCs’
market entry, Rivalry for recoverable product, Adverse effects on core business, and
Remarketing opportunities (figure 3)—as well as a set of subordinate attributes that determine the
power and direction of each force. We depict the influence of a particular force in a given instance in terms of a positive or negative connector; for example, increasing threat of IRCs’ market entry reduces (a “minus” sign), access to an abundance of recoverable product increases (a “plus” sign), the attractiveness of a reverse market. Descriptions of these forces, which in the aggregate determine how attractive recovery of a given product or product group is from the perspective of OEMs, are provided below.

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<heading level 2> Access to recoverable products

The effort expended on the acquisition and collection of products by companies involved in reverse markets is well documented (Matsumoto et al. 2010) and constitutes a critical issue (Geyer and Jackson 2004; Jayaraman and Luo 2007; Ravi 2012), hence the importance of identifying the factors that influence the accessibility of these products.

We designate as reverse market potential the total volume of end-of-life and end-of-use goods in a market. This number represents the upper bound of products that is theoretically collectable and can be approximated from a product’s lifecycle and average length of use (Geyer et al. 2007). Long lifecycle products in a mature stage are likely to generate a steady flow of recoverable goods, especially when the period of use is relatively short. The metal and steel industry, for instance, obtains secondary raw material largely from the building and automotive sectors, both extremely mature industries that generate a constant and predictable flow of material that can be collected at any time (C3). We analyze below factors that influence the reverse market potential.
**Customer structure** in the primary market exerts a major influence on ease of access to goods (Li et al. 2011; White et al. 2003). The complexity of the collection process is reduced in B2B, relative to B2C, segments because the former produce substantial quantities of recoverable goods at fewer sites, thereby improving the ability to forecast the timing, quantity, and quality of backflows and facilitating active management of the reverse market suppliers (Knemeyer et al. 2002; Lebreton and Tuma 2006). That service agreements are common accounts, in part, for this circumstance (C7). Acquisition and backflow forecasting are perceived as less challenging for products commonly bought by corporate customers (C6; C8). Although IT equipment as well as scrap metal and steel are supplied by both the B2B and B2C segments, C1 and C10 rely mostly on corporate customers to feed their reprocessing systems. Companies that rely on B2C segments (C9) should expect to collect smaller fractions of reverse market potential.

Product design and degree of degradation as well as length and intensity of customer use affect the **quality of returns** (Oraiopoulos et al. 2012; C1; C7). The influence of these factors varies widely across customer segments. Some indemnification of supply risks is possible in the presence of **3rd party sourcing opportunities** interposed between recovery companies and the customer segments (Galbreth and Blackburn 2006). Reverse markets for such commodities as metals (C3; C10) and plastics (C5), and goods discarded to the municipal waste stream, rely almost entirely on collection by 3rd parties.

Access to recoverable goods is also determined by the **mobility of a product**. Smaller, lighter weight products facilitate handling and transportation, but dissipate through use (e.g., mobile phones), becoming difficult to trace and localize, which complicates supplier targeting and product acquisition. Dissipation may accrue to trade among customers or improper disposal.
Lesser degrees of dissipation are observed for immobile products like server racks (C1) and computer tomography scanners (C8).

Dissipation is also a factor in customers’ perceived marginal value of a recoverable product (Morana and Seuring 2007). If, for example, marginal value is perceived to be higher than actual market value, consumers are likely to offer end-of-life products to one another (C9), negotiate with various demanding actors (C1), or simply store products at home (C12).

The dominant forward business concept of the involved OEMs may also affect reverse market potential. Leasing contracts and product-service-systems, such as are observed in the aerospace (C7) and mechanical engineering industries (C6) and IT sector (C1), limit the free flow of goods in reverse markets. Equally important are established take-back channels, which may be constituted by means of OEMs’ trade-in programs (C1; C6; C7) or public collection of goods like WEEE or waste paper (C1; C2). Established take-back channels may limit the number of products freely offered in reverse markets, even as they reduce transaction costs and generate a steady flow of core for those involved. Further analysis of take-back channels may yield insights relevant to the development of promising take-back concepts (Morana and Seuring 2007).

Regulation & policies have also been determined to “impact the amount of product returns to a great extent” (Srivastava and Srivastava 2006, 534). As regulations, we refer here to mandatory laws that may limit access to particular products for purposes of reprocessing or constrain collection, as for reasons associated, for example, with toxicity (C1; C12). Policies are somewhat less overt attempts to influence market patterns or alter the mindsets or behavior of market actors (Tan et al. 2014). Policy initiatives may increase customers’ willingness to
return products, an example being “Dual system Germany” (www.gruener-punkt.de), a plastic waste collection initiative that was successfully supported by an awareness campaign in schools and using billboard advertisements, among other measures (C5). Customers’ willingness-to-return product may also be positively influenced by (financial) incentives (Guide and Van Wassenhove 2001).

<heading level 2> Threat of IRCs’ market entry

This force summarizes factors on reverse markets that may serve as barriers to prevent a future market entry of IRCs. Among these barriers is the need for a reverse network to support implementation of reverse logistics activities, the development of which requires investment in various assets (e.g., specific facilities and equipment) that “did not exist previously” (Dowlatshahi 2005, 3459). Such strategic costs may be higher for IRCs, which typically lack a forward-supply-chain-oriented infrastructure at least partly suitable for reverse logistics. As “reverse distribution is not necessarily a symmetric picture of forward distribution” (Fleischmann et al. 1997, 6), even OEMs face strategic costs in the form of investment in specialized infrastructure. Such costs being subject to economies of scale, smaller actors particularly experience this barrier. In process industries, for example, product recovery is almost entirely the domain of OEMs (C2; C3; C5), related industries naturally having invested heavily in equipment, and integration of secondary inputs into primary production being well established.

The technical feasibility of product recovery is a fundamental consideration, reprocessing of some goods being extremely complex or even impossible (e.g., breaking chemical bonds). Recovery of carbon fiber composites, for example, is not possible in the desired quality due to fiber length issues (C7), and gradual contamination of scrap with
undesired elements is a major problem in steel recycling (Geyer and Jackson 2004; C3). Remanufacturing of some products is rendered financially unviable for IRCs by OEMs’ monopolistic price setting for spare parts (e.g., control boards) (C11).

Even for products for which recovery is technically feasible, high technology requirements may pose a barrier to IRCs’ market entry (C2; C3; C5). This barrier mainly depends on the ease of reprocessing (C8; C11). For instance, “[s]pecialist equipment is […] required, especially for running diagnostics and testing of components” (Chapman et al. 2010, 42). Apart from equipment, product recovery may depend on product-related specific knowledge including particulars of product composition and utilization and location of products in use, and/or a specific skillset for inspection and reprocessing (Hammond et al. 1998). Lack of the requisite skillset can render remanufacturing by IRCs virtually impossible (C8; C11). Large complex products “often composed of tens of thousands of components and parts” pose a “technical challenge” to recovery (Guide and Van Wassenhove 2009, 13). OEMs not only enjoy an information advantage over IRCs with respect to recovering certain products (Ferguson and Browne 2001), but may also incorporate features specifically designed to deter third party remanufacturing (Hammond et al. 1998; Majumder and Groenevelt 2001).

Entry to reverse markets can also be impeded by framework conditions in the form of certifications & laws. Disposal of products containing noxious substances is often subject to tight control and reprocessing limited to certified actors (C1; C7; C8). Certification may also pose a barrier to entry in the sense that certified organizations tend to be trusted by consumers to recover products in a way that satisfies the ecological and societal zeitgeist (C9). A similar effect is observable in the IT industry, consumers, owing to data security issues, preferring to surrender post-use equipment to trusted market players that guarantee data deletion (C1).
Rivalry for recoverable products

Rivalry aims to assess the status-quo competitive structure in existing branches. In traditional markets, rival companies offer the same or similar products or services to the same markets (Carpenter and Sanders 2007). Understanding rivalry is less easy in reverse markets, market players not being clear-cut and commonly more heterogeneous. Rivalry in reverse markets centers on demand for the same kind of recoverable product (Knemeyer et al. 2002), and rivals can include OEMs, IRCs, waste brokers, non-governmental organizations (NGOs), and second-hand trading businesses, many of which, not being active in primary markets, are frequently overlooked by executives used to forward-supply-chain-oriented analyses.

Assessment of rivalry must thus begin with a thorough, differentiated analysis of a multiplicity of actors that employ different business models. Rivals’ segmentation can be determined by analyzing their business models. An evaluation of the overall market for purposes of market positioning is necessarily informed by an in-depth understanding of its segments, the aims and scope of the players in each, and segment-specific competitive situations. Rivalry among OEMs may be driven by take-back legislation. Collective take-back schemes tend to increase competition, individual take-back by OEMs to result in monopolistic structures (Atasu and Subramanian 2012). Rivalry is thus expected to increase more consequent to the involvement of other OEMs than to that of other types of players (Ferguson and Toktay 2006). Because IRCs and brokers collecting computers, among other goods, for purposes of retrieving and trading valuable materials like copper and silver also constitute competition (Hatcher et al. 2011), other computer manufacturers must not be considered the only rivals (C1). Brokers acquire for direct reuse a significant fraction of the functional cores available in the reverse market, and various non-profit organizations (e.g., Create UK) are also involved in electronics
recovery. More familiar, perhaps, is charity organizations’ collection of used textiles and furniture (C9). A significant portion of backflows may enter non-structured sinks that, albeit not classified as rivals, should nevertheless be considered (e.g., municipal solid waste streams and landfills and other forms of dissipation).

Development of segments and business models is influenced by the availability of recovery alternatives. The desired quality and composition of backflows differs with the recovery alternative represented by each segment. The quality level sought by OEMs primarily interested in equipment at least partly functional to be remanufactured or used as a source of components (C1; C6; C7), for example, differs from that which is acceptable to recycling-oriented actors (C3; C5). Pure trading companies, on the other hand, collect almost exclusively reusable cores. Degree of rivalry may thus differ across quality levels.

Diversity among the actors that originate reverse market demand, referred to as the heterogeneity of rivals, may reduce market attractiveness by inducing greater effort with respect to monitoring competitors’ actions and posing challenges with respect to projecting rivals’ strategic moves (C1; C9). A qualitative understanding of rival segments and patterns must thus be supplemented with quantitative information including the number, size & concentration of competitors within each segment (C2; C3; C9).

Competitive structure may also be influenced significantly by the existence of intermediaries that may accumulate large quantities of recoverable items (C2; C3; C4). Brokers and public waste collection institutions that offer product on the reverse market tend to prefer business partners of considerable size that procure large quantities of diverse quality, rendering the market most attractive to OEMs.
Adverse effects on core business

The interplay between primary and secondary products may affect the collection, recovery, and remarketing of recovered products and resources, and product recovery influence aspects of primary production and sales in primary markets. A major influence on sales of primary products is referred to as **cannibalization** (Guide and Li 2010; Atasu et al. 2010). Cannibalizing primary product sales diminishes reverse market attractiveness from the perspective of OEMs. The perceived **quality differential between new & recovered product** determines the extent of cannibalization. If the differential is marginal, reprocessed products are seen as perfect substitutes and cannibalization is not a concern if, and only if, product returns are collected exclusively by OEMs and customers cannot distinguish between the primary and reprocessed product (Atasu et al. 2010). Cannibalization becomes a problem when OEMs recover and remarket used product that is distinguishable from the primary product, which decreases customers’ willingness to pay for the latter (Agrawal et al. 2012), and when recovered goods offered on the secondary market by IRCs decrease OEMs’ primary sales. In the former case, the resale must be balanced with the cannibalization effect (Oraiopoulos et al. 2012), in the latter, **strategic stakes** as well as profitability may play a major role, as an “OEM may choose to remanufacture for the sole purpose of discouraging an external firm from doing so” (Ferguson and Toktay 2006, 361). In fact, the impetus for product recovery by companies active in an industry is often prevention of third-party acquisition of technology and market share (C1; C8).

Product recovery’s **effects on brand image** must also be taken into account. Using recovered inputs can benefit OEMs by contributing to a positive green image (C2); those that neglect product recovery may even “seriously jeopardize their brand image and reputation” (Jayaraman and Luo 2007, 56). In some industries, however, product recovery can have an
opposite, negative effect on brand image and is scrupulously avoided by OEMs. Customers’ perception that use of remanufactured components may compromise brand quality has been observed, for example, in the healthcare and automotive (C4; C8). Product recovery may incur additional operational risks as well as, for example, with respect to the earlier referenced issue of data security in the recovery of computers (C1).

Decisions that impinge on primary products may also affect product recovery. With respect to speed of innovation, for example, less frequent innovation in a primary product increases the time frame during which recovered product can be remanufactured and vice versa (C1; C12). Product recovery also has implications for product design. Although products are “typically not designed for end-of-life value recovery” (Geyer and Jackson 2004, 59), considering recovery issues during a product’s design-phase may “significantly influence[…] the cost of disassembly, component inspection and repair, remanufacturing and recycling” (Chung and Wee 2008, 528). Planned obsolescence, notwithstanding its negative effects on consumers and the environment, as a design strategy can secure a steady flow of cores.

Remarketing opportunities

Because companies’ voluntary participation in product recovery hinges on the profit potential of remarketing (Quariguasi Frota Neto and Van Wassenhove 2013), the existence of a secondary market is essential. Secondary markets can be internal, involving substitution of recovered for primary inputs and generation of spare parts (Toffel 2003), as in the aerospace sector, in which use of recovered components enables primary product to be maintained without diverting manufacturing capabilities to spare parts production (C7), or external, in which recovered products are offered on external secondary markets. The existence of such markets depends on quality of reprocessed goods, cost structure, and price, among other factors.
**Customers’ willingness to pay** depends on customers’ perception of the value of a recovered good. Products composed of recycled metals and plastics, for example, are often indistinguishable from new products (C3; C5), whereas other recovered products are perceived to be of lower quality (Geyer and Jackson 2004; Guide and Li 2010; Harms and Linton 2015; C4). Willingness to pay for recycled commodities is largely determined by raw material prices (Rathore et al. 2011; C10). Subramanian and Subramanyam (2012), Quariguasi Frota Neto et al. (2016) and Pang et al. (2015) conducted empirical studies of price differentials between new and recovered products based on eBay data, and Quariguasi Frota Neto and Bloemhof (2012, 102) conclude that, for mobile phones and personal computers, willingness to pay “is a function of the prices of the corresponding new products at launch, and years elapsed between launch and remanufacturing.” Abbey et al. (2015a) and Abbey et al. (2015b) showed that for certain products consumers would not be willing to purchase a remanufactured product, regardless of the levels of discounting. Customer segment can also influence customers’ willingness to pay (Ferrer and Ayres 2000). All else being equal, business customers’ focus on functionality leads them to act more rationally and, as a result, to be more likely to buy reprocessed products (Lebreton and Tuma 2006). For example, although remanufactured tires can be as-good-as-new, private consumers tend to perceive them to be of lower quality and exhibit an unwillingness to pay a price close to that for newly manufactured product, whereas business customers (e.g., truck operators and airlines) are willing to pay near new tire prices for remanufactured product (C4). Other aspects such as risk perception levels (Hamzaoui-Essoussi and Linton 2014), pricing strategies (Ovchinnikov 2011), and consumer knowledge (Wang and Hazen 2015) were also reported to affect willingness to pay.
Many secondary markets not yet being fully developed, their **potential and dynamics** warrant consideration. Market size and growth rate must be projected as well as secondary market potential including consumer sensitivity to new technologies in connection with innovation (Rathore et al. 2011). **Technology life-cycles** may also afford opportunities for remarketing secondary products. Although former technologies often become obsolete and are no longer offered on the primary market as new technologies are introduced, specific customer groups (‘laggards’), antithetical to adopting new technologies or unable to do so owing to incompatibility with existing system infrastructure (e.g., VHS or cassette recorders) may demand older product. Spare parts for long-lasting products like automobiles, aircraft, and manufacturing equipment are similarly demanded long after production of the primary product has ceased (C6; C7; C8). Short technology lifecycles not surprisingly may significantly diminish customer willingness to pay for reprocessed product.

Because they also influence costs, **sinks for unwanted by-products**, which may represent a significant part of overall backflow, also warrant examination. Unwanted products include non-focal product types, focal product types that do not satisfy quality requirements, and by-products generated by reprocessing (Knemeyer et al. 2002). The availability of appropriate sinks can significantly influence the cost structure of recovery operations in either direction, by adding costs (e.g., of dissipating toxic substances in CRTs; C1) or generating revenues (e.g., from the sale of cardboard; C2).

**<heading level 1> Empirical Validation: Case Studies**

We demonstrate the implementation and versatility of the R5F model by applying it to two distinct markets. We analyzed the viability of white goods recovery for an OEM located in
the United Kingdom, and, for a large, global paper manufacturer in Germany, the market for waste paper.

Application of the R5F to the reverse market for white goods reveals that it could be a potentially attractive market for OEMs in the future, especially for those with high brand recognition. Major challenges are the access to recoverable products and the adverse effects on core business. Nevertheless, some levers are revealed that may help the OEM altering the reverse market to its own advantage.

Application of the R5F to the reverse market for paper leads to the conclusion that it is highly attractive for companies already involved in the primary business. One of the most important points for this assessment are the considerable synergies that can be realized between the primary and secondary manufacturing processes. These processes are not practically distinguishable, which leads to another important point of very high entry barriers as a complete set of primary manufacturing machinery is necessary to use secondary input material.

While table 4 gives a brief overview of the assessment of the according forces, detailed descriptions of the cases are provided in the electronic appendix: www.insertlinkhere.com.

The case studies revealed the R5F model to be helpful in enabling corporate decision-makers to derive a holistic picture, and thereby enhance their understanding, of all of the relevant aspects of the respective markets.

Discussion and limitations

The R5F model is a hands-on managerial tool that ensures that relevant market-shaping factors are fully addressed in strategic decisions regarding market positioning. We demonstrate in the cases how it can help OEMs develop a profound understanding of reverse markets. OEM
decision makers will find the model useful for identifying attractive and profitable segments of reverse markets, detecting internal and external risks associated with product recovery, evaluating potential market developments, and revealing levers that can be employed to favorably re-shape a particular reverse market.

The model does not, however, address every aspect of strategic decision-making with respect to product recovery. Although the forces that shape reverse markets are essentially the same for all organizations, capabilities and resources vary across them, as the resource-based view suggests (Wernerfelt, 1984). That means that the extent to which it is suitable to enter a market will also vary across companies. Thus, besides market characteristics revealed by the R5F model, company-specific characteristics must be considered. To revive results from the case studies, OEMs for white goods with a positive brand reputation are likely to benefit from entering the reverse market as customers’ willingness to pay is influenced by brand reputation. In the case of paper manufacturing, primary production equipment and recycling equipment is congruent and expensive. Hence, market entry requires either possession of primary production equipment or substantial financial resources. Reverse market opportunities must be weighed against corporate strengths and weaknesses to gauge a prospective market entrant’s position relative to existing and potential future players. The R5F model thus constitutes a crucial part of an extensive decision-making process that integrates reverse market analysis with a structured evaluation of corporate capabilities. Integrating resources and capabilities is a natural extension of the R5F model and an opportunity for future research. Helpful starting points for capability analysis are articles on company-specific planning and decision-making, like Geyer and Jackson (2004) and Nuss et al. (2015).
Conclusion

Product recovery, as a contributor to sustainable supply chains and, potentially, greater profits, has captured the attention of decision-makers, politicians, and the general public. But notwithstanding hundreds of articles devoted to the importance of markets for remanufactured and recycled products, prior research has failed to provide a comprehensive approach to evaluating the attractiveness of reverse markets. Reverse markets exhibit significant differences that render approaches to assessing the attractiveness of traditional markets inadequate. Understanding the forces that shape these markets is vital to strategic decision-making. Hence, the present article’s contribution is the development of a dedicated model for assessing reverse market attractiveness.

We identified, through interviews and industrial projects conducted with companies engaged in product recovery in different countries, supplemented by prior research, factors that affect the attractiveness of reverse markets (Q1). We then developed a comprehensive model, which we term R5F (Q2), and discuss the integration of its analysis of reverse market characteristics with the evaluation of internal capabilities and resources in a comprehensive corporate decision-making process (Q3).

The R5F model affords management a hands-on managerial tool not only for assessing market attractiveness, but also for identifying levers by which reverse markets might be reshaped such that corporate capabilities and resources can be leveraged to achieve a competitive edge. The model can also be used to justify engagement in product recovery to shareholders and other stakeholders. Our research identifies characteristics that determine the attractiveness of reverse markets, reveals the structure of those markets and levers by which they might be reshaped, and yields insights that facilitate anticipation of market developments that can guide the formulation of resilient strategies for entry and positioning. More broadly, the model can be used to inform
and suggest policy measures, beyond simple regulations, that might expand the magnitude and scope of product recovery activities within particular industries. The R5F model is, for example, currently used by the Bavarian State Ministry of the Environment and Consumer Protection in a public project aimed at facilitating development of innovative approaches to increasing product recovery quotas in southern Germany.

Our research into the forces that drive product recovery and influence reverse markets has been validated in applications in which the R5F model has been effectively employed to provide comprehensive assessment of reverse markets and it supports the formulation and execution of strategies for reverse market entry and product recovery. The model contributes “freshness in perspective to an already researched topic” (Eisenhardt 1989, 548) and may serve as a catalyst for the genesis of a theoretical foundation for evaluating the attractiveness of reverse markets.

<heading level 1> Acknowledgements

The authors thank their industry contacts who provided valuable inputs and continuous feedback during the development of this article. A special thanks is due Luk Van Wassenhove, whose thoughtful observations and comments clearly served to improve the article.

<heading level 1> References


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Figure 1: Markets in closed-loop networks.

Figure 2: Methodological approach for development of theoretical model.

1st stage: Identification of relevant factors

Scientific knowledge base
- Literature review using EBSCO and ScienceDirect following vom Brocke et al. (2009)

Extraction of factors using open coding

Industry expertise
- Case study approach following Eisenhardt (1989) relying on interviews and industry projects with a total of 12 companies

2nd stage: Consolidation of insights

Sequential model development (following Eliram 1996, Strauss & Corbin 1990)
1. Elimination of redundancies
2. Building of logical groups (axial coding)
3. Identification of interrelations (selective coding)

3rd stage: Validation

Validation of theory
- Application of model to reverse markets for white goods as well as paper & pulp (Observational field study)
Figure 3: Reverse Five Forces Model (R5F).

Table 1: Comparison of market characteristics.

<table>
<thead>
<tr>
<th>Primary/secondary markets</th>
<th>Reverse market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of manufacturer</td>
<td>Consumer</td>
</tr>
<tr>
<td>Role of customer</td>
<td>Supplier</td>
</tr>
<tr>
<td>Origin of traded products</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>Sink of traded products</td>
<td>Customer</td>
</tr>
<tr>
<td>Product flow</td>
<td>Diverging</td>
</tr>
<tr>
<td>Network structure</td>
<td>Few-to-many</td>
</tr>
<tr>
<td>Main source of uncertainty</td>
<td>Demand side</td>
</tr>
<tr>
<td>Input quality</td>
<td>Homogeneous, deterministic</td>
</tr>
<tr>
<td>Scope of market</td>
<td>Customer-/ Functionality-centered</td>
</tr>
</tbody>
</table>

Reverse market potential
Customer structure
Quality of returns
3rd party sourcing opportunities
Mobility of product
Customers' perceived marginal value
Forward business concept
Established take-back channels
Regulation & policies
Customers' willingness to return

Access to recoverable products
Reverse market potential
Customer structure
Quality of returns
3rd party sourcing opportunities
Mobility of product
Customers' perceived marginal value
Forward business concept
Established take-back channels
Regulation & policies
Customers' willingness to return

Rivalry for recoverable products
Rivals' segmentation
Recovery alternatives
Heterogeneity of rivals
Number, size & concentration of competitors
Existence of intermediaries

Cannibalization
Quality differential between new & recovered product
Strategic stakes
Effects on brand image
Speed of innovation
Product design

Remarking opportunities
Existence of secondary market
Customers' willingness to pay
Potential and dynamics
Technology life-cycles
Sinks for unwanted by-products

Adverse effects on core business
Strategic costs
Technical feasibility
Technology requirements
Specific knowledge
Certifications & laws

Reverse Market’s Attractiveness

Threat of IRCs’ market entry

Strategic costs
Technical feasibility
Technology requirements
Specific knowledge
Certifications & laws

Access to recoverable products
Reverse market potential
Customer structure
Quality of returns
3rd party sourcing opportunities
Mobility of product
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Adverse effects on core business
Strategic costs
Technical feasibility
Technology requirements
Specific knowledge
Certifications & laws

Reverse Market’s Attractiveness

Threat of IRCs’ market entry
Table 2: List of companies studied within this article.

<table>
<thead>
<tr>
<th>Company ID</th>
<th>Industry sector</th>
<th>Type of Company</th>
<th>Revenues (in USD)</th>
<th>Number of employees</th>
<th>Roles Involved</th>
<th>Implemented method</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>IT - Equipment</td>
<td>OEM</td>
<td>30 – 50 bn</td>
<td>More than 150,000</td>
<td>Vice President Product Recovery</td>
<td>Action research</td>
</tr>
<tr>
<td>C2</td>
<td>Paper &amp; Pulp</td>
<td>OEM</td>
<td>10 – 20 bn</td>
<td>20,000 – 50,000</td>
<td>Director Supply Chain Management</td>
<td>Action research</td>
</tr>
<tr>
<td>C3</td>
<td>Metal &amp; Steel</td>
<td>OEM</td>
<td>10 – 20 bn</td>
<td>20,000 – 50,000</td>
<td>Head of Procurement (Scrap steel)</td>
<td>Action research</td>
</tr>
<tr>
<td>C4</td>
<td>Tire manufacturer</td>
<td>OEM</td>
<td>N/A</td>
<td>N/A</td>
<td>Representative of German Tire Manufacturer Lobby</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C5</td>
<td>Paper &amp; Pulp</td>
<td>OEM</td>
<td>N/A</td>
<td>N/A</td>
<td>Head of Department Plastics and Environment</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C6</td>
<td>Mechanical Engineering</td>
<td>OEM</td>
<td>10 – 20 bn</td>
<td>20,000 – 50,000</td>
<td>Head of Production</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C7</td>
<td>Aerospace</td>
<td>OEM</td>
<td>10 – 20 bn</td>
<td>50,000 – 150,000</td>
<td>Head of Strategic Capability; Defence Aerospace Project Manager</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C8</td>
<td>Healthcare</td>
<td>OEM</td>
<td>&gt; 50 bn</td>
<td>50,000 – 150,000</td>
<td>Vice President Environment, Health and Safety (EHS); Director Global EHS; Director Refurbished Programmes</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C9</td>
<td>Furniture/ NGO</td>
<td>IRC</td>
<td>N/A</td>
<td>&lt; 10,000</td>
<td>Managing Director</td>
<td>Action research</td>
</tr>
<tr>
<td>C10</td>
<td>Metal &amp; Steel</td>
<td>IRC</td>
<td>5 – 10 bn</td>
<td>20,000 – 50,000</td>
<td>Executive Assistant</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C11</td>
<td>White goods</td>
<td>IRC</td>
<td>N/A</td>
<td>&lt; 10,000</td>
<td>Company Director; Sales Manager; Technician</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>C12</td>
<td>IT - Equipment/ NGO</td>
<td>IRC</td>
<td>10 – 20 bn</td>
<td>10,000 – 20,000</td>
<td>Director International Partners Compliance; Sales and Customer Service Specialist; Technician</td>
<td>Semi-structured interview</td>
</tr>
</tbody>
</table>
Table 3: Relevant factors influencing the attractiveness of a reverse market.

<table>
<thead>
<tr>
<th>Forces</th>
<th>Opportunities</th>
<th>Remarketing</th>
<th>Adverse effects on core products</th>
<th>Rivalry for recoverable products</th>
<th>Adverse effects on core business</th>
<th>Remarketing opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to recoverable products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse market potential</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Customer structure</td>
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<tr>
<td>Quality of returns</td>
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<tr>
<td>3rd party owning opportunities</td>
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<tr>
<td>Mobility of product</td>
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<tr>
<td>Customers’ perceived marginal value</td>
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<tr>
<td>Forward business concept</td>
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<tr>
<td>Existing take-back channels</td>
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<tr>
<td>Regulation &amp; policies</td>
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<tr>
<td>Customers’ willingness to return</td>
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<td></td>
</tr>
<tr>
<td>Threat of IRGs’ market entry</td>
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<tr>
<td>Strategic costs</td>
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<tr>
<td>Technical feasibility</td>
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<tr>
<td>Technology requirements</td>
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<tr>
<td>Specific knowledge</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Certifications &amp; laws</td>
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<td></td>
</tr>
<tr>
<td>Rivalry for recoverable products</td>
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<tr>
<td>Rival’s agitator</td>
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<tr>
<td>Recovery alternatives</td>
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<td></td>
</tr>
<tr>
<td>Heterogeneity of rival</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number, size, &amp; concentration of competitors</td>
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<td></td>
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<tr>
<td>Existence of intermediaries</td>
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<tr>
<td>Adverse effects on core business</td>
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<tr>
<td>Cannibalization</td>
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<tr>
<td>Quality differential between new &amp; recovered product</td>
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<tr>
<td>Strategic stakes</td>
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<tr>
<td>Effects on brand image</td>
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<tr>
<td>Speed of innovation</td>
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<tr>
<td>Product design</td>
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<tr>
<td>Remarketing opportunities</td>
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<td></td>
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<tr>
<td>Existence of secondary market</td>
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<td></td>
</tr>
<tr>
<td>Customers’ willingness to pay</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential and dynamics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology life cycles</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sinks for unwanted by-products</td>
<td></td>
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</tr>
</tbody>
</table>

Table entries indicate the presence of factors influencing the attractiveness of a reverse market. Factors are classified into access to recoverable products, threat of IRGs’ market entry, rivalry for recoverable products, and adverse effects on core business. Each factor is evaluated across different studies indicated at the bottom of the table.
### Table 4: Application of the R5F to the case studies

<table>
<thead>
<tr>
<th>Forces</th>
<th>Attributes</th>
<th>White Goods</th>
<th>Paper &amp; Pulp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access to recoverable products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reserve market potential</td>
<td></td>
<td>High</td>
<td>Virtually infinite, regenerating</td>
</tr>
<tr>
<td>Quality of returns</td>
<td></td>
<td>Significant fraction of bad condition</td>
<td>Highly heterogeneous</td>
</tr>
<tr>
<td>3rd party sourcing opportunities</td>
<td></td>
<td>Collection points run by municipalities, brokers and other third parties with strong position on the market</td>
<td>Municipal waste system</td>
</tr>
<tr>
<td>Customer structure</td>
<td></td>
<td>Mostly households, geographically dispersed</td>
<td>Heterogeneous</td>
</tr>
<tr>
<td>Understanding, moral value</td>
<td></td>
<td>Low to moderate</td>
<td>High, but negligible because of small value and high amounts</td>
</tr>
<tr>
<td>Forward business concept</td>
<td></td>
<td>Independent from manufacturing</td>
<td>Independent from forward business concepts</td>
</tr>
<tr>
<td>Regulator &amp; policies</td>
<td></td>
<td>High, without a fee</td>
<td>High</td>
</tr>
<tr>
<td><strong>Threat of IRCs market entry</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic costs</td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Technical feasibility</td>
<td></td>
<td>Particularly hard</td>
<td>Easy for low quality</td>
</tr>
<tr>
<td>Technology requirements</td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Certifications &amp; laws</td>
<td></td>
<td>Ineffective</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Rivalry for recoverable products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail segmentation</td>
<td></td>
<td>Brokers, remanufacturers, recyclers</td>
<td>Recovery market dominated by manufacturers</td>
</tr>
<tr>
<td>Recovery alternatives</td>
<td></td>
<td>Scarce</td>
<td>Virtually no recovery option above recycling</td>
</tr>
<tr>
<td>Industry size</td>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Niche of competitors</td>
<td></td>
<td>High number of small players, low concentration</td>
<td>Oligopoly</td>
</tr>
<tr>
<td>Existence of intermediaries</td>
<td></td>
<td>High</td>
<td>Preevaluated as collection is publicly organized</td>
</tr>
<tr>
<td><strong>Adverse effects on core business</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cannibalization</td>
<td></td>
<td>No concern</td>
<td>No concern</td>
</tr>
<tr>
<td>Quality differential between new &amp; remanufactured products</td>
<td></td>
<td>Not present</td>
<td>Cost reductions in primary manufacturing</td>
</tr>
<tr>
<td>Strategic stakes</td>
<td></td>
<td>Unknown</td>
<td>Positive</td>
</tr>
<tr>
<td>Effects on brand image</td>
<td></td>
<td>Unknown</td>
<td>Positive</td>
</tr>
<tr>
<td>Product design</td>
<td></td>
<td>Not suitable for remanufacturing</td>
<td>Easily recyclable</td>
</tr>
<tr>
<td><strong>Remarketing opportunities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer secondary market</td>
<td></td>
<td>Existential, but unknown size</td>
<td>Congruent to primary market</td>
</tr>
<tr>
<td>Customers’ willingness</td>
<td></td>
<td>Relatively high for products with high brand equity, low for the rest</td>
<td>Slightly lower for some products</td>
</tr>
<tr>
<td>Potential and dynamics</td>
<td></td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Technology life cycle</td>
<td></td>
<td>Continuous innovations</td>
<td>Negligible</td>
</tr>
<tr>
<td>Market for remanufactured products</td>
<td></td>
<td>Existent for most parts</td>
<td>Existent, partly profitable</td>
</tr>
</tbody>
</table>
Appendix:

On the attractiveness of product recovery in the white goods sector

This case considers, from the perspective of an OEM and in the context of the application of the framework developed in this paper, the attractiveness of the reverse market for washing machines in the United Kingdom. The case is distinguished from the other case elaborated in the paper by the fact that the remanufacturing processes are still not fully consolidated. That is, the focal OEM does not engage in product remanufacturing. Notwithstanding the focus on the OEM, multiple conversations were held with two IRCs and the remanufacturing facilities of them were visited at least once by two of the researchers. Interviewing independent remanufacturers was particularly important to gain an understanding of the dynamics of forces ‘Threat of IRCs’ market entry’ as well as ‘Access to recoverable products’ and ‘Rivalry for recoverable products’. While the OEM is a global brand, the independent remanufacturers both located in Europe act domestically.

‘Access to recoverable products’ is a serious issue for the OEM. Although the reverse market potential is high, obtaining high quality core is a challenge. The customer structure mainly consists of geographically dispersed households. Regarding the forward business concept, liaison with these B2C customers is via retailers, which is not beneficial to OEMs seeking to collect core. A significant fraction of returned core is of bad condition as the OEM observed that consumers “use [their machines] until [...] [they] break down.” Quality of returns thus also reduces the attractiveness of the market. 3rd party sourcing opportunities do exist, but they hold strong positions in the market limiting the possibility of a good bargain. On a positive note, mobility of the product is not a major issue as the product is mostly heavy and of considerable size making it hard to transport. Moreover,
customers’ perceived marginal value is low, a segment of the customer population shows a high willingness to return the product as long as no expense is incurred in doing so. Established take-back channels are in place for one of the remanufacturers and could potentially be useful should it decide to engage in remanufacturing. Regulations & policies are geared towards recycling, and government-provided financial incentives for remanufacturers seem to be lacking. In summary, with respect to access to recoverable products, this is not an attractive market.

‘Rivalry for recoverable products’ is low if only the market for remanufactured products is considered. There is, however, a group of well-established rivals in the business of product take-back. These are segmented (rivals’ segmentation) into brokers that compete for any type of core, recyclers looking for high- and low-quality core, and remanufacturers that tend to consider only high-quality returns. This leads to a reverse market that exhibits high heterogeneity of rivals comprising numerous players of different size and interests (number, size & concentration of competitors). Recovery alternatives thus differ among these players. With regard to intermediaries, retailers control much of the supply chain for returned products. Intermediaries exist in large numbers. The intermediaries that sell returns to remanufacturers may also be engaged in product recycling. Their power in the supply chain fluctuates with, among other things, the price of metal. Obsolete products are readily obtained when metal prices are low, but the balance tips in favor of intermediates selling core when the price of metal increases.

‘Threat of IRCs’ market entry’, works in favor of the OEM as outlined below. Strategic cost is not a major impediment to newcomers, not least because economies of scale are difficult to achieve and the remanufacturing process is mainly conducted manually. Therefore, the technology requirements are low in many cases.
Conversely, **technical feasibility** is a far greater barrier to IRCs, particularly for the high-end spectrum of machines due to the ever-increasing complexity of the electronics and software components. Independent remanufacturers find it difficult to remanufacture washing machines when problems with defective returned core are electronics-related, and OEMs can to a large extent, whether intentionally or not, lock out new independent remanufacturers by controlling the supply of key spare parts and employing proprietary software for control boards. These circumstances can make IRCs’ market entry technically impossible for certain product types. Potential competition from IRCs is further impeded by lack of **specific knowledge**, there being a shortage of trained personnel. Acquisition of the required knowledge to remanufacture low-end analog washing machines is straightforward, not so for newer, more sophisticated models. **Certification & laws** are ineffective in reducing impediments to or promoting future competition. In summary, technical feasibility and specific knowledge issues pose relatively high entry barriers to IRCs and thereby enhance the attractiveness of the market for OEMs.

With respect to ‘Adverse effects on core business’ our conversations with the OEM did not reveal fear of **cannibalization**. With the focal OEM not having a remanufacturing operation in place, our conversations with the IRCs have shown the issue of **quality differential between new & remanufactured products** for certain models of washing machines to be quite high. **Strategic stakes** not being present unlike the case in which proper functioning of products is crucial (e.g., healthcare equipment), the OEM is less concerned with driving competitors out of the reverse market to prevent poorly remanufactured washing machines. The **product design** is largely not suited for remanufacturing. Whether potential positive or negative **effects on brand image** exist, is a question that could not be clearly answered by the OEM.
**Speed of innovation** is also relevant. In general, although the product can be classified as functional, efficiency gains drive machines to rapid obsolescence, which guarantees a steady flow of returns. Summing up, ‘Adverse effects on core business’ are marginal favoring the market attractiveness.

A new line of remanufactured products, in particular of high-end models, would have a **secondary market**, but how large is unclear. A certain segment of the population shows a high **customers’ willingness to pay**, as they perceive remanufactured washing machines with high brand recognition to be of good quality, but for most other washing machines that can potentially be remanufactured willingness to pay is low and the market insufficiently large to attract OEMs’ participation. It is difficult to predict market **potential and dynamics**, but the OEM stated that it continuously re-assesses the secondary market observing a slow growth. Concerning **technology life-cycles**, we believe that OEMs will continue to drive innovation in order to persuade consumers to buy new products, and that this will only change if the current business model changes.

By conducting the analysis some major insights concerning the reverse market could be revealed. First of all, it can be noted that the market is characterized by an overall sufficient potential of recoverable products and a lucrative secondary market, especially for remanufactured goods with high brand-recognition. Nevertheless, this market is widely ignored by OEMs although the analysis suggests certain levers that may help the OEMs to further increase the attractiveness of individual product recovery. In particular, OEMs may mitigate the influence of IRCs on the market as they have a monopoly for needed spare parts and have advantages on the technical and informative knowledge necessary for recovery operations. Another lever may be an alteration of the forward business concept, for example by introducing product-
service bundles, leasing contracts or old-for-new offers at retailers. The benefits for an OEM with high brand recognition are threefold: First, by entering the reverse market the OEM may tackle its low-brand competitors on their playing field with limited risk of jeopardizing its primary market. Second, it may mitigate the risk from IRCs that remanufacture their own products. Third, and probably most importantly, it may offer the opportunity for earning additional profits. Surely and as already mentioned in the article, these insights alone are not sufficient for a holistic decision-making. Based on these initial observations and the thorough market understanding, the OEM must further elaborate on the topic matching its own capabilities, assess profit and loss effects in more detail and evaluate the needed changes within the organizational structure.

On the attractiveness of product recovery in the paper and pulp sector

This case evaluates the attractiveness of waste paper recovery from the perspective of a manufacturer that uses paper and pulp as inputs to the papermaking process. Information for this case was derived from a collaborative project that re-assessed a large paper manufacturer’s European sourcing strategy for secondary raw material. Executives in charge of production planning, strategic purchasing, and supply chain management were engaged in numerous conversations throughout the project. In contrast to the white goods case, the focal manufacturer is already involved in product reprocessing, and waste paper has a long tradition as an input in the industry. The R5F model was consequently used primarily to enhance understanding of the market and potential rivals as opposed to evaluate market entry, as was the case for the white goods manufacturer.
Access to recoverable products is not a concern in reverse markets for paper. 

**Customer structure** typically involves a distinction between pre- and post-consumer waste paper, the former consisting largely of packing materials and other wastes concentrated at manufacturing sites, the latter of more heterogeneous materials that are highly dispersed. As both B2C and B2B customers regard used paper as waste, **customer’s perceived marginal value** is negligible. Established **take-back channels** commonly organized by local authorities as part of municipal waste systems (3rd party sourcing opportunities) contribute to a high **customers’ willingness to return** both pre- and post-consumer paper, and large amounts of pre-consumer waste may be returned directly to the reprocessing facility. The recovery rate for paper is consequently as high as 70% in Europe, and paper being used in manifold applications and sold in large quantities on the primary market. The overall **reverse market potential** is virtually infinite and continuously regenerating. Availability of recoverable paper is not restricted by **regulations**, most waste paper being free of toxic or otherwise harmful substances. Indeed, waste paper recovery is facilitated by laws like the European Directive on Packaging and Packaging Waste. As leasing and similar concepts are not common in paper trading the reverse market is totally decoupled from the **forward-business concept** of primary manufacturers. **Quality of returns** of post-consumer paper is highly heterogeneous as products include packaging, newspaper as well as graphical and office paper, and many other varieties. Although most authorities offer separate disposal channels for waste paper, returns are also often contaminated with other products (staples, plastics, organic wastes, etc.). Quality requirements in paper recovery are quite low and separation processes are well established. Although the high **mobility of the product** gives rise to numerous possibilities for dissipation (e.g., the general waste stream and the
fireplace), this concern is marginalized by the vast amounts of paper in use and
continuous replenishment via the primary market. In sum, access to recoverable
products registers as a positive factor with respect to the attractiveness of the reverse
market.

Degree of rivalry for recoverable product is low in the reverse market for
waste paper. There are fundamentally two **recovery alternatives**. Waste paper can
either be used as a secondary input to the primary production process or can be
energetically recovered. In practice (at least in central Europe), the latter occurs
mostly in connection with such grades that cannot be used as secondary inputs due to
technical restrictions (e.g., fiber length). **Rivals’ segmentation** hence focuses on
companies that demand waste paper to substitute primary inputs. As competition from
IRCs is negligible, primarily companies active in the primary market are left as rivals.
This market being characterized by a low level of **heterogeneity of rivals**, relevant
competitors are easily monitored, being well known to one another. The resulting
market can be best described as an oligopoly with few but large players (**number, size & concentration of competitors** able to exploit their position as the largest
consumers of waste paper collected and offered by **intermediaries**, whether local
authorities or private contractors. These attributes clearly favor the OEMs and
increase the attractiveness of the market.

Entry into the paper recovery business, **technical feasibility** notwithstanding
(washing, re-pulping, fractionation refining, and dispersion, among other reprocessing
steps, being well established and mature), is highly unattractive for IRCs. Waste paper
used as a secondary raw material in the primary production process can be mixed in
large quantities with primary raw material. Depending on the final product, the
fraction of secondary material may vary between 30% for office paper and 100% for
newspaper grades. The need for a player seeking to enter the waste paper reprocessing business to invest in capabilities similar to those employed in primary production are consequently impeded by strategic costs driven mainly by high technology requirements. This is clearly the dominant attribute within this force. Paper manufacturing on an industrial scale is highly automated and requires special machinery costing several hundreds of million euros. Specific knowledge and certification & laws play inferior roles in paper recovery. That the threat of market entry by IRCs is consequently quite low increases the attractiveness of the market for OEMs.

Although product design is not explicitly considering recovery, waste paper is fully integrated into the primary manufacturing process. The quality differential between totally new product and products containing secondary input generally being marginal, distinct primary and secondary product does not exist, eliminating the risk of cannibalization. Moreover, use of waste paper resulting in reduced costs and being considered environmentally friendly contributes to positive effects on brand image. Strategic stakes (beyond these positive effects) do not factor as an impetus for entering reverse markets. Advances affecting recovery operations not being anticipated, speed of innovation is not a consideration. We thus perceive no adverse effects, and even some positive effects, on paper manufacturers’ core business.

The secondary market for products made from or with secondary input is largely the same as for primary products. Only in specific niches is customers’ willingness to pay higher for high-quality paper containing lower fractions of secondary material. At the other end, many environmentally conscious consumers prefer paper with high fractions of secondary input, up to 100%. Relative to secondary market potential and dynamics, demand for paper is considered to be
stable despite the print media seeming to be in enduring crisis, which is partly compensated by increased demand for packaging materials in connection with mail orders. **Technology life-cycles** likely to alter secondary market dynamics are not observed on the horizon. **Sinks for unwanted by-products** generated in the reprocessing of waste paper may in many cases be a source of additional profit (staples and cardboard, for example, can be sold to brokers).

Summing up, the reverse market for paper is highly attractive for companies already involved in the primary business mostly due to the considerable synergies that can be realized between the primary and secondary manufacturing processes. Indeed, these processes, being wholly symbiotic, are not practically distinguishable. Competition for waste paper consequently occurs exclusively between OEMs, which command a strong position *vis-à-vis* the intermediaries charged with waste paper collection. The foregoing analysis suggests that disruptive changes that would alter the structure of the market are not conceivable at present.