Managing a complex global circular economy business model: Opportunities and Challenges

Abstract

This paper presents an in-depth case study detailing the history, experiences and wider practitioner and policy lessons from a circular economy business model over a thirty-year period highlighting the successes, difficulties and conflicts of adopting a circular economy model. The case is based on interviews, key documents and customer insight. The findings demonstrate how sustained circular economy business practices can deliver significant new revenues, resource productivity and business continuity benefits, but also require managers and practitioners to develop competencies and capabilities, such as balancing linear and circular systems, to address complex and highly dynamic factors including rapid technological shifts and market volatility.

Introduction

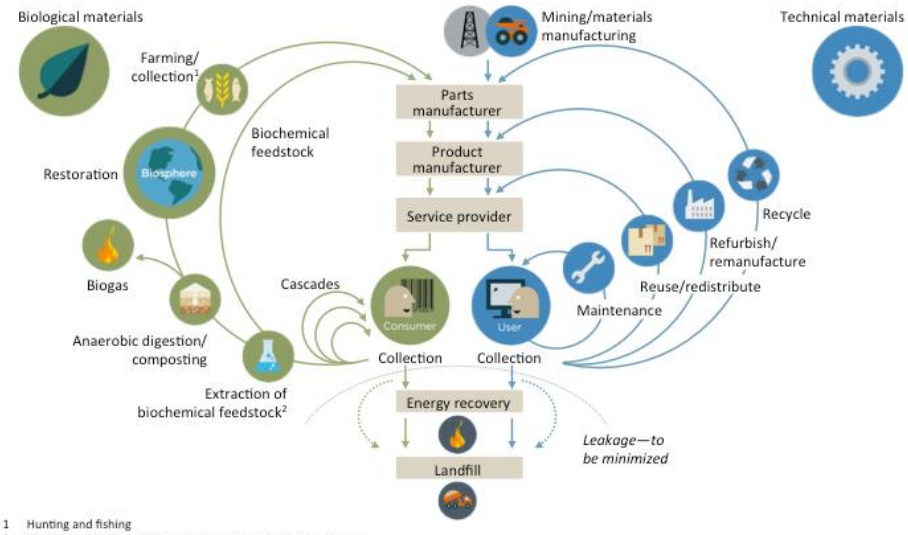
The term circular economy (CE) has a long history, multiple definitions and distinctive developments in different global contexts[1]. In Europe and increasingly in other global regions a CE framework, originally devised and developed in the UK by the Ellen MacArthur Foundation (EMF)[2], has been a catalyst at EU policy level[3] and has become influential in business circles. A key reason for the popularity of this framework, sometimes referred to as the 'butterfly model' (see Figure 1) is that it aligns a compelling business rationale[4] with the need to decouple wealth creation from the consumption of finite resources[5].

Despite the growing interest in circular economy practices, there are few published empirically based evaluative studies into the actual experiences and outcomes within specific businesses through time. The present paper contributes to the literature by providing a detailed case study of the successes of implementing a circular economy system over many years via unprecedented access to a key manufacturer and combining the technical/design, supply chain, (reverse) logistics challenges also from a business model and management of a circular transition perspective. The case study also details the difficulties of trying to move away from the linear

economy and how even the best laid plans and a management committed to the principles of CE can be challenged by external environmental factors. This provides an important first-hand insight for senior executives into the management journey of one of the communities best known CE-case examples in an industry which exhibits many similarities with many other manufacturing and high-tech businesses in a fast changing environment.

A circular economy aims to upgrade the linear take-make-dispose economy to one that is restorative by design[6]. One well-known visual depiction of a circular economy is shown in Figure 1[7]. In the technical sphere (right-hand side, and the focus of this paper) value creation lies in the ability to preserve the embedded labor, energy, material and capital costs in higher forms of product and component integrity and can be achieved through four primary ways[8]. Firstly, via performance business models[9] and maintenance which allows the extension of product usage[10].Secondly, via recommerce (via reuse or redistribution), that is an existing product is resold to a new user with little or no rework. Thirdly, via refurbishment and remanufacturing[11] (using components to create new or extend the usage of existing products). Fourthly, via recycling (in which resources are extracted to their most basic and most interchangeable form e.g. by milling and remelting metals into new metal feedstock). Resource decoupling therefore depends on the ability to spot opportunities and then extract higher value from reusing assets including products, components and their materials at the end of a use phase or find value added from recycling.

Figure 1: A Circular Economy characterization[12]



1 Hunting and fishing
2 Can take both postharvest and postconsumer waste as an input
Source: Ellen MacArthur Foundation circular economy team drawing from Braungart & McDonough and Cradle to Cradle (C2C)

Proponents of this circular economy model have argued that there is business opportunity and advantage from circular models when compared to traditional sales-ownership-disposal models. In the case of asset recovery for remanufacturing for example, the value of US remanufactured production is growing rapidly and recent national data valued the industry at $43.0 billion supporting 180,000 full-time US jobs[13].

A number of the business opportunities and challenges of initiating and managing circular models such as remanufacturing and asset reuse have long been of interest to academic researchers and practitioners and been reported previously including optimal pricing strategies, branding and segmentation[14], cannibalization issues[15], feedstock challenges[16], consumer acceptance[17], reverse supply chain design[18], and how often to remanufacture[19]. The profitable establishment of remanufacturing

systems when there are high rates of innovation and short usage cycles, or in business-to-consumer markets, has also been identified as a major issue in positive business cases[20].

Commercialization and Branding

The role of consumer acceptance and the question of whether or how remanufactured or reused products should be branded is highlighted here as a particularly important challenge facing managers. Companies develop brands for many reasons. Importantly a strong brand will differentiate the product and create a desire that goes beyond utility leading to desire and loyalty in consumers and commanding premium prices[21]. Goods and services in consumer societies are used as sense-making devices and brands form part of our extended self[22]. Brands succeed in part due to the influences that impact consumption. Marketing activity over many years has led consumers to believe that *new is best* and these influences from both marketers and other consumers can reinforce this opinion on the individual consumer. Giannias[23] points out that the quality of brands can be assumed from an analysis of the secondhand market for such brands. So, quality brands will also have a greater value in the preowned market. There are clearly a group of consumers that favor secondhand or reused goods based upon (amongst other things) their environmental concerns or as a deliberate attempt to be anti-ostentatious[24].This group however is studied as a niche or minority group. One important aspect of this paper is to suggest that branding and marketing activity can perhaps reeducate consumers as to the value of products produced in a circular economy process.

In addition there are a number of well-known external barriers and policy challenges affecting trade in remanufactured goods and asset reuse vary by product and country[25]. These include transportation costs, the high price of cores (used components), import prohibitions/bans, foreign regulatory barriers, and tariffs. Few countries have legally defined remanufacturing and this is reported as the single largest barrier to increased sales of remanufactured goods[26]. Remanufactured goods are often categorized as used products, the importation of which may be restricted or banned.

The case presented here addresses all of the above issues and is distinctive in providing a detailed internal perspective and insight from managers into the interplay between these, and other challenges and how they combine and vary over time. The case also provides clarity into the specific framing and practice of a circular economy model as defined by circular economy thought leaders and drawing on our experience of working with over 100 different global businesses on the circular economy over the past 5 years addresses three critical questions for future academic and practitioner directions:

> How does a firm initiate and scale up a successful CE business model within an existing linear set-up and what is the role of the four levers – design, business model, reverse networks and system enablers – that have been identified as central to circular value creation[27]?
>
> How does a management team manage the inflexion points of the CE? These include its dynamic challenges and transitions at points of growth, scale-up, and product innovation and technological change, alongside the manufacture and sale of new products and services.
>
> What is the evidence that CE is a source of sustained competitive advantage and what are the wider lessons for policy makers to create the conditions and enablers for an accelerated transition?

The following section outlines the case method utilized, followed by the case findings. The final sections present a synthesis and wider implications for managers, practitioners and policy makers followed by conclusions and future directions for practice and research.

Methodology

The methodology utilizes a single in-depth case study. Ricoh is a Japanese global printer, imaging and document management original equipment manufacturer (OEM) with a long-standing program in product manufacture, remanufacture and asset

reuse. The company HQ is based in Japan with three Regional HQs covering the Americas (HQ Malvern, US), Europe, Middle East and Africa (EMEA, HQ London), and Asia, Pacific, China (HQ Singapore). The scale of remanufacturing varies by region; it is much lower in the US for example compared to Europe which in turn is lower than in Japan, partly due to the complex nature of the European market structure described later. The company has 110,000 employees, of which 17,000 are in Europe, across 230 consolidated companies with sales of 19Bn USD in 2016, making Ricoh the top-ranked company in its sector by turnover[28]. Japan accounts for 34% of sales by region, followed by the Americas (31%) and EMEA (24%). The company has a long-standing commitment to the environment and sustainability, winning many global awards and accolades over four decades[29] as well as a long-standing reputation for technical innovation.

The case is built upon close collaboration between the authors with key managers within Ricoh UK and Europe and was built via multiple-depth interviews, on-site visits and observational research, access to public and private company documents and customer insight. Quotes from interviews with managers across the business and dealerships are used to highlight key points. To facilitate the flow of the case study it will be narrated in chronological order and followed by a synthesis of implications for managers and policy observations at the end.

FINDINGS

The case starts in Time Period 0, before remanufacturing emerged in the UK for the first time.

Time Period 0: Emergence phase of remanufacturing 1980 - 1994

In the 1980s and 1990s, the typical manufacturing cycle of a Ricoh copier or printer would be between 18 months and three years. After this period the company would typically begin the manufacture of an upgrade or successor model. At that time, the primary driver for the company was to ensure a throughput of (new) product in order to drive economies of scale within its production base. Similarly, the drivers for the

sales force were linked to this production cycle. They were therefore focused on and incentivized to encourage customers to upgrade to new machinery at the end of each lease contract (typically between three and five years in duration). One consequence of this was a stockpile of copiers and printers being returned at the end of lease periods, but which still had not reached anywhere near the end of their useful life cycle[30]. Moreover the widespread prevalence of printers began to shift the market dynamics of the industry as a whole, increasing pressure on the price of machines, and shifting profits to consumables (toner) and the print contract.

The emergence of remanufacturing in the industry, dominated then by Xerox, Fujitsu and latterly Ricoh, was founded on a number of key axioms which created an alignment of capabilities and incentives for the entire industry to embrace remanufacturing and asset reuse as a natural extension of their core businesses[31].Initially (early 1980s) import tariffs meant that it was attractive for printer OEMs to set up production facilities for new printers and cartridges within the EU. By ~2010 those tariffs were finally removed. As a result the removal of those tariffs, China and Taiwan make all new Ricoh printers and cartridges.

Table 1: Overview of key challenges, developments and impacts

Time period	Adaptive phase	Design	Business model	Reverse Logistics	Enablers	Business impact
T0 1984-1994	Emergent	Robust, durable machines – slow innovation cycle	Underlying performance model and in field maintenance as standard Attractive margins on consumables	Reverse logistics core to business models Extensive in field service engineers in place	Positive starting conditions across three key levers	Asset re-use as a cost effective way to grow market share in an expanding market
T1 1994-2006	Growth	Improved design of machines for, and capabilities in remanufacture	Remanufacture recognized as a profitable model	Focusing recovery and recycling facilities to achieve economies of scope and scale	Corporate culture and MRP inc. COMET Circle framework to systematically build capabilities to scale reman.	Stable growth and abundant feedstock Confidence to invest to create separate production lines Profitable business
T2 2005-2012	Maturation Strategic Integration – growing complexity Financial downturn challenging profitability	Standardised technology and compatibility with consumables	Differentiated branding Deployment strategy(geography, segments) to exploit new markets and manage cannibalization	Asset tracking tools Expanding and extending capacity and reach of reverse networks Network infrastructure established to support remote treatment of cores	British Standard to define performance and warranties Policy setting across multiple organizational entities to maximize re-use	Drive for growth in new markets Emergent Pan European strategy 3R aligned to Global MRP vision Branding and Scaling Continuous profitable growth in reman.

T3 2008- 2016	Renewal Disruptive change Android software and product innovation	Improved TCO and resource productivity Refitting of consumables (TBC) –	New sources of value creation and value propositions Market share focus for certified reman. products	Proactive asset management and governance in the field Greater real time visibility, data and intelligence of conditions, ueage and Integrating management across all COMET circle loops Targeting of collection volumes in regions Increasing recovery rates from customers and grey markets Economies of scale, scope and density Increased attention to outer lops of COMET circle.	Clear metrics and decision tools for optimizing reman operations	Return to number 1 and profitability Focus of reman and re-use intp emerging markets Clear positioning and customer targeting to manage cannibalisation concerns Targeted management of assets to maximise their re-use value through varying channels and outlets. Focus on dealers, distributors and core business New Ricoh Global Medium Plan and Long term view and central role of COMET Circle in 2050 materials feedstock vision The development of global resource lifecycle management and new capabilities of managing mixed fleets Specific partnerships to ensure governance in extended re-use supply chain.- collaboration

Time Period 1: The early growth of asset reuse by Ricoh UK 1994 – 2004

The initial steps taken by Ricoh in formal remanufacturing came about largely by accident. A site in the UK, Telford started as a production plant in 1985, producing copiers, printers, faxes and toner cartridges for the European market. Initially, the site was successful and profitable in focusing on its core operations, however, by 1994, Ricoh was operating in Europe primarily on a leasing basis, and through growth (largely by acquisition) it recognized that its market was maturing and hence opportunities for further growth from manufacturing new machines were limited. Commercial pressures, and the need to remain competitive and productive as a manufacturing site within Ricoh globally, meant that the UK site needed to diversify its production activities and the opportunity for remanufacturing was recognized.

However, in the mid-1990s, the company's approach to asset reuse was defined internally as 'reconditioning' or 'refurbishment' rather than being seen or managed as remanufacturing, and was managed separately from the core manufacturing business as a 'recycling division'.

While not achieving substantial scale across Europe in this period, Ricoh created the foundation for scaling up remanufacturing by making important steps along the four circular economy value creation levers.

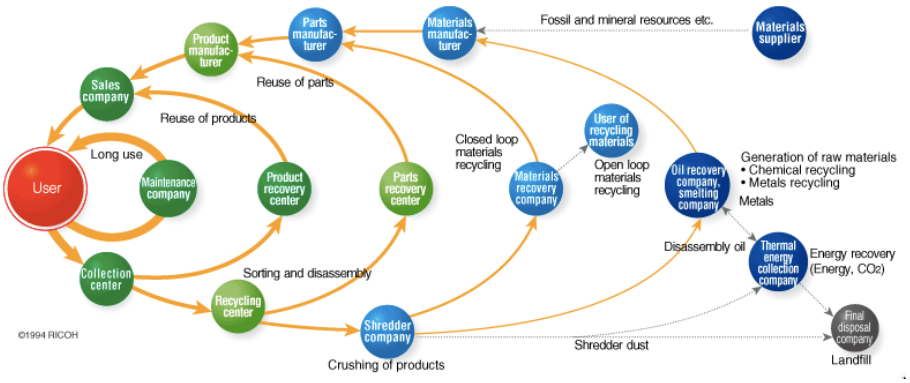
Regarding design, Ricoh extended the scope of its operations and moved into the reuse of toner cartridges and other components for copiers and printers. Design capabilities improved and by the mid-2000s a Ricoh remanufactured printer, for example, consisted of approximately 80% retained and reused materials from the original machine. As a business model, remanufacturing was better understood and recognized as a stand-alone profitable arm of the business.

On the reverse flow dimension, Ricoh Europe invested in recovery and asset reuse infrastructure and consolidated operations at a few major sites to increase scale and

reduce their reprocessing costs, extending such activity across the supply chain, incorporating other partners.

In 1992 the parent company established the Ricoh General Principles on the Environment and by 1994 had designed a full asset recovery framework known as the COMET Circle – an explicit recognition that a linear model reliant on growing levels of material consumption and waste couldn't continue. This conceptualization was an important internal enabler in the development of a European perspective during the late 1990s around the time that asset reuse began to grow and the shift to remanufacturing that was 'as good as new' was achieved.

Figure 2: The Ricoh COMET Circle[32] (Source Ricoh n.d) ~~ABOUT HERE~~



As a consequence the asset reuse business was recognized as a profitable operation worthy of developing and the COMET Circle enabled a group-wide management philosophy that started to embed the culture of a circular economy

within Ricoh. Even so, as Colin Weaver, Head of Ricoh UK Remanufacturing, and involved with the UK operations since the mid-1990s, noted:

"Looking back…. reuse and remanufacture has never been an easy option for Ricoh UK and Europe. We had to develop a market, an infrastructure for reuse and a cultural acceptance that the on costs of reuse were less than the on costs of take, make, dispose, even in an environment where we did not have the evidence to support our claims."

Time Period 2: 2005 – 2012 Growth of remanufacturing

Up to 2004 asset reuse and 'remanufacturing' for copiers and printers displayed steady growth both in the UK and Europe although the overall market was relatively small and remained distinct from mainstream operations across European markets. Greater levels of uptake and sales of reused units varied dramatically, and significant complexities for the growth of reuse were created by the lack of homogeneity in the European market.

During this time period the early 'remanufacturing' business had reached sufficient scale and impact within Ricoh to expand from its UK and European origins. A dedicated European cross-functional team was created by Ricoh Europa PLC (EU HQ), headed by a member of the Ricoh Europe Board, extending to the Middle East, covering 22 business units and a total market in excess of 1.5 million machines. A scale-up program – '3R' (recover, reuse, recycle) – covering machines, parts and supplies, and third party traders was created to manage and coordinate the complex range of challenges including asset recovery, matching supply to demand, market place variations, and managing profits across a complex dynamic network.

As a result of the scaling up Ricoh Europe was beginning to face key strategic challenges: whether to differentiate the remanufactured product, and how to position this product in the marketplace. Developing a remanufacturing and asset reuse strategy was beginning to raise concerns within Ricoh about brand reputation (e.g. quality, reliability etc.) and also marketplace acceptance. With ambitions to grow the

market a decision was taken in 2008 to review and develop specific branding for the remanufactured products in the UK, targeted at the UK public sector market, a price-sensitive customer segment that was also increasingly required to demonstrate commitments to 'green' procurement.

Figure 3: The Greenline brand[33] (source Ricoh 2011)

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This decision was not difficult as a new industry standard for remanufactured products – BS8887-220[34] had been published. Remanufacturing, as defined in BS8887-220, guarantees the original specification and the only distinction is that for a remanufactured product, the packing indicates that the product may contain recycled or reused parts. In all other respects they are identical, and therefore, from a customer perspective, it is essentially impossible to differentiate the two products. As a result for the first time there was industry clarity over the term 'remanufactured' which was a major boost to Ricoh Europe in overcoming potential negative customer perceptions. As the only OEM to attain this standard, Ricoh was able to create a de facto monopoly in the remanufactured sector and this success led to the creation in 2011/12 of a European-wide brand – Greenline (See Figure 3).

Olivier Vriesendorp, Vice President Product Marketing, Europe, Middle East and Australasia (EMEA), explains why the standard and the Greenline branding provided major growth: "*the Greenline brand allowed Ricoh to harmonize a number of regenerative initiatives under a single umbrella. From a customer perspective the value proposition brings together Ricoh certified product and service provision; attracting a competitive price point and the guarantee that all products, service parts and consumables used in the provision of print will be returned to and reused within Ricoh's own global supply chain.*"

The development and positioning of the Greenline brand enabled Ricoh to differentiate the remanufactured machine and more latterly cartridges to develop new market opportunities targeting consumers sensitive to a lower price relative to new and/or customers wishing to demonstrate their green credentials. Rached Dekker, Sales Director, Ricoh Netherlands, highlights the advantages of having preowned devices in the product portfolio:

"It enables us to enter into new markets where a traditional long-lease offer with new devices with the latest models would be attractive. Think about markets with greater uncertainties or where the extra flexibility is a must. Ricoh successfully serves customers with remanufactured equipment in construction, the events business or any other project-based industry where printing needs are required for a limited period of time."

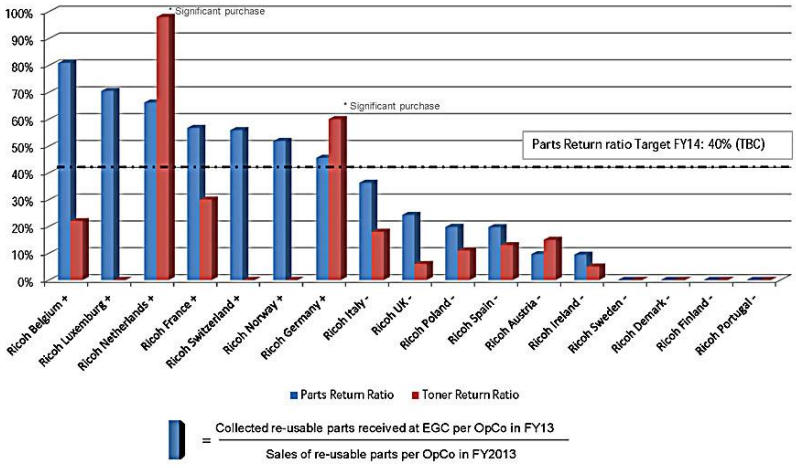
These developments enabled the Greenline brand to grow to a sizeable operation with sales currently of around 10,000 machines per annum representing about 4% of total sales whilst also recovering and reusing 30 to 40% of all eligible toner cartridges sold within the European market.

In order to build up the remanufacturing from this base a second key issue for the 3R team was the collection and recovery of assets sold outside of its contract for initial service as approximately 40% of printers were not recovered at the end of contract or usage period. In the case of cartridges a review showed consumer perceptions of and willingness to return cartridges for remanufacture varied dramatically across markets which made it difficult to scale up and optimize a reuse strategy across such a large geographic area as Europe. One of the biggest challenges to overcome in

developing the European cartridge remanufacturing business was, again, the complexity of the market. This necessitated dealing with 22 separate operating companies in 22 different countries, each with their own supply chains buying individually from manufacturers in China and distributing products in their local markets in different ways. Third-party non-Ricoh refillers also target empty cartridges, reducing the number of cartridges available in the remanufacturing supply chain.

As a consequence whilst return rates across Europe average around 20% they vary dramatically between markets (Figure 4). The near 100% return figure in the Netherlands for example is incentivized by a rebate for every cartridge returned. In the Nordic countries there is no cost-effective infrastructure for consumers to return cartridges so they dispose locally to third parties. Germany and France have strongly developed cultures and systems to return products whereas in the UK, it has been normal practice to throw them away.

Figure 4: Reusable Ricoh parts and supplies return ratio by operating country in 2013



The growth of the 3R program meant managers needed to be able to predict future demand and optimize profit opportunity across the network. Sporadic flows create variable and unpredictable utilization of remanufacturing and reuse capacity which in turn reduces the fixed cost recovery or creates additional costs[35]. Limited visibility of supply or ability to forecast supply accurately makes it difficult to set production and sales targets, balance out trade-offs between second use cycle and new assets, and adds risks and costs in terms of needing to hold excess inventory or potentially running out of stock[36].

The 3R business model is based upon a 'value realization cascade' - a decision tree which was developed iteratively by managers in the 3R team to help define the optimum value that the company can realize from returning assets; both hardware (machines), as well as consumables and spare parts. The cascade process is embedded in the Ricoh EU-wide Enterprise Resource Planning (ERP) system. The system extracts data remotely from all contracted machines (e.g. number of copies made) and is used to determine which route through the cascade a machine should take (i.e. the smaller the number of copies a machine has made the lower the cost of remanufacture as parts replacement levels will be lower). The real lesson from Ricoh is no matter how much the process is automated, the prioritization and routing of assets through the cascade requires continual iterations of manual intervention and management decisions.

Speaking in 2016 Harald Keding, Head of Supply Chain for Ricoh in Germany, observes that,

"we have to be extremely agile as we cannot afford to hold inventories of used stock; we need to move assets quickly. The key therefore is to predefine an asset's destination prior to its removal from the market, and by understanding the location and condition of assets in markets versus the real-time demand for reused product, we can predefine the reuse route of each asset".

Despite having many impressive circularity characteristics, much of Ricoh's turnover and profits still come from the sale of new equipment. Huge amounts of capital, fixed assets, collateral and human resources have been committed to this goal and hence sales and marketing teams, financial targets, performance bonuses and overall strategy will potentially be affected by the scale-up of 3R. As a result asset reuse creates a tension and is always likely to be perceived as a threat to new machine sales with the potential to cannibalize new sales and hence impact on manufacturing output and a raft of performance metrics[37].

Whilst the period from 2007 saw sales teams engaged with markets that value the 'Greenline' credentials and lower cost solution offered (as indicated above), incentive structures for the wider sales force which are designed to drive sales of new machinery were beginning to act as a block on their willingness to push remanufactured machines and a reluctance to engage in understanding the different nature of the product.

The 3R program management team recognized the need to both feed a fixed infrastructure for the production of new machines and to grow the reuse business; and that the alignment of sales targets across geographic and commercial boundaries required a constant iteration of price and margin alignment for the company. It was recognized that sales teams will inevitably strive to achieve their personal commission targets and therefore simply adjusting their incentives altered behavior. Peter Andersson, Director / Vice President, Ricoh Sweden, reinforces this point noting that:

"The sales reps who are successful in selling remanufactured machines are typically also the ones who perform well in new equipment sales. Remanufactured Greenline machines sales are rewarded mainly based on gross margin and therefore interesting to sell. These salespeople know well that new and preowned sales are strongly connected. They find the best total solution with the right balance of products and services in their offerings to customers, and know that offering remanufactured devices can help them to sell new machines and other new businesses as well".

The challenge to Ricoh of offering reused assets is therefore twofold. Firstly, how to manage the cannibalization of sales of new product which will also increase the marginal costs of Ricoh's fixed infrastructure. Secondly, how to address the lost opportunities of not offering reused assets. In response the company has cultivated a dual sales approach: growing revenues and market share. The first approach involves remanufactured machines sold into discrete channels, segments or markets within which the company has little or no presence with new machines (e.g. emerging markets), thereby avoiding the risks of cannibalization. The second is via a so called 'balanced deployment' approach, whereby contracts are won on the basis of a mixed fleet of new and remanufactured devices at a lower overall price than is possible via new machines alone.

In summary this time period marked a period of intense change in the Ricoh story building upon the underlying strength of the four primary CE levers allowing CE activity to become recognized as a successful, differentiated pan-European operation. On the technical design front the ability to remanufacture a larger scope of products has been established. On the business model front Ricoh created a clear brand position through Greenline, developing clear market segmentation and growing the business without risking cannibalization of the core business.

By defining clear metrics to prioritize remanufacturing, a clear asset valuation decision tree was developed and embedded in the central ERP-system across products and geographies in order to optimize the return on remanufacturing operations.

This was supported by developing new capabilities in reverse networks including asset tracking and demand and supply balancing tools, as well as broadening the capacity and reach of the reverse network to serve all major markets in Europe. The intervention of regulators and standards were important external systems enablers to remove the ambiguity of definitions and criteria for different revalorization options (e.g. remanufacture vs. refurbishment) and provide protection and clear guidance to customers by establishing standards and clear signage of "as-good-as-new" products.

An important development, however, is the period following the financial crash of 2008 when a number of disruptive changes in the global competitive and technological environment created a parallel and overlapping set of new challenges.

Time Period 3: Reinvention. The impact of technological disruption and accelerated innovation cycles (2008 – 2016)

As global pressures mounted in 2008 the organization was forced to reconsider its position. Eugene Kersjes**,** Vice President, Ricoh Europe Supply Chain Management, commented in 2015 that *'the industry as a whole moved into a commodity market. Until then we had been able to keep high price levels as a result of continuous innovation (B/W to color, analogue to digital). As the economic downturn from 2008 took hold the high prices started to murder us. Our main business model of leasing meant that we only fully became aware of the changed world (dramatic price decreases) at the time of contract expiries".*

From 2009 onwards Ricoh set in place a number of actions to allow it to fight back in the market, to return to profitability and to build in organizational resilience such that its previous lack of agility, and the narrow product focus that had served it so well pre-downturn, but had been its Achilles' heel during the downturn, would not be repeated. Not only did Ricoh refine its organizational structure, merging or reducing divisions, optimizing operations and realigning responsibilities; it also took the opportunity to look at its key markets and the products and services offered in these.

Whilst new entrants were a possible threat Kersjes commented *"that the three main US competitors, Lexmark, Hewlett Packard and Xerox, all had lower fixed costs. They each however made a strategic decision to bet on growth in services adjacent to printing, made large non-core acquisitions but were unable to convert these to core revenues and margins. Ricoh took a different decision, instead acquiring all its key distributors and expanding its dealer network into emerging markets."*

Since 2012 the company has seen revenues return to pre-downturn levels and its number one market share position restored. The principal driver for the restoration of the company's fortunes has been the complete overhaul of its main technology

engine, towards a modular design, incorporating the latest technologies which have significantly reduced manufacturing and running costs whilst simultaneously enhancing functionality and allowing the company to build upon the connectivity value of its products.

The company now has a core product range that is cost-effective to manufacture, and that costs less to run, resulting in a lower total cost of ownership (TCO) for customers, and encompasses the convergence of technologies such as Android. This allows the company to create new value through the use of User Applications directly embedded within, or importable to, the devices themselves. As a result the company has seen unit placements grow in the last three years which in turn has seen an upturn in feedstock availability for the reuse programs that the company deploys, as incumbent customers swap out their older devices to realize the inherent benefits of the newer, more efficient, more technologically advanced products that form the company's new product line-up.

Whilst remanufactured device costs remain relatively attractive versus a new device, efficiency gains in the running costs of new devices are reflected in a lower Total Cost of Ownership (TCO), particularly on five-year lease contracts, and the 10% saving on a remanufactured machine is not sufficient to be attractive to many customers. One of the key resource productivity gains is in toner efficiency (33-40%) which is both beneficial in material terms but also a crucial determinant in overall running costs.

At the same time, Olivier Vriesendorp, Vice President of Product Marketing Europe, Middle East and Africa, reflects on similar erosions in the 'circular' credentials of a remanufactured device versus a newly manufactured Ricoh device: *'the latest generation Ricoh devices use far less material than their predecessors, as they become lighter, more compact and more standardized, bringing not only material sourcing gains but also upstream sustainability benefits in logistics and technical service. On top of this, new devices have become far more energy efficient in recent years, resulting in an overall erosion of the once clear space between a new and a remanufactured Ricoh device'.*

In principle such developments should be great news for the asset reuse programs, feedstock is more readily available, and recent advances in the company's supply chain management systems allows Ricoh to visualize the landscape of available assets in the near- to mid-term. Yet paradoxically the company has in essence undermined its remanufacture offer, certainly its hardware offer, as new devices are now so cost effective, and convergent with adjacent technologies such as User Applications, that the Greenline branded remanufactured three- to five-year-old devices are struggling to compete.

At face value one may speculate that Ricoh's T3 phase is time-boxed, and that within three years the new generation of devices will return to the reuse program and equilibrium will be restored in the form of T2 tactics. However, its asset reuse model itself is now transitioning itself towards new sources of value creation. Eugene Kersjes, Vice President of Supply Chain Europe, Middle East and Africa, and concurrently head of Ricoh's European 3R organization, leads Ricoh's response to T3. Kersjes has created a virtual team, crossing multiple disciplines including marketing, sales, service, manufacturing, research and development.

Vriesendorp and his team have established new value propositions for Ricoh's remanufactured hardware and the marketing team is targeting new segments of the market. Furthermore, the opportunity to recover more products from grey markets is one that the company will now actively pursue.

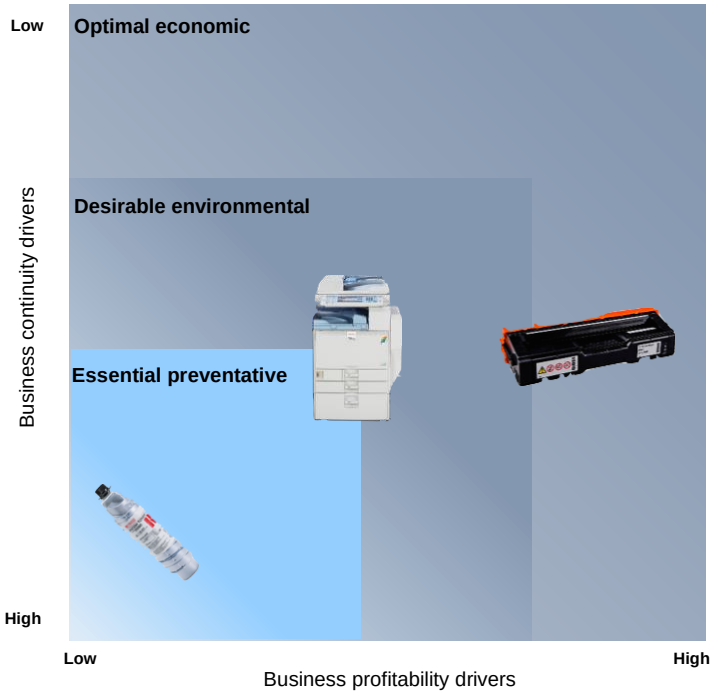
Such opportunities require careful analysis and are bounded by Ricoh Corporate Policy that dictates that every remanufactured item has to be demonstrably cheaper to make and distribute than a new product, and be approved by the Japanese HQ. Comparing the economics of new machine production and remanufacture is complex because they are so different, and also often mixed (new and remanufactured are produced in the same plant using a combination of resources). New manufacture is more structured and controlled, therefore efficiency (measured as unit of output per

unit of input (generally time)) is maintained >90%. For remanufacture the material inputs are variable, consequently efficiency levels are lower.

Despite the challenges remanufacture continues to be an important and profitable part of the global and European business. Financial Year (FY) 2016 saw EU sales of remanufactured Greenline machines at around 13k (7% of total sales) with a margin approximately 20% higher than new machines. In the same period Ricoh sold in excess of 330k remanufactured cartridges, with an attractive margin and an estimated overall benefit to Ricoh of around €15M. Additionally 220k spare parts were sold of which 85k were remanufactured. The cost benefit of spare parts varies enormously according to the original cost of manufacture although the margin is generally higher for parts than for cartridges.

From a Ricoh UK/Europe perspective the maturity and growing understanding of the economics of circular practice have led to a three-segment model defined as essential preventative practice, desirable environmental practice and optimal economic practice. To illustrate this Figure 5 shows a Greenline MFD, a toner bottle and an all-in-one toner cartridge, although each product may cross two or even three of these segments depending on quality and volume. The cost/benefit for MFD and the all-in-one devices remain profitable and contribute to environmental objectives and business continuity.

Figure 5
Product segmentation by environmental, economic and business continuity drivers



In comparison the economics of toner bottle reuse are challenging and by themselves they barely merit reuse. However, In terms of preventative behavior the opportunity costs for Ricoh are potentially very high. In Europe alone the company ships well in excess of one million toner bottles every month. Theoretically every empty toner bottle is an available asset for a third-party refiller and Ricoh suffers from piracy and counterfeiting within its toner business. The company is not therefore incentivized by the potential profit to be gained from toner bottle reuse, nor does the amount of material consumed to produce a bottle represent a significant contribution to the 2050 material vision, but in terms of business continuity, toner bottle reuse is essential.

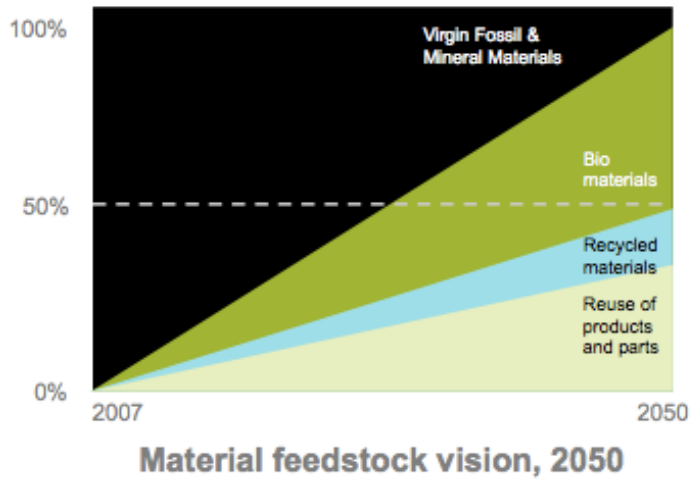
For Kersjes and his supply chain team, continuous proactive asset management and governance is an essential element of the mix, targeting assets in their first usage cycle, to be actively collected or plucked from the field for remanufacture or reuse where greater value can be found, or, if this is not economically viable, cascade product and materials to the outer loops of the COMET Circle.

Ricoh is looking far beyond T3, to design for reuse, and to generate an infrastructure across its value chain that manages the product range across an extended life cycle with multiple product lives, with differing distribution channels, and with clear and differentiated propositions at each stage of the life cycle.

The implications of the recent changes for the continued success of the remanufacturing and reuse program are considerable. In the case of Ricoh UK and Europe the ability to manage those changes and recalibrate reuse and remanufacture as a core strategic activity is made possible by wider support and capabilities from the long-standing commitment to environmental issues and the broader Ricoh corporate 2050 vision which states,

"Ricoh is committed to a managed and long-term reduction in the impact of our activities upon the environment including to reduce resource use by 25% from fiscal 2007 levels in 2020 and by 87.5% in 2050"[38]. Within this vision, Ricoh recognizes a need to seek alternative sources of material supply and by far the most accessible and available is that material embedded in our current and future contracted fleet. The company therefore has a built-in incentive to continue to pursue reuse mechanisms in whatever forms these may take and add new capabilities of design for remanufacture.

Figure 6 Ricoh Material Feedstock Vision 2050



Material feedstock vision, 2050

Managing these issues effectively across a global business requires close attention to internal collaboration and cooperation. Whilst the regional subsidiaries have a certain degree of autonomy, the emergence of the 3R strategy in T2 has been integrated across the global business in T3 and increasingly embedded in the company's three-year management plans that drive overall strategy[39]. The company has three global "3R communities", Europe, Asia and the US, all of which work within a global virtual matrix organization named "Business Solutions Group" run from Tokyo. Global best practice conferences are held annually at which the heads of each 3R community plus technical and commercial experts meet to discuss and deploy regional opportunity into global horizontal deployment of best practice. In the case of Europe monthly conference calls are held with the US community to share market intelligence and technical best practice (to avoid duplicating technical development and therefore waste cash). A good example of how that works in practice is the technology that was developed in the US to support the Latin American market for toner cartridge reuse (where price is always the main driver and piracy is rife) was deployed specifically in one European business group to help reduce service costs and make a previously unprofitable multi-million pound contract profitable.

Looking to the future Ricoh globally believe that their recent technological leap will lead to a period of relative stability over the next 5 years. In this next period the

improved durability of the new generation of machines has turned attention to consolidating efforts around the inner loop of the Comet Circle and keeping current assets in use longer via remote diagnostics and swap-outs for parts that have malfunctioned or require replacement. This also leads to a reduced reliance on and reduced costs of traditional field servicing. The strategic challenge for Ricoh is what balance of actions is required to achieve the 2050 vision and the inherent risks in design for remanufacture in the event of any further technological leap. Significant R & D activity in bio-based materials reflects a growing recognition that the material feedstock vision is unlikely to be achieved via reliance on traditional fossil fuel material choices. These complex issues are currently being debated and modelled by the 3R team and forms Time period 4 (2016-2021) in the unfolding Ricoh story.

Synthesis and implications

Detailed case studies on corporate circular economy practices, as conceptualized in this paper, are nascent. The Ricoh case study represents a distinctive and detailed circular economy story encompassing a 35-year journey drawing on managerial and practitioner insights and perspective across four distinct time periods. It demonstrates in a single case the value creation opportunities from circular practices, previously depicted in Figure 1[40]. In this case the company's COMET Circle illustrates the various value creation opportunities from recovered product: the ability to capture this value relies on a wide range of capabilities, investments and enabling conditions.

The case adds detailed insights from managers and cost benefit data into how a balanced strategic portfolio management of reused assets, alongside the sale of new products, can reach new price-sensitive or environmentally conscious segments[41], block counterfeits[42], and capture new revenues and profit from recovered assets[43]. The case vividly highlights the opportunity costs of not recovering and offering reused assets[44]. Time period 3 illustrated the dynamic responses required to the challenge of maintaining profitable remanufacturing systems when there are high rates of innovation and short usage cycles[45].

The issue of branding provides an interesting twist to the story, showing both the potential of specific branding and certification to overcome customer concerns about the quality of 'reused' products, and the fresh challenges that emerge when new products with equivalent or better economic and environmental credentials create the potential for customer confusion. In this case the Greenline brand equity has been eroded and leaves open the question of future segmentation, product pricing and branding. It is perhaps important to look at branding holistically here. Rather than merely a sales opportunity, branding can be used to spread the message of, and philosophical support for, a CE model both internally (amongst employees) and externally (amongst customers). The role of branding as a means to educate and influence consumers is an important theme and area of future research to direct practice in this area.

Whilst the contribution of the case provides insight and better understanding of the specific aspects of asset reuse the more interesting and distinctive feature of the case is in showing the complex interplay between a wide range of challenges facing managers and practitioners, often simultaneously, over time.

The complex and nuanced interplay between economic, environmental and business continuity factors means that a circular economy is unlikely to scale up randomly and once established may itself come under threat. The Ricoh case study has demonstrated that the best intentions of a CE model have been threatened by the significant advances in manufacturing efficiency.

The role of circular economy building blocks

The first implication for managers and practitioners therefore is that the transition and scaling up of a circular model requires the continuous iteration of the four key levers previously described and a long-term view (Table 1). Operating any one in isolation is unlikely to be successful or profitable. Many cradle-to-cradle products

designed for disassembly or recirculation for example end up in landfill at the end of a first life. To avoid this they themselves need to be designed into appropriate closed or open business models and reverse networks to maintain their material quality and value at the highest level. Likewise a leasing or rental model or recovery of poorly designed products might simply end up circulating toxicity or erode the value potential due to the difficulty of repair, resale or refurbishment. This leads to specific requirements and key capabilities in relation to each building block:

From a design perspective innovation managers need to address design for reuse and remanufacture to enable repeat sales and use all product and material combinations to not only enhance, but also protect future revenues. The emergence of remanufacturing in Ricoh UK, as with many OEMs, was largely serendipitous, and the interface between new product design and value creation through recovery and remanufacture or reuse remains an open area of research[46,47]. Fully integrated design for remanufacture involves or requires attention to a variety of issues including material choices affecting disassembly and subsequent biological or technical pathways, durability of design, simplifying products via standardization or modularity of structures, and future-proofing equipment including upward compatibility of software. Without this, OEMs or third-party collaborators may not achieve the full value creation potential from remanufacturing or reused assets.

From a business model perspective it is widely acknowledged that the role of services is of growing significance to differentiation and competitive advantage both in terms of added value customer services (new delivery models, new service contracts, performance-based deals) but also ensuring product designs (see above) are easy to service and can be repaired or remanufactured at least cost[48]. As the case indicates, for an OEM, operating these at scale requires a strategic decision of whether to actively recover third party (grey) markets or work with intermediaries and achieve economies of scale, scope and density.

Reaching scale has the potential for reducing reverse network costs and maximizing network profits which can be enhanced by improving the level of automation of remanufacturing by integrating management across all the circular economy loops in

a compound fashion rather than focusing solely on individual loops (e.g. remanufacturing alone).

Individual firms can further influence broader system enablers and conditions in support of circularity by setting standards to drive down costs or promoting standards to influence consumer awareness and purchase decisions and supporting regulation for remanufacture and reuse (see discussion below on Policy).

The Ricoh story illustrates the growing complexity of the circular model over four time periods and at various stages, the need to manage critical inflexion points, and transitions at points of growth, scale-up and product innovation or technological change. As the case reveals, an established, profitable and resource-productive program is not immune from changing corporate strategy, financial circumstances, competitive pressures and technical innovation cycles. Moreover the case has shown the ability to extract higher value from reusing products, components and materials at the end of their first use phase, even if a strong business case is not a given. To take full advantage of the building blocks in Table 1 management teams must make a strategic decision to resolve some of the fundamental challenges and tensions in the businesses.

Managing challenges, tensions and trade-offs

Hence the second implication for managers from this study is that going circular and mainstreaming from relatively small and well-defined niche operations in remanufacturing will create tensions and conflicts with the entrenched way (the linear manner) of doing business. Accepting these tensions as inevitable and as an impetus and source for business model innovation is required to enable and empower future management teams to develop agility and apply their capabilities to circular economic changes, which can be hard to predict.

As the Ricoh case demonstrates a circular set-up is not a static system and through time the volatility of commercial pressures, regulatory change and faster innovation

cycles requires capabilities to manage transitions back and forth and the need to be able to realign the circular model.

This requires committed resolution from management teams.

Two of the important aspects of managing such transitions is to:

1) Anchor circularity within the wider business by setting a clear, unambiguous target (e.g. the 2050 decoupling material vision of Ricoh) for scaling up the circular model to provide strategic direction for many of the long-term decisions, e.g. in upgrading technology and using natural discontinuities to replace existing capabilities with more circular ones.

In the case of Ricoh the COMET Circle has proved a critical framework to maintain the founding values of the company and its long-term commitment to environmental standards and innovation.

2) Be very cognizant of the many trade-offs and tensions in the short term and treat these as opportunities for further improving the management system and the day-to-day operations towards more circular practices over time.

Sustaining circular value creation and future policy requirements

The third implication is that Circular Economy business models are a potential source of growth, market share and profit for individual firms[49]. The interest in circular economy business practices as a source of new value creation is growing[50] although detailed evidence of cost/benefit comparisons to linear processes remains elusive, and this is one of the key directions for future research and practitioners (see below). As the Ricoh case illustrates however macro-economic and competitive pressures are a constant and circular economy propositions have to demonstrate their positive business contribution. The growing use of the term circular economy then raises important research questions across a wider range of business and industrial cases, for example how the concept is perceived, implemented, and managed alongside established environmental or sustainability strategies? Does it challenge current sustainability strategies or take them in a different direction, and if

so how will these be managed internally? As the number of businesses beginning to test out circular economy practices increases there is a growing sample of companies to provide evidence to identify the specific challenges in adapting the Circular Economy concept to individual business problems.

Policy

It is further argued that remanufacturing also offers other benefits including the potential for reshoring parts and products, opportunities in improving national resource resilience and the potential for economic growth and the creation of skilled jobs. Further research into these wider macro-economic opportunities is required.

To achieve further growth and transition to a circular economy requires global cooperation between governments and businesses to ensure that key policy and system barriers to development are addressed. From the Ricoh study three areas of policy and cooperation are apparent.

Firstly the role of defined standards and nomenclature for remanufacturing to address consumer concerns regarding quality and performance, and overcome consumer uncertainty about the term remanufactured versus other terms such as refurbished, repaired or reconditioned[51]. This is an opportunity for marketing managers to really understand customer interpretation of CE offerings and then provide a compelling brand offering.

Approaches to defining and providing quality assurance for remanufacture vary by country. Korea and China for example are promoting national strategies for the remanufacturing industry whilst Japan currently provides quality assurance of remanufactured products with related associations. The federal and state governments of the United States, through USITC are promoting various laws and systems to encourage the remanufacturing industry[52]. In the UK BS 8887-220:2010 is a specification for design for manufacture, assembly, disassembly and end-of-life processing (MADE) and specifies requirements for the process of remanufacture.

To develop global trade and sales in remanufacture requires cooperation between key players to actively exchange policies, technologies and experiences with partners, and international remanufacturing standards are required to be prepared to increase quality reliability of remanufactured products.

The sharing of more case studies on real examples of remanufactured products meeting the ‘as new’ standard is required to build awareness and confidence amongst policy makers and nations directly involved with remanufacturing trade.

Second is the role of regulation in driving change. On top of a number of technical and structural barriers there are a number of regulatory frameworks and directives that focus too strongly on classifying products as waste when they have reached their end-of-first-life stage. Ricoh anticipated and circumnavigated this issue in Europe in relation to European WEEE regulations. In 2012 toner cartridges were not considered to be electrical waste but rather than assuming this would always be the case Ricoh anticipated they would come under WEEE sometime in the future and therefore by creating a recovery system and network post 2012 would have a material and competitive advantage and compliance strategy in place. EU WEEE legislation is now being finalized and by 2019 it is likely there will be such an obligation for cartridges.

Finally Industry-wide metrics can also hinder the perception and recognition of remanufacturing. For example it is only since 2011 that Infosource (a market research organization for the office automation industry) has allowed remanufactured products to contribute to firms' overall market share figures. Ricoh and its competitors had to be careful to ensure that they did not fulfil their market share requirements through remanufactured product, highlighting how industry bodies and wider system conditions can inadvertently hold back potential growth in circular economy activities yet can be relatively easily adapted with industry agreement.

Conclusions

In sum there are many strategic reasons why firms initiate or scale up circular business practices. The claim and appeal to businesses is that this transition could be self-reinforcing by being profitable rather than solely requiring costly regulation[53].

The circular economy framework provides an overarching conceptualization of a new type of economy, where products, components, services, materials and their by-products circulate at their highest value for the longest period. The Ricoh case and COMET Circle highlight a successful case but also the complex interplay between investments in business models, product and service design, management of reverse flow infrastructure and networks and the ability to leverage key system conditions to reduce transaction costs. The day-to-day operation of a global circular economy model requires constant iteration and requires an overarching value asset decision tree and end-to-end visibility of stocks and flows of assets in the field, in itself requiring investment in information management and tools to manage complex system dynamics and anticipate future scenarios.

The shift to a circular economy is not straightforward, and the current transitional phases may collide against many entrenched features of the highly successful and much older linear economy model, which has delivered many benefits. However many features of our current economies are predicated on an era of low-cost, readily available resources and a system of national accounts which fail to take into account much of the degradation and degeneration of natural capital on which our entire economies and societies depend.

However, the responsibility for CE should not be left with manufacturing and operations managers. Marketing is very much needed to do its share and it is a change in the culture of consumers (including business users) that should be the focus of marketers.

There is no question that the industry has spent the best part of a century educating consumers that new is best. However, with marketing work this could change. A good example is the use of free plastic bags in supermarkets. The consumer always used to bring their own bags to the store until supermarkets educated them not to. For 40-50 years the consumer then collected bags from the store. However, in the

last two years (in England) a system of charging per bag has led to a major shift in behavior to ensure customers bring their own bags again.

Ricoh has many resilient circular features but is not immune to competitive market pressures, customer requirements and technological shifts. The COMET Circle and the Greenline brand demonstrate Ricoh's clear value system within its corporate brand[54], and committing to a circular economy model has been a clear differentiator for the company. There are broader valuable lessons from this for the marketing profession in how to create consumer acceptance of preowned products. The lesson from this case is that it is possible to initiate large-scale circular models and navigate the complex and volatile challenges through transitional phases but these cannot be underestimated.

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[6] EMF 2012 op. cit.

[7] EMF 2015 op. cit.

[8] These four approaches are shown as the four feedback loops shown in Figure 1. In a circular economy, these feedback loops operate as part of an overall system enabling product, components and materials to be circulated at their highest value for repeat use. The first EMF report (2012) demonstrated a $600Bn p.a. economic and business opportunity from the application of these approaches at scale when applied to a small number of common technical durable products in the EU economy, when compared to the linear base case.

[9] Stahel op. cit.

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[49] EMF (2012, 2013, 2014) op.cit.

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[51] BS8887 for example defines 'recondition' as return a used product to a satisfactory working condition by rebuilding or repairing major components that are close to failure, even where there are no reported or apparent faults in those components; 'refurbish' as aesthetic maintenance of a product to bring it back to a condition comparable to that of a new product. It does not include repairing or rebuilding any components: repair as Returning a faulty or broken product or component back to a usable state any subsequent warranty is generally less than that of newly manufactured, remanufactured or reconditioned equivalents and may apply only to the component that has been replaced or repaired.

[52] United States International Trade Commission (2012) op.cit.

[53] EMF (2012) op.cit.

S. Roper and C. Fill, *Corporate Reputation, Brand and Communication* (Harlow, UK: Pearson Publications, 2012).