Developing a Circular Economy through remanufacturing Refrigerated Display Cabinets: An investigation into the behaviours of stakeholders in the UK Retail Refrigeration Sector

Żaneta Muranko

A thesis submitted in partial fulfilment of the requirements
of London South Bank University for the degree of Doctor of Philosophy

This research programme was carried out in collaboration with the Bond Group

April 2019

Abstract

The Retail Refrigeration Industry currently operates in a linear system, where Refrigerated Display Cabinets (RDCs) are manufactured using material and energy intensive processes, and are commonly disposed of at their end-of-life, which is unsustainable and causes several environmental and socio-economic issues. This in conjunction with an increasing demand on resources, necessitates an alternative Circular Economy through more resource-efficient industrial processes such as remanufacturing. Remanufacturing can prolong the life of components from old RDCs, by reusing them in the reproduction of RDCs. However, in the Retail Refrigeration Industry remanufacturing rates are currently low. This is largely due to the low demand and availability of remanufactured RDCs in the market. This thesis researches the behavioural barriers that are preventing the adoption of remanufacturing in the industry and investigates behaviour change interventions that could help overcome them.

This thesis develops a theoretical framework (a Pro-Circular Change Model; PCCM), which uses an extended Theory of Planned Behaviour and Persuasive Communication to investigate and influence pro-circular behaviours, specifically in the context of purchasing and producing remanufactured RDCs within the Retail Refrigeration Industry. The framework was used in three empirical studies. The first is a pilot study, which used two-part structured surveys to investigate whether the use of Persuasive Communication could be effective in influencing positive beliefs towards the purchase of remanufactured RDCs among professionals (N=26) working in the Food and Retail Refrigeration Industry. The results of the pilot study suggest that Persuasive Communication can positively influence beliefs held about the purchase of remanufactured RDCs.

The Persuasive Communication was then embedded into the second study, in which structured surveys were completed by UK grocery retailers (N=20) to see if the intervention had a similarly positive impact on behavioural beliefs, although this time, specifically on the intention to purchase remanufactured RDCs. The structured surveys provided the data to identify the key behavioural determinants of their behavioural intentions. The results of the study reveal that grocery retailers have little interest in buying remanufactured RDCs. This is largely due to a lack of positive Perceived Behavioural Controls, particularly the perception of remanufactured RDCs not being available in the

market. The intervention however showed that Persuasive Communication can be effective in changing the behavioural intentions of grocery retailers.

The limited availability of remanufactured RDCs in the UK market was then put towards RDCs manufacturers (N=6), in the third study, which in the form of similarly structured surveys, aimed to identify the determinants and influencers of them producing remanufactured RDCs. The results of the study reveal that RDC manufacturers are unlikely to provide remanufactured RDCs to the UK market. This was a result of them lacking positive Perceived Behavioural Controls and Subjective Norms, particularly the perceptions of remanufactured RDCs being in low demand and remanufacturing being an uncommon offering in the industry. The empirical studies also found there to be other factors, such as price and quality standards that are important drivers of grocery retailers' and RDC manufacturers' remanufacturing behaviours. Finally, this thesis provides an industrial case study which outlines how a RDC remanufacturer used Persuasive Communication to successfully encourage a UK grocery retailer to purchase their remanufactured RDCs.

The results were drawn from a small sample of participants and cannot be concluded as being representative of the population at large. Rather, this thesis provides an insight into the current behavioural landscape towards remanufacturing in the UK Retail Refrigeration Industry according to grocery retailers and RDC manufacturers. This thesis provides recommendations on the development of interventions and forms a knowledge platform for future research on enabling pro-circular behaviours in this sector.

Acknowledgments

I would like to express my gratitude to my supervisors, Dr Deborah Andrews, Dr Elizabeth Newton and Dr Issa Chaer, for their continuous guidance, encouragement and expert advice. Their support has been invaluable to the completion of this PhD. I would also like to thank the Bond Group, in particular Chris Woollett, whose passion and commitment to sustainability enabled this project to take place; and Philip Proudman, whose support and industry knowledge have been indispensable to this research. Finally, I would like to thank my partner, Wayne Ullah, for being the amazing person he is.

List of Publications

Muranko, Z., Andrews, D., Chaer, I. and Newton, E. (2019). Circular economy and behaviour change: Using persuasive communication to encourage pro-circular behaviours towards the purchase of remanufactured refrigeration equipment. *Journal of Cleaner Production*, 222, pp.499-510.

Muranko, Z., Andrews, D., Chaer, I., Newton, E. and Proudman, P. (2019). Encouraging Remanufacturing in the Retail Refrigeration Industry. *Elsevier Energy Procedia*, 161, pp.283-291.

Muranko, Z., Andrews, D., Newton, E., Chaer, I. and Proudman, P. (2018). The Pro-Circular Change Model (PCCM): Proposing a framework facilitating behavioural change towards a Circular Economy. *Resources, Conservation and Recycling*, 135, pp.132-140.

Muranko, Z., Andrews, D., Chaer, I., Newton, E., Proudman, P. and Longhurst, M. (2017). Pro-circular behaviours and Refrigerated Display Cabinets: supporting resource efficiency in the Retail Refrigeration Sector. *Elsevier Energy Procedia*, 123, pp.70-75.

Muranko, Z., Andrews, D., Chaer, I., Newton, E., Proudman, P. and Longhurst, M. (2017). Incentivising pro-circular behaviours: proposing a new Enhanced Capital Allowance scheme for remanufactured products - the case of Refrigerated Display Cabinets in the United Kingdom. *Elsevier Energy Procedia*, 123, pp.369-374.

Muranko, Z., Andrews, D., Chaer I, I., Newton, E., Proudman, P., Longhurst, M. (2016). Developing a Circular Economy through the remanufacture of Refrigerated Display Cabinets (RDCs) and implications of the Enhanced Capital Allowance scheme in the UK. *Proceedings of the 21st International Sustainable Innovation Conference*, 07-08 November 2016, University for the Creative Arts, Epsom, UK

Muranko, Z., Andrews, D., Chaer, I., Newton, E. J., Proudman, P. and Longhurst, M. (2016). Developing Circular Economy for the Retail Refrigeration Industry: how financial incentives could influence remanufacturing of Refrigerated Display Cabinets in the UK. *Proceedings of the Avnir LCA Conference 2016*, Lille, France

Andrews, D., Muranko, Z., and Chaer, I. (2015). An assessment of differing environmental and economic factors and their impact on the development of a Circular Economy for Refrigerated Display Cabinets in the UK. *Proceedings of the 20th International Sustainable Innovation Conference*, 09-10 November 2015, University for the Creative Arts, Epsom, UK

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1. Background

The linear economy was established in the early days of the industrial revolution and is still prevalent in a significant majority of industries. It is based on the *take-make-use-dispose* system, where products are made, used and disposed of at the end of their life. This system is founded on the assumption of an infinite material supply and contributes to continued waste and pollution through the inefficient use of natural resources. While the practice of the linear economy is common, governments [e.g. EU (European Commission 2015a; European Environmental Agency, 2017); United Kingdom (Department for Environment, Food and Rural Affairs, 2015; HM Government, 2018] and businesses [e.g. Unilever (2018), Google (Rana and Brandt, 2016); Renault, 2017; Phillips, 2017;] prompted by the environmental pressures, are now beginning to realise the potential and "importance of moving to a more sustainable economy" (Department for Environment, Food and Rural Affairs, 2015, p. 2) – the Circular Economy.

The Circular Economy is an industrial system in which resources are kept in use for as long as possible. It aims to eliminate waste, provide resource security and lessen the environmental cost in the production and consumption of products to help regenerate natural systems (European Commission, 2015a). The Circular Economy typically involves businesses implementing a range of alternative business models which focus on achieving a more resource-efficient and *circular*[1] product. This can be implemented by either providing a product-service system (e.g. product leasing, sharing) or by extending a products life-span (e.g. repair, reuse, refurbishment, remanufacture).

The UK retail refrigeration sector is an industry that continues to operate the *take-make-use-dispose* system. This can be demonstrated by the large amounts of waste generated from the disposal of the refrigerated display cabinets (RDCs). RDCs are used to stock and display chilled and frozen food and beverages in retail grocery stores. They developed in conjunction with the growth of self-service retail grocery stores throughout the 1950s and there are now over 800,000 RDCs across 8000 retail grocery stores in the UK (Bibalou et al., 2011). The manufacture of RDCs is typified by the extensive use of

[1] *Circular* products - Products designed and used in line with the Circular Economy principles i.e. design for longevity, reuse, repair, refurbishment, remanufacture. The circular product is directly associated with or is a consequence of performing a pro-circular behaviour (Muranko et al., 2019).

materials including metals, glass and polymers. The Centre for Remanufacturing and Reuse (Walsh, 2009) forecast that in 2015, an estimated 69,000 *end-of-life* RDCs were disposed of and entered the waste stream. With the UK retail grocery sector predicted to grow over the next decade[2], there will be a continued and increasing demand for RDCs (European Commission, 2014a). As a result, the manufacturing industry will need to procure more resources to produce and meet demand. Should the industry continue to operate using in a linear system, then an increasing amount of cabinets will be subject to disposal.

Purchasers (retail grocery stores) and Manufacturers of retail refrigeration equipment can be more resource-efficient when purchasing and producing RDCs, through adopting *circular* business models such as remanufacture. Remanufacture is a process where good quality and reusable components in end-of-life cores are used in the production of 'good-as-new' products. As a result an end-of-life RDC is brought to a condition equivalent to a brand-new cabinet. Typically, RDCs are used by retail grocery stores for five to eight years before they are disposed of. The process of remanufacturing RDCs has the potential to increase their lifespan to 15-20 years (Bibalou et al., 2011). Nevertheless, the practice of remanufacture in the UK Retail Refrigeration Industry is uncommon.

This research project was supported by an industrial partner – the Bond Group. The Bond Group is a UK manufacturer and remanufacturer of retail refrigeration equipment. They supply RDCs nationwide to leading grocery retailers, some with over 500 stores in the UK such as Marks & Spencer, Sainsbury's, Aldi and Spar (The Bond Group, 2017). The Bond Group has embedded remanufacture into their business model to provide customers with the option to extend the life of their existing RDCs. Despite the Bond Group having an established remanufacturing process for RDCs, the option to buy remanufactured RDCs remains unpopular among their customer base.

Many experts agree (e.g. European Commission, 2014b; Department for Environment, Food and Rural Affairs, 2015; Atherton, 2015; Ellen MacArthur Foundation, 2013a), that moving to a Circular Economy requires a behavioural change to the way that products are produced and consumed. The low adoption of *circular* business models in the Retail Refrigeration Industry, such as remanufacturing can

[2] Despite the large format supermarkets closing, UK grocery sales are expected to rise, particularly due to the rapid growth of convenience and discount stores (Ruddick, 2015).

be attributed to business-to-business consumers (i.e. retail grocery stores) and producers (i.e. manufacturers) not performing pro-circular behaviours[3]. If retail grocery stores showed more demand for remanufactured RDCs, then manufacturers would be more inclined to implement remanufacturing into their business models.

To date research on behaviour change remains underrepresented in Circular Economy literature (Chamberlin and Boks, 2018; Korhonen et al., 2018; Ellen MacArthur Foundation, 2013a). A review of literature identifies several gaps in academic knowledge about the adoption of pro-circular behaviours. This includes the lack of effective methodologies for investigation and encouragement of pro-circular behaviours, and subsequently there is an absence of data on remanufacturing behaviours in the Retail Refrigeration Industry. In order to encourage pro-circular behaviours in the Retail Refrigeration Industry, a detailed understanding of the factors that influence the purchasing behaviour (of retail grocery stores) and manufacturing behaviour (of RDC manufacturers) is fundamental to the design of effective interventions that aim to encourage the uptake of remanufacturing.

1.2. Research Aims

This aims of this research are to:

- develop a behaviour change model that details methods for investigating and encouraging pro-circular behaviours (the Pro-Circular Change Model),
- fill the gap of knowledge in current literature on the determinants of pro-circular behaviours specifically related to the *purchase* and *production of remanufactured RDCs,*
- provide an insight on interventions that could be implemented to facilitate the behavioural change of purchasers (retail grocery stores) and manufacturers (RDC manufacturers) to encourage the uptake of remanufacturing within the Retail Refrigeration Industry.

[3] Pro-circular behaviour is an action which is brought about due to prioritising resource-efficiency. This behaviour benefits or at least reduces damage to the environment, economy and society (Muranko et al., 2017a). Behaviours such as *purchasing remanufactured products* and *producing remanufactured products* are pro-circular.

1.3. Research Questions

The review of literature on behaviour change in the Circular Economy, specifically on remanufacturing within the Retail Refrigeration Industry, has led to this research to ask:

1. What are the key behavioural determinants that influence whether grocery retailers purchase remanufactured RDCs?
2. What are the key behavioural determinants that influence whether RDC manufacturers produce remanufactured RDCs?
3. Can Persuasive Communication be an effective Behaviour Change Intervention in encouraging the purchase and production of remanufactured RDCs within the Retail Refrigeration Industry?
4. What other types of Behaviour Change Interventions would be effective in encouraging the purchase and production of remanufactured RDCs within the Retail Refrigeration Industry?
5. How willing are grocery retailers and RDC manufacturers to support the development of the Circular Economy in the Retail Refrigeration Industry?

1.4. Original Contribution to Knowledge

The findings in this study contribute to literature on the Circular Economy and Behaviour Change within the Retail Refrigeration Industry by:

- developing a novel methodology for investigating and influencing pro-circular behaviours (Pro-Circular Change Model),
- undertaking a quantitative data analysis on the behavioural determinants that influence grocery retailers and RDC manufacturers to purchase and produce remanufactured RDCs,
- developing and measuring the effectiveness of several Behaviour Change Interventions aimed at influencing grocery retailers and RDC manufacturers intentions to purchase and produce remanufactured RDCs,
- identifying the industry enablers that would facilitate remanufacturing of RDCs.

1.5. Thesis structure

As illustrated in Figure 1.5., the thesis content is as follows:

Chapter 2. The Circular Economy and its development in the Retail Refrigeration Industry

This chapter introduces the Circular Economy concept, its aims, origins and adoption within the technical sector. It provides an analysis of how *circular* the UK Retail Refrigeration Industry currently is and a summary of the processes that could advance its adoption. It also explores the behavioural constraints of developing the Circular Economy and emphasises the lack of research available on the methods of identifying and influencing human behaviour in regards to its adoption.

Chapter 3. The Pro-Circular Change Model: design of a framework to support the adoption of pro-circular behaviours, particularly the remanufacturing of RDCs

This chapter presents the Pro-Circular Change Model (PCCM) - a theoretical framework, developed to provide methods for investigating and influencing pro-circular behaviours, specifically in the context of purchasing and producing remanufactured RDCs. This model is implemented throughout this thesis to address Research Questions 1, 2 and 3, and specifically it is used in the studies contained in Chapters 4, 5, 6 and 8.

Chapter 4. Influencing Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs

This chapter presents Study 1, which used selected constructs of the Pro-Circular Change Model to investigate how effective the use of Persuasive Communication could be in influencing the Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs. Participants in this study (N=26) were individuals from the Food and Retail Refrigeration Industry, including engineers and academic experts of food and retail refrigeration equipment who work directly and indirectly with RDCs. The data in this study was collected using a two-part structured survey administered to measure the impact of the Behaviour Change Intervention. This study answers Research Question 3. Study 1 was conducted to pilot the methods proposed in the PCCM. The results of this study informed the design of Study 2 described in Chapter 5.

Chapter 5. Investigating and influencing grocery retailers' pro-circular behaviours: purchasing remanufactured RDCs

Study 2 has been divided into two parts. This chapter presents the first part of Study 2 which used selected constructs of the Pro-Circular Change Model to investigate and influence grocery retailers' pro-circular behaviours – defined as purchasing remanufactured RDCs. Participants in this study (N=20) were individuals who purchase RDCs for UK retail grocery stores. The data in this study was collected using structured surveys. This study answers Research Questions 1 and 3. The results of this study have led to further research in Study 3, as described in Chapter 6.

Chapter 6. Manufacturers' Pro-Circular Behaviours: producing remanufactured Refrigerated Display Cabinets

As in Chapter 5, Study 3 has also been divided into two parts. This chapter presents the first part of Study 3 which used selected constructs of the Pro-Circular Change Model to investigate and influence pro-circular behaviours among RDC manufacturers – defined as producing remanufactured RDCs. Participants in this study (N=6) were individuals who produce and sell RDCs to the UK retail grocery stores. The data in this study was collected using structured surveys. This study answers Research Questions 2 and 3.

Chapter 7. Other Factors influencing remanufacturing behaviours of stakeholders in the Retail Refrigeration Industry

This chapter presents the second parts of Study 2 and Study 3. It identifies other factors that have an influence on the decisions of grocery retailers and RDC manufacturers to purchase and produce remanufactured RDCs. Participants in this study (N=25) were individuals who purchase and produce RDCs for retail grocery stores in the UK. The data in this study was collected using structured surveys. This study answers Research Questions 1, 2 and 4. In addition, this chapter identifies the extent to which stakeholders are willing to support the development of the Circular Economy in the Retail Refrigeration Industry. This study answers Research Question 5.

Chapter 8. Using the Pro-Circular Change Model to encourage the purchase of remanufactured Refrigerated Display Cabinets

This chapter presents an industrial case study in which the Behaviour Change Intervention methods from the Pro-Circular Change Model were used by a RDC manufacturer to encourage a grocery retailer to purchase remanufactured RDCs. The methods used in this case study have been influenced by the results in Studies 2 and 3. This chapter addresses Research Question 3.

Chapter 9. Conclusions and recommendations

This chapter summarises the key findings, outlines the original contribution to knowledge and proposes further research to address any shortcomings and limitations identified in this thesis.

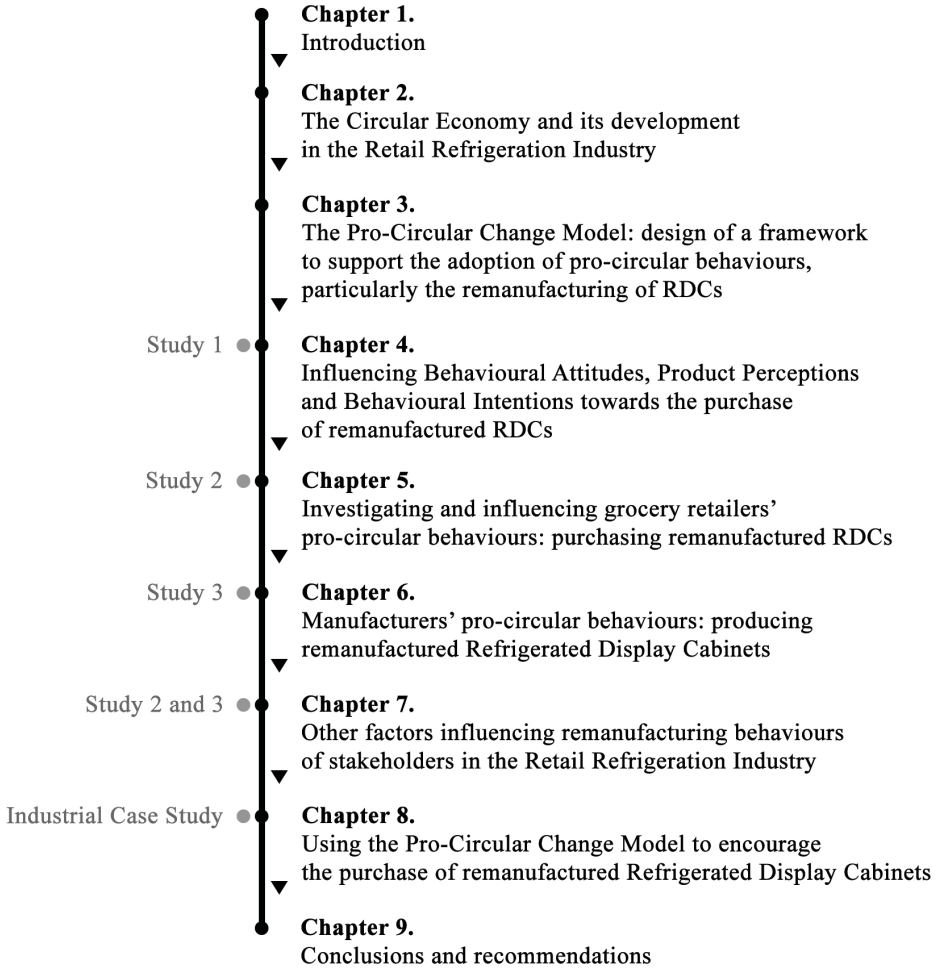


Figure 1.5. Thesis – outline.

2. The Circular Economy and its development in the Retail Refrigeration Industry

Introduction

This chapter introduces the Circular Economy concept by providing a review of literature regarding its aims, origins and adoption within the technical sector. This follows, an analysis of how circular the UK Retail Refrigeration Industry currently is and a summary of the processes that could advance its adoption. This chapter concludes with an exploration of the behavioural constraints of developing the Circular Economy and emphasises the lack of research available on the methods of identifying and influencing human behaviour in regards to its adoption. It also highlights lack of available data on the current behaviour of purchasers and manufactures of RDCS in relation to remanufacturing.

This review was conducted using literature from academic databases, particularly Scopus, Science Direct, Springer Link and Google Scholar. Due to a growing interest in the Circular Economy in recent years, works published by governmental bodies, businesses and research organisations were also included in this review.

2.1. The Circular Economy

The linear economy is still prevalent in many industries. It is based on the *take-make-use-dispose* system where products are made, used and disposed of at the end of their life (Figure 2.1.a).

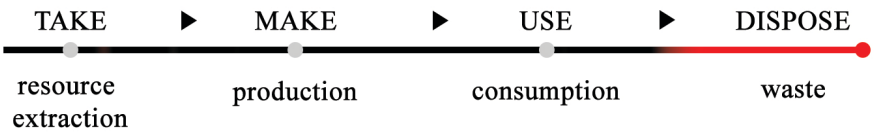


Figure 2.1.a. The Linear Economy.

In the linear economy, economic growth relies on the extensive and constant consumption of resources (Stahel, 2010). This type of industrial practice is unsustainable and causes several environmental and socio-economic issues, such as global warming (Intergovernmental Panel on Climate Change, 2014), resource overuse (Behrens, 2016), commodity and market volatility (McKinsey Global

Institute, 2011), air, water and soil pollution, all of which threaten ecosystems (Ellen MacArthur Foundation, 2013b) and are a risk to human health (Kampa and Castanas, 2008; World Health Organization, 2018). The linear economy also threatens the future availability of primary resources that are typically used in manufacturing. This issue has become widespread in geo-political discussions, especially in countries that are dependent on importing finite resources from resource-rich countries whose government policies can influence exports through implementing tariffs and restrictions (European Rare Earths Competency Network, 2015). The supply of primary resources is further exhausted[4] by a growing population[5], which results in rapidly evolving economies and larger consumer markets (McKinsey Global Institute, 2012), which is mirrored by the growing commodity prices (Figure 2.1.b). This increased demand for materials [Organisation for Economic Cooperation and Development (2012) recorded growth in the extraction of resources increased by 65% between 1980 and 2007] emphasises the need for government and business to look at utilising more secondary resources that are already in circulation and therefore accessible.

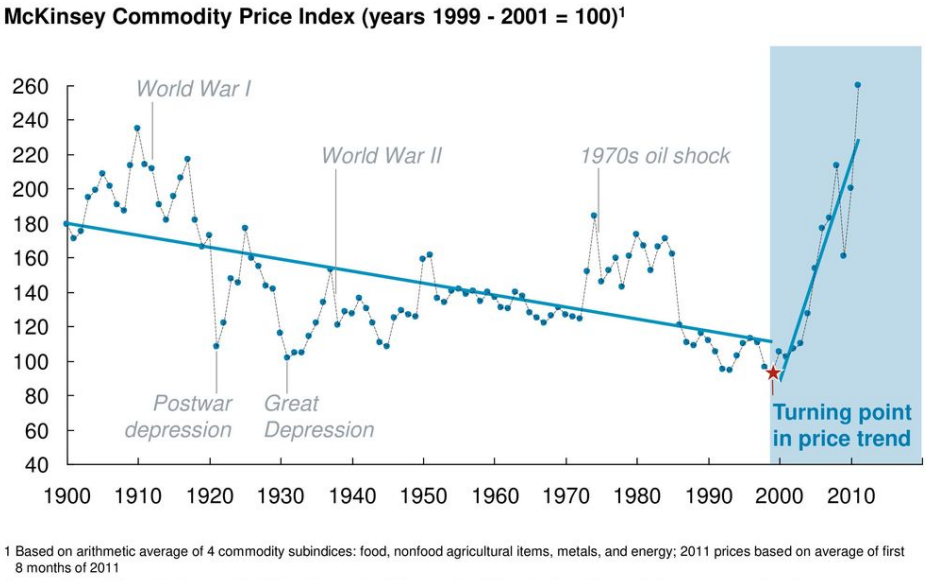


Figure 2.1.b Commodity Price Index (McKinsey Global Institute, 2012).

Governments, government departments (e.g. European Commission, 2015a; Department for Food, Environment and Rural Affairs, 2015; HM Government, 2018), businesses (e.g. Unilever, 2018;

[4] The global use of material resources is expected to double between 2015 and 2050 (United Nations Environment Programme, 2017)

[5] Forecasts show that the global population will grow from 7.3 billion in 2015 to 11 billion by the end of the 21st century (United Nations, 2017).

Kingfisher, 2017; M&S, 2018; Renault, 2018; Philips, 2016; Hewlett Packard, 2017; Google, 2016) and other organisations (e.g. British Standards Institution, 2017; Ellen MacArthur Foundation 2013b) recognise the importance of shifting towards a more resource-efficient and sustainable economic system. This shift can be achieved by a widespread implementation of the Circular Economy (European Commission, 2015a).

The Circular Economy is an industrial system that promotes sustainable resource management, by maximising the lifespan of products and materials. In contrast to the linear economy, the Circular Economy recommends a *closed loop* approach (Stahel, 1982), where end-of-life products are utilised in the production of new products rather than being disposed (Huber, 2000). To support the *closed loop*, the Circular Economy suggests a more restorative approach in the design of materials, products, systems and business models (Ellen MacArthur Foundation, 2013b). The overall purpose of the *closed loop* approach is to reduce the negative effects of the prevailing linear economy and consequently, be less damaging on the environment, economy and society.

2.1.1. Concept foundations

The origins of the Circular Economy "cannot be traced to one single date or author" (Ellen MacArthur Foundation, 2017). However, the concept gained momentum in 1970s in various publications.

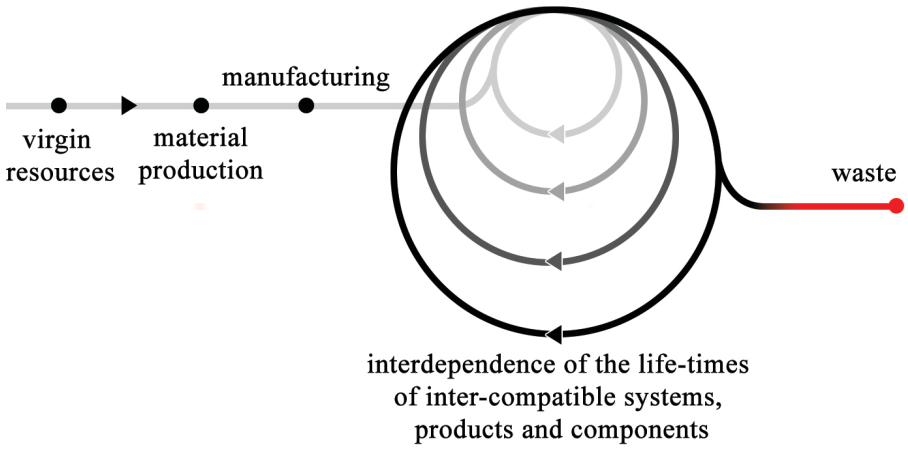


Figure 2.1.1.a. The Self-Replenishing System, adapted from Stahel and Reday-Mulvey (1981).

In 1972, The Club of Rome's The Limits to Growth (Meadows, 1972) report highlighted an unstable relationship between population and economic growth and the supply of finite resources. It highlighted the necessity for change away from linear resource consumption in order to provide for sustainable growth. The Circular Economy was first defined as a "closed-loop" system by Reday-Mulvey and Stahel in 1977, who emphasised the importance of extending the lifecycle of products, as a way to achieve a more sustainable economy (Reday-Mulvey and Stahel, 1977). As shown in their framework (Figure 2.1.1.a), this is a result of consistently reusing, repairing, reconditioning and recycling products and components (Stahel and Reday-Mulvey, 1981). The Circular Economy principles were also supported by the theory of Industrial Ecology, which was also developed in the 1970s. The theory proposes that the controlled flow of resources and industrial processes based on maintaining an ecological equilibrium could secure a long-term material supply, reduce energy consumption and have positive environmental impacts (Barlow, 2013). In the 1990's, the Circular Economy was again advocated by McDonough and Braungart (2002), who were proponents of the Cradle to Cradle approach. This approach focuses on *closed-loop* design and manufacture, which seeks to maintain the value, quality and productivity of resources in a sustainable way (Braungart et al., 2007). Hawken et al. (1999) in their vision of Natural Capitalism, emphasised that the production of goods is strongly reliant on the supply of natural resources. Feng (2004) and Yong (2007) promoted the "reduce, reuse and recycle"[6] (3Rs) approach as a foundational practice of the Circular Economy. In more recent literature, the Circular Economy has been discussed by Thackara (2015), who emphasised the need to shift towards a more sustainable and natural economic system, and Pauli (2010) who recommended utilising the waste of end-of-life products in the production of products. Pauli advocated this as a potential innovation model for businesses. In the last decade, the Circular Economy has been championed by the Ellen MacArthur Foundation. The Foundation works with businesses, governments and academia to engage decision makers and leaders in the Circular Economy framework.

McDonough and Braungart (2002) divided the Circular Economy into two distinct cycles for biotic ('green') and abiotic ('blue') material, as illustrated in Figure 2.1.1.b. The biotic cycle of the Circular

[6] 3Rs: Reduce the use of resources in making of products, reuse and therefore prolong the functioning life of products and recycle them at the end of life into returnable resources

Economy (Figure 2.1.1.b, left) is driven by the reuse of organic waste. The biotic loop recovers the value of waste through a series of transformative processes such as the extraction of biochemical feedstock, anaerobic digestion or nutrients restoration. The results of which can be the production of soil additives, animal feed, chemicals and heat (Bastein et al., 2013).

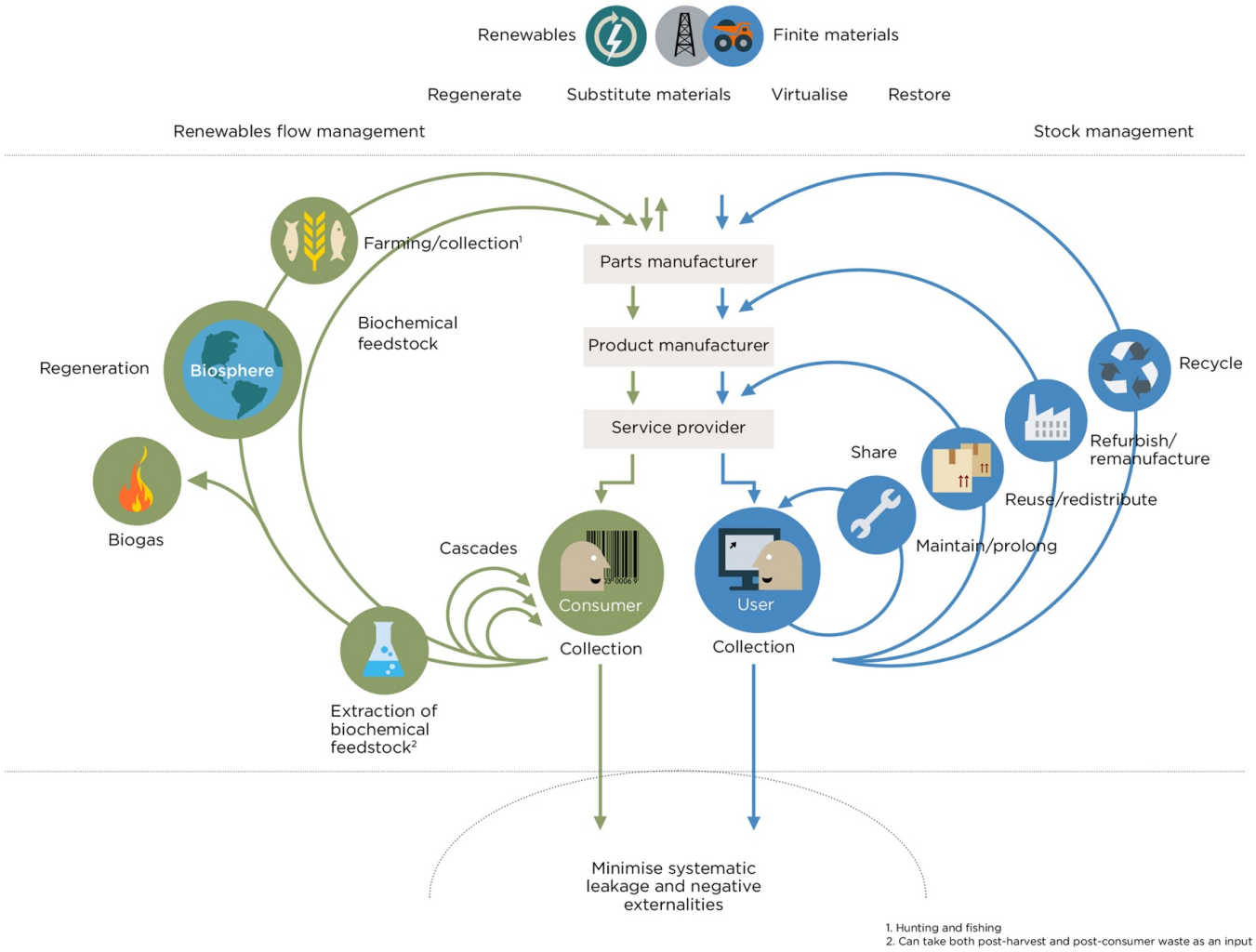


Figure 2.1.1.b. Biotic and Abiotic Cycles of Circular Economy (Ellen MacArthur Foundation, 2013b).

Due to Refrigerated Display Cabinets being a technical product (Bastein et al., 2013), this research focuses solely on the abiotic loop of the Circular Economy. The abiotic cycle of the Circular Economy (Figure 2.1.1.b, right) is accomplished through the circulation of materials from the technical sector. The core value of materials can be retained through a variety of processes, including the reuse of existing products and the reprocessing of end-of-life products. These processes are ranked according to their efficiency in the EU Waste Hierarchy Framework Directive (Directive 2008/98/EC; European Commission, 2016), for example the reuse of products is more favoured than recycling (Figure 2.1.1.c). The fewer number of processes required to retain the value of materials, the more efficient the abiotic cycle is. This is represented by a smaller loop which is recommended by proponents of the Circular Economy.

The sharing of products is considered to be most efficient abiotic process. This is followed by the life extension of existing products (e.g. maintenance, reuse, refurbishment) and the extension of end-of-life products (namely though remanufacture). Recycling is the least efficient abiotic process; however, it is important because it can prevent materials from end-of-life products (that are not suitable for reuse or life extension) being sent to landfills.

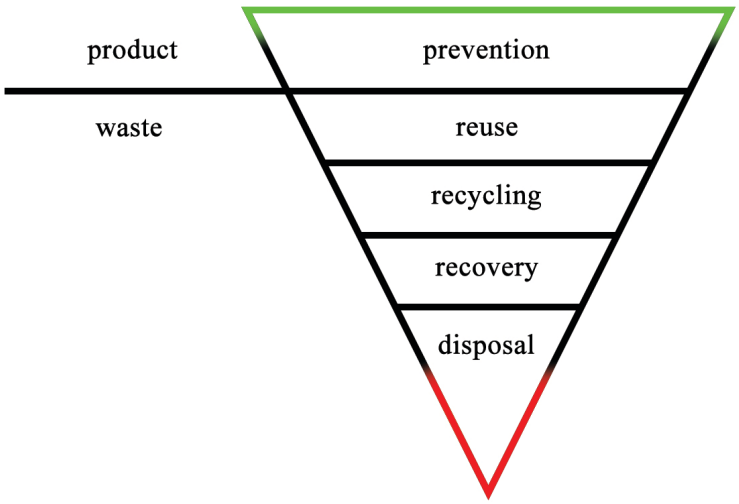


Figure 2.1.1.c. Waste Hierarchy, adapted from European Commission (2016).

2.1.2. Impacts of Circular Economy

In the European Union, the adoption of Circular Economy could boost resource productivity by 3% in 2030 and add an estimated £1.6 trillion to the economy annually (Ellen MacArthur Foundation et al., 2015). Between £215 - £430 billions of this can be attributed from the potential material savings in the manufacturing industry alone (Ellen MacArthur Foundation, 2012b). In addition to this, the growth of the *closed-loop* practices could potentially generate between 710,000 - 2 million jobs by 2030 (European Environmental Bureau, 2014; Cambridge Econometrics and BIO Intelligence Service, 2014),

By comparison, in the UK, the adoption of Circular Economy could add between £9 - £29 billion to the economy annually (Eunomia, 2016; Voulvoulis, 2015) and create a potentially large job market for skilled workers (Stahel, 2010; Ellen MacArthur Foundation, 2013a; Waste and Resources Action Programme, 2015). Estimates forecast this number to be between 10,000 - 102,000 new jobs (Waste and Resources Action Programme and Green Alliance, 2015). This could regenerate regions where unemployment rates are high (Rizos et al., 2017), particularly the UK's industrial cities and towns that have recently experienced economic downturns.

In terms of environmental benefits, by 2030 it is projected that the potential 3% growth in resource productivity across the European Union, would also result in a 25% reduction in greenhouse gas emissions (Cambridge Econometrics and BIO Intelligence Service, 2014) and reduce current levels of primary material use by a third (Ellen MacArthur Foundation et al., 2015).

2.1.3. Circular business models

A *Circular business model* is an industrial approach that supports the development of the Circular Economy; it is based on businesses "utilising the economic value retained in products after [their] use in the production of new offerings" (Linder and Williander, 2015, p. 2). This involves businesses implementing the *closed loop* approach into their industrial practices, namely to how products are produced, used and treated at the end of life.

Rizos et al. (2017) grouped *circular* business models into three interlinked categories. In the first category are models that are driven by a change in procurement from outright product ownership to product-service systems. Product-service systems challenge the traditional material-intensive methods

of product utilisation, by providing dematerialised services (Mont, 2002) such as pay-per-use[7], leasing[8], renting/sharing[9] and pooling[10] Tukker (2004). This effectively increases the number of users per product, at the same time as reducing the requirement for manufacturing new goods. These approaches encourage and incentivise the service provider to prolong the functional life of products they own.

The second category of *circular* business models focus on preserving the highest value of materials in products by extending their life Tukker (2004). These include the reuse, maintenance/repair, refurbishment (which focuses on life-extension of existing products) and remanufacture (which focuses on life-extension of end-of-life products). Reuse is "*any operation by which products or components that are not waste are used again for the same purpose for which they were conceived."* (Directive 2008/98/EC; Article 3.13, p. 312/10). The reuse often involves a resale of a product or its parts (European Commission, 2011)[11]. Maintenance and repair help to preserve the function of an existing product for continued use[12] or resale (British Standards Institution, 2009). Refurbishment is more extensive than a repair process, that involves an aesthetic restoration of an existing product or its components (Van Weelden et al., 2016), making the product look like new, but often with none or limited improvements to its performance (All Party Parliamentary Sustainable Resource Group, 2014)[13]. Remanufacture is a manufacturing process that involves an aesthetic and technical renovation of an end-of-life product, bringing it to a 'good-as-new' condition. The performance of a remanufacturing product is equivalent and in some cases, better than newly manufactured products (British Standards Institution, 2009)[14].

The third category details recycling as a *circular* business model that reduces the use of primary resources in the manufacturing of new products (Tukker, 2004). Recycling has been the most widely adopted *circular* business model, and for decades has helped to capture the value of materials in end-of-life products and reduce vast quantities of waste (Rizos et al., 2017). It is defined as a "*recovery operation by which waste materials are reprocessed into products, materials or substances whether for*

[7] An example of this model in the industry is Pay Per Lux service provided by Philips (Philips, 2014).
[8] E.g. engine leasing implemented by Rolls Royce (2015) in their Power by the Hour programme.
[9] E.g. vehicle sharing implemented by ZipCar (2016).
[10] E.g. car-pooling implemented by the BlaBlaCar (2016).
[11] E.g. resale and purchase of second-hand products facilitated by Ebay (2017).
[12] E.g. maintenance/repair service offered by repair cafes (e.g. The Restart Project, 2018).
[13] E.g. refurbishment of mobile phones by Apple (2017).
[14] E.g. remanufacture of industrial vehicles by Caterpillar (2015).

the original or other purposes" (Directive 2008/98/EC). In practical terms, it involves *"collecting, sorting, decontaminating and returning of waste materials to* commerce as commodities for use or exchange" (Wiard and Sopko, 1991, p. 3). Recycling solely focuses on the reproduction of materials contained within products, rather than the extension of a products life-span. Recycling should therefore be viewed as stepping stone to achieving total resource efficiency. However, recycling does have its drawbacks; the process is complex and typically produces a material of lower quality than virgin materials. During the collection, storage and separation, the purity of recycled materials can also be reduced due to contamination. This is caused by materials of different origins being processed in a single waste-stream. Furthermore, during the material recovery process, recycled materials can lose their qualities such as strength, durability and flexibility etc. This subsequently has a negative effect on the number of times a material can be recycled (Ellen MacArthur Foundation, 2013a). These issues have led to some businesses redesigning their products[15] to allow for the easy separation of materials which allows the quality of materials to be maintained. Nevertheless, recycling processes remains a complex *circular* business model across most sectors and material groups.

2.2. Refrigerated Display Cabinets

A Refrigerated Display Cabinet (RDC) is an "appliance intended for the storage and display of chilled and/or frozen products for merchandising at specified temperatures below the ambient temperature[16]" (European Commission 2014a, p.11). RDCs have a key function in ensuring the quality, longevity and safety of foods and beverages in retail grocery stores (Jouhara et al., 2017), and allow consumers to conveniently select products for purchase via an "opening in the cabinet, or through a transparent door or lid" (Department for Business, Energy & Industrial Strategy, 2016). Based on the configuration, RDCs display foods horizontally, vertically or semi-vertically (Monier et al., 2007; Figure 2.2).

[15] For example, Desso, global manufacturer of carpets and sport pitches, have faced the challenge of material recovery of Polyamide6. To help recover this material, Desso redesigned their products to ensure easy disassembly (Desso, 2016).

[16] The operating temperatures for RDCs range form -18 C to +10 C (British Standards Institution, 2005); The temperature levels depend on the type of RDCs. Chilled foods i.e. meat (+2°C), dairy products (+5°C), fresh vegetables (+7°C) are stored above 0°C. Frozen foods are stored below 0°C.

Figure 2.2. Open vertical RDC.

The technology of commercial RDCs is similar that used for domestic fridges. The technology produces a low temperature within the insulated storage space of a RDC. The low temperature is generated by a vapour-compression cycle in which a compressed refrigerant gas is cooled through rapid expansion, before entering a cooling coil. This results in the chilling of air temperature within the display area where the foods and beverages are stored. The flow of chilled air is distributed both inside and outside the shelves by the operation of electric fans that are installed within cabinet (Monier et al., 2007).

RDCs can be categorised as either integral or remote (Monier et al., 2007). An integral RDC is a self-contained (plug-in) unit in which all refrigeration components are housed within the cabinet body, namely a compressor, evaporator, condenser and expansion device. A remote RDC is designed to operate from an external refrigeration system, where a part of the refrigeration components is located outside the cabinet body (typically on-site of a retail grocery store), namely the compressor and condenser. This means that the material (particularly metal) content in integral RDCs can be considerably higher than remote RDCs because of the increased number of components. Typically, remote RDCs are used in medium and large retail grocery stores (e.g. supermarkets and hypermarkets),

whereas integral RDCs are used in smaller stores (e.g. convenience and small independent stores) (Monier et al., 2007). In 2017, it was estimated that the stock of remote RDCs (2.77 million units) in the EU was twice the amount of the integral type (1.36 million units) (European Commission, 2014a).

In terms of design, RDCs are *simple*, modular structures made of prefabricated components (British Standards Institution, 2005), that are usually assembled using mechanical fixings (Watkins and Tassou, 2006). The fabrication of components in RDCs can involve several manufacturing processes, such as punching, cutting, bending (of sheet materials), moulding and powder coating. The dimensions and characteristics of RDCs vary from one model to another, which is largely due to their design being based on the specific request of the retailer (European Commission, 2014a). An RDC can weigh 200kg - 900kg (depending on the size of the display area) (Monier et al., 2007) and is mostly made of ferrous (steel/iron) and non-ferrous (aluminum, copper) metals, this normally accounts for 85% of the cabinet body. The rest of the cabinet body is made of polymers (e.g. ABS, PVC, HDPE, PS, epoxy coating and polyurethane foam), glass and wood (e.g. MDF) (Andrews et al., 2015; Bibalou et al., 2011; Monier et al., 2007; Table 2.2). The large proportion of metals used in the manufacture of RDCs ensures that its components are strong enough to retain shape under load or movement (British Standards Institution, 2005). The materials in RDCs are specifically selected to minimise wear and tear (i.e. interior/exterior cracking, chipping, softening, corrosion) and enable the user to easily clean the cabinet (British Standards Institution, 2005). The outer shell of an RDC is usually insulated by a polyurethane foam. This thermally efficient material also provides additional rigidity to cabinet body (European Commission, 2014a).

Table 2.2. Materials in a typical RDC (Andrews et al., 2015).

Metals	steel (stainless, carbon, galvanised), aluminium alloy, brass, copper
Polymers	polyurethane, polystyrene and phenolic foams, polycarbonate, polypropylene, polyethylene
Glass	plate, fibre
MDF	wood and other natural fibres, urea formaldehyde resin
Electronics	including precious metals

2.2.1. Circular Economy and Refrigerated Display Cabinets

The lifespan of RDCs can be prolonged through adopting two key circular principles to its design and end-of-life treatment. First, the use of durable parts and long-life materials can ensure longevity (Lagerstedt and Luttrop, 2006; Ardente and Mathieux, 2014). Secondly, simple modular structures can allow for easy disassembly at the end of life[17] (Duflou et al., 2008). RDCs that meet these two principles are the most viable for reuse, refurbishment and remanufacture. These processes can allow a cabinet to remain in service for longer than their typical lifespan (European Commission, 2014a), from five to eight years to between 15 to 20 years (Watkins, R. and Tassou, S., 2006; Bibalou et al., 2011; Centre for Remanufacturing and Reuse, 2009). The longevity of RDCs can be limited by the operations of grocery retailers, which may include rebranding (aesthetic modifications to cabinets) and arranging new store layouts (changes to size and configuration of cabinets) (European Commission, 2014a; Oakdene Hollins, 2004).

Those grocery retailers can choose to integrate *circular* business models into their strategy to prolong the longevity of their RDCs by regular maintenance and repair, refurbishment or remanufacture (Bibalou et al., 2011, Muranko et al., 2017a; Figure 2.2.1). Nevertheless, research into the grocery retailers choices, particularly with regards to procuring circular equipment is lacking.

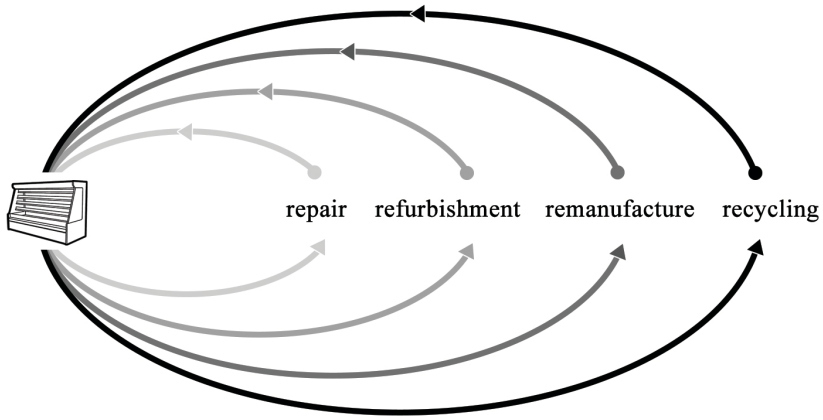


Figure 2.2.1. Circular Economy of RDCs.

[17] One issue is that the variability in the design of RDCs causes difficulties in identifying common features for dismantling (European Commission, 2014a).

The maintenance and repair of RDCs[18] are regularly conducted by specialist refrigeration engineers who typically clean the condenser and evaporator coils, replace broken parts and perform general system checks (Monier et al., 2007; Carbon Trust, 2012). During this process a small proportion of materials within the cabinet (on average a maximum of 10%; Muranko et al., 2017a) is replaced. This process ensures that RDCs remain in continuous operation throughout its lifespan.

The refurbishment of RDCs occurs when manufacturers or specialised refurbishment companies are commissioned by retail grocery stores to recondition their cabinets on-site. Refurbishment is occasionally practiced by retail grocery stores. This is normally performed overnight and during closing hours to avoid store disruption (Muranko et al., 2017a). During this process, between 10% to 50% of a RDC's body mass is replaced (Bibalou et al., 2011)., this normally involves upgrading old or damaged components with new or remanufactured parts (e.g. fan, lighting, shelves, door, panels). As a result, the lifespan of a refurbished RDCs is normally extended for five to eight years (Bibalou et al., 2011).

The remanufacture of RDCs is usually performed on units that are around ten years old, that require cosmetic and technical modifications in order to be brought to a 'good-as-new' condition. It is typically performed at a request of individual grocery retailers (European Commission, 2014a). The remanufacture of RDCs is rarely practiced by retail grocery stores, because retailers and manufacturers perceive this process as complex. They usually choose the 'hassle-free' option of purchasing or producing a new RDC (Centre for Remanufacturing and Reuse, 2009). As a result, remanufacturing is rarely practiced and therefore a missed opportunity for businesses in the UK. The remanufacturing process always take place away from the retail store, in an industrial set up and is typically performed by manufacturers who specialise in remanufacturing (Watkins, 2015; European Commission, 2014a; Muranko et al., 2017a). Typically, the remanufacturing of RDCs requires end-of-life cores, which are old RDCs that have been in operational use and are now considered as redundant by their owner. These cores are the material source of the remanufacturing processes. The remanufacture of RDCs utilises at least 50% of the components from the original end-of-life core (Muranko et al., 2016). The process can involve an upgrade to more energy efficient components [i.e. optimised fan motors and blades, LED

[18] Improving maintenance practices can reduce energy consumption of RDCs by 15% (Monier et al., 2007).

lighting, high efficiency compressors, night curtains, glass doors (Monier et al., 2007)] and changes the dimensions, style and configuration of the RDC.

Despite the potential for product-life-extension models, the most commonly practiced model in the Retail Refrigeration Industry is recycling (Monier et al., 2007). Generally, a material created by recycling consumes less energy than if the material was manufactured from new. Nevertheless, recycling is still a very energy-consuming process in comparison to other *circular* business models such as remanufacturing. For example, for an end-of-life cabinet[19] to be recycled, it must go through several energy-intensive processes such as transportation, disassembly, extraction of hazardous materials, shredding, separation and material recovery (Ardente et al., 2015; European Commission, 2014a). Furthermore, the effectiveness of recycling is dependent on several variables. The recycling of RDCs involves materials of different types being processed in one waste stream. This can lead to contamination and therefore a lower quality of recycled material (European Commission, 2014a). Moreover, some materials in RDCs are difficult to recycle and require specialist treatment. For example, as a prerequisite to shredding a cabinet body, glass components (such as glass doors, shelves, and end-walls) must be removed (often manually) before processing to prevent damage to the shredder blades (European Commission, 2014a). Furthermore, the rigid polyurethane (PUR) foam[20] contained in the insulation panel of the cabinet body requires specific treatment when recycling. This is due to the PUR foam containing highly flammable and ozone depleting gases, which require specialist recycling processes to ensure the safe capture of gases. Electronic components, such as printed circuit boards, displays, switches and batteries within RDCs, also require specific treatment when recycling. This is because they may contain hazardous materials[21] (i.e. mercury, arsenic, antimony, beryllium, brominated flame retardants, cadmium and lead) that require removal before processing (European Commission, 2014a). On average, the recycling process can recover 85% of materials from a RDCs body (Monier et al., 2007).

[19] RDCs are covered by the European directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) which requires separate collection, treatment and recovery of waste at the end-of-life.

[20] Insulating foams can contain ozone depleting blowing agents such as CFCs and HCFCs (Deng et al., 2008) or highly flammable hydrocarbons specified as hazardous waste (Environment Agency, 2012). Insulating foams have low recyclability (European Commission, 2014a), however their durability means they can be reused in the remanufacture of RDCs (Andrews et al., 2015).

[21] Some materials and components in RDCs are difficult to treat, and therefore obstruct the recycling process. These must be extracted form cabinets' body before shredding and include glass (which has potential to cause damage to shredders' blades) and electronic components, i.e. printed circuit boards, displays, switches and batteries. RDCs produced before the introduction of Directive 2002/95/EC in 2003 can contain hazardous materials and precious metals (gold, silver, palladium, platinum) (Directive 2002/95/EC; European Commission 2014a).

In line with the Circular Economy an end-of-life RDC should only be considered for recycling at its absolute end of life, i.e. when other circular models that aim to restore the cabinet cannot be successfully performed. For RDCs that are in generally good condition and where most components are functioning, repair and refurbishment are the most suitable options for extending their life spans. However, for end-of-life RDCs that show extensive signs of damage or where most components are no longer functioning, remanufacture should be considered as a more *circular* approach than recycling (Watkins, 2016).

Remanufacturing processes are typically adopted in sectors that manufacture products that are of high value, quality, and rarely subject to major technological changes and fashion trends (APSRG, 2014). In the UK, these include the automotive, aerospace and machinery sectors. Caterpillar (CatReman) is an example of a successful manufacturer in the heavy-duty machinery sector, who have made remanufacturing an integral part of their business model since the 1970s. The company supply remanufactured parts (e.g. gas engines) and fully-assembled equipment (e.g. construction, mining machinery and diesel-electric trains). As in the case of RDC remanufacture, the remanufacturing process adopted by Caterpillar requires a skilled workforce and an industrial set up that allows for the disassembly, modification (including technological upgrade) and reassembly of a product. At Caterpillar, the remanufacture of products has been supported through their core deposit incentives scheme, which provides consumers with a guaranteed deposit return that ensures the availability of end-of-life cores (APSRG, 2014). Caterpillar's remanufactured products are sold as 'good-as-new' with a warranty that is equivalent to those that are issued for brand-new products (Parker and Butler, 2007). In 2005, Caterpillar's global remanufacturing operation prevented 45,000 million tons of components from end-of-life equipment that would have otherwise entered the waste-stream (Parker and Butler, 2007), making it by far the largest manufacturer in the heavy-duty machinery sector (European Remanufacturing Network, 2015). This sector is estimated to be worth £800 million which equates to almost a quarter of the overall remanufacturing market in Europe, with UK together with Ireland, representing 12% of its share (European Remanufacturing Network, 2015).

Xerox are another example of a manufacturing company that have successfully adopted remanufacturing practices since the 1960s (Xerox, 2010). The company are known for producing printers. Typically, a remanufactured printer is produced by reusing 80% of components

from end-of-life cores in the production of a 'good-as-new' product equivalent (Canon, 2018). This cheaper method of production allows for printers to be sold at substantial discounts (up to 70% when compared with a new product) and results in higher profit margins for remanufacturers when compared to those typically achieved on brand-new products (Matsumoto and Umeda, 2011). For example, in 2009 Xerox saved £3.2 million by using end-of-life cores when remanufacturing their printers in Australia (Bulmus et al., 2014) and recovered 45,000 tonnes of printer components from entering the waste-stream across their global processes (Xerox, 2009). The remanufacturing process at Xerox has been enabled through printers being designed to allow easy disassembly and leasing models that ensure the return of products at their end-of-life (Kerr and Ryan, 2001). The market for printer remanufacturing has been established in the United States, Europe (i.e. UK, Austria, the Netherlands), Australia and Japan (APSRG). In the United States and Europe, Xerox products are distinguished as either brand-new and remanufactured, similar to the Retail Refrigeration Industry and the sale of RDCs. However, interestingly in Japan, Xerox do not distinguish their products using such terms, instead choosing to sell brand-new products only that have been produced using remanufactured components (Matsumoto and Umeda, 2011). This has led Xerox to have the highest ratio of reused components in their products when compared to their competitors (Matsumoto and Umeda, 2011).

Between 2009 and 2015 several governmental and research reports indicated the need for UK businesses to implement remanufacturing processes when manufacturing products (APPSRG and APPMG, 2014; APPSRG, 2014; Centre for remanufacture and Reuse, 2009). However, the most recent UK governmental report on Industrial Strategy (HM Government, 2018) does not promote remanufacturing as a model for national manufacturers to follow. Whilst this indicates that little effort is being made to embed remanufacturing into the manufacturing agenda of UK businesses, countries such as China have done the opposite. The Chinese government see remanufacturing as pathway to reaching their economic and environmental goals and are now investing in the development of national remanufacturing hubs (Oakdene Hollins, 2018).

In the UK, the uptake of remanufacturing is generally low, especially across sectors that produce electrical products and white goods (e.g. washing machines and refrigerators) for commercial and domestic consumers (APSRG and APPM, 2014). In the RDC sector in particular, there is a lack of

research on remanufacturing, particularly on stakeholders' attitudes and perceptions towards it (APSRG and APPM, 2014). As a result, RDC remanufacturing and stakeholders' behaviours is the focus of this research.

2.2.2. Linear Economy in the Retail Refrigeration Industry

2.2.2.1. Production of RDCs in the Linear Economy

Studies show that the production of RDCs, is the second most environmentally impacting phase[22] of its lifecycle (Watkins and Tassou, 2006; Bibalou et al., 2011; European Commission, 2014a). This impact is largely attributed to the extraction and formation of raw metals, in addition to the manufacturing process which results in approximately 5% of raw metals being scrapped (Monier et al., 2007). Another significant contributor to environmental impact during the production phase is the manufacture of polyurethane insulation foam (Monier et al., 2007). This impact is typical of a linear economy, where processes are inefficient and the manufacture of products requires new materials to be sourced. As a result, resource efficient production and end-of-life treatment of RDCs have become topical subjects in modern literature (e.g. Bibalou et al., 2011; Andrews et al., 2015; Watkins and Tassou, 2006).

Nevertheless, when purchasing RDCs, the grocery retailers are more concerned with the energy efficiency of cabinets than the environmental impact caused during their production (Monier et al., 2007; Centre for Remanufacturing and Reuse, 2009). This is due to the extremely large costs attributed to the energy consumption of an RDC, which typically amounts to 45% of a grocery stores total energy bill (Watkins, 2016). This has led to the manufacturing sector focusing their efforts on producing RDCs that are more energy efficient (Monier et al., 2007). This has been to the detriment of advancing *circular* design and end-of-life treatments, such as remanufacture.

[22] The usage of an RDC is the most environmental impact phase - 95% of an RDCs total environmental impact comes from the energy consumed during its usage (Watkins, 2006; Monier et al., 2007).

2.2.2.2. Disposal of RDCs in the Linear Economy

No current statistics on the amount of retail refrigeration equipment disposed of in Europe are available. However, it was estimated that in 2012 approximately 147,000 tonnes[23] entered the waste-stream (Ardente et al., 2015). More recent statistics are available in the UK, where it was estimated that in 2015 approximately 68,000[24] potentially remanufacturable end-of-life units were disposed of and replaced by new cabinets with only 12,150 being remanufactured[25] (Centre for Remanufacturing and Reuse, 2009). This equates to around 51,000 tonnes[26] (43,350 tonnes of metal, 1,530 tonnes glass, 4,590 tonnes of polymers) of possibly long-life reusable components entered the waste steam. There are also reports that some end-of-life RDCs are buried in landfill (European Commission, 2014a). Even during the process of RDCs recycling, 5% of materials in cabinets' body can be disposed of to landfill (Monier et al., 2007).

These disposal figures are even more remarkable when considering that UK retailers purchased and imported over £42 million worth of brand-new RDCs in 2015 (HM Revenue and Customs, 2017). The import of RDCs has continued to grow with UK retailers spending £55 million in 2016 and £63 million in 2017; the majority came from China, Italy and Turkey (HM Revenue and Customs, 2017). RDCs imported from outside the UK are typically cheaper than those produced domestically and therefore more financially attractive to grocery retailers (Centre for Remanufacturing and Reuse, 2009; Oakdene Hollins, 2004). Despite the more attractive cost, imported RDC's generally have a shorter lifespan due to the typical use of inferior materials (i.e. use of galvanized steel instead of stainless steel) (Centre for Remanufacturing and Reuse, 2009; Andrews et al., 2015). As a result, a proportion of imported RDC's are of lower quality and can end up being disposed earlier than those produced in the UK.

[23] This estimate includes other refrigeration equipment i.e. refrigerated vending machines.
[24] In 2015, 68,000 out of 81,000 potentially remanufacturable end-of-life RDCs were disposed of (Centre for Remanufacturing and Reuse, 2009).
[25] The majority were bought by UK retailers (Centre for Remanufacturing and Reuse, 2009), with the remaining potentially being sold to second-hand markets in Eastern Europe, Africa and Asia (Monier et al., 2007).
[26] This is based on an average cabinet weighing 750kg (Centre for Remanufacturing and Reuse, 2009).

The demand for retail refrigeration equipment is growing exponentially[27], which inevitably also brings an increase in the number of RDCs reaching their end-of-life and potentially being disposed of. This will add more pressure on the supply of raw materials required for the production of new RDCs - should there be no change away from the linear economy.

Although the design of RDCs allows some components to be easily removed, disassembly can be problematic (as it can require specific tools) and time consuming. Consequently, there is scope for manufacturers to improve the design of fixings, which will optimise the disassembly of RDCs and allow for remanufacturing at the end-of-life (Watkins, 2016).

2.3. Behavioural barriers to adoption of Circular Economy

Governments and experts (e.g. Meadows et al., 1972; Chartered Institution of Waste Management, 2014; The Scottish Government, 2016, European Commission, 2015b; Department for Environment, Food and Rural Affairs, 2015; Atherton, 2015) agree that the development of a Circular Economy relies on consumers and producers changing their behaviours from linear to *pro-circular*. Pro-circular behaviour is a term that defines *"any action which is brought about due to prioritising resource-efficiency [and] benefits or at least reduces damage to the environment, economy and society"* (Muranko et al., 2017; Table 2.1).

Table 2.3. Examples of pro-circular behaviour.

Circular business model	Consumer	Producer
remanufacture	*purchasing remanufactured products*	*producing and selling remanufactured products*
refurbishment	*purchasing refurbished products or refurbishment service*	*producing and selling refurbished products or refurbishment service*
maintenance, repair, reuse	*preserving owned products or purchasing repaired products*	*selling repair and maintenance service or repairing and selling pre-owned products*
product-service systems	*purchasing performance of products*	*selling product performance*

[27] Total sales of global retail refrigeration equipment are estimated to increase from $29 billion - $46 billion between 2014-2022 (Grand View Research, 2016). In the European Union, the demand for RDCs is projected to grow 0.24 % annually until 2030 (European Commission, 2014a).

Current linear patterns of the resource consumption show that pro-circular behaviours are not widely adopted. Although an environmental conscience appears to be present among some parts of society, it is not yet dominant enough to drive sustainable, pro-circular behaviours. Literature suggests that the low uptake of pro-circular behaviours by producers and consumers is due to several behavioural barriers.

For producers, there is lack of support and guidance (i.e. process-supporting tools) on how to implement *circular* business models (Pajunen et al., 2012; Ormazabal et al., 2018). This prevents them having the necessary knowledge to confidently divert away from the current linear-based norm (European Commission, 2014b; Rizos et al., 2015; Ritzén and Sandström, 2017). Furthermore, the implementation of *circular* business models requires producers to undertake a radical change to their culture (Pieroni et al., 2019; Pheifer, 2017). This should be driven by business leaders (i.e. company directors and managers) who champion resource-efficiency as a key strategy of their businesses' operations (TNS Political & Social, 2013). Despite many producers advertising sustainable initiatives in their corporate social responsibility and sustainability reports, the practice of the linear economy remains mainstream (Schulte, 2013). This may be a result of some business leaders being reluctant to adopt new behaviours (Korhonen et al., 2018; Mont et al., 2017). This cautiousness can be due to them holding unfavourable attitudes towards change (Bastein et al., 2014; Ritzén and Sandström, 2017), which can be triggered by perception of *circular* products not being in demand and therefore not being profitable (Schulte, 2013; Ritzén and Sandström, 2017; Mont et al., 2017; Ormazabal et al., 2018). Therefore, an increase in consumer demand for *circular* products, could result in producers being more inclined to implement circular models. In turn, this could drive technological innovation, a lack of which has stifled the development of *circular* business models to date (Ormazabal et al., 2018).

Through their purchasing decisions, consumers can directly communicate to producers (and governments) what kind of economy they wish to live in – linear or circular (Atherton, 2015). The behaviour[28] behind consumers' purchasing decisions can be influenced by several factors. The first, is having an adverse attitude, belief, perception or value towards a *circular* product and service[29] (Houston

[28] Consumer behaviour is "the processes involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires" (Solomon et al., 2006, p. 27).
[29] E.g. repair service or purchase of a product-as-service system.

et al., 2018; Bastein et al., 2014) or a lack awareness of Circular Economy (Xue et al., 2010), particularly at the stage of purchase (Smol et al., 2018). For example, products that are remanufactured are often wrongly perceived by the consumer as being of lower quality than brand-new products (APPSRG and APPMG, 2014). The misperceptions of remanufactured products being of low quality are caused by the absence of common definitions (European Remanufacturing Network, 2015; Centre for Remanufacturing and Reuse, 2009). In the Retail Refrigeration Industry in particular, the lack of common remanufacturing definitions leads to the remanufacturing of a RDC being mistaken with its refurbishment and/or reuse (Centre for Remanufacturing and Reuse, 2009). Consumers also hold similarly negative perceptions about refurbished products (YläMella et al., 2015; Van Weelden et al., 2016). A concern about the hygiene and safety of repaired and reused products, can also lead consumers to hold adverse attitudes towards *circular* products (Mont et al., 2017). Therefore, the promotion of *circular* products (and appeasing concerns about their performance in particular), in addition to educating consumers about the merits of the Circular Economy is essential in attempting to change behaviours (Smol et al., 2018; Suárez-Eiroa et al., 2019). This is particularly important, as the implementation of pro-circular behaviours by consumers is often disregarded due to benefits such as resource security and waste reduction, not being immediately apparent to them (Atherton, 2015).

Despite being able to identify common behavioural barriers and drivers, there is currently a gap in knowledge about common methodologies for investigating and influencing pro-circular behaviours (Boks et al., 2015; Wastling et al, 2018; De Jesus and Mendonna, 2017). This due to the subject's challenging and multi-disciplinary scope (Atherton, 2015). As a result, consumer and producer behaviour in regards to the Circular Economy has lacked investigation and the majority of literature so far has been based on assumptions (Daae et al., 2017). Consequently, organisations such as the World Bank (2014) have called for research into the influencers of psychological change in resource consumption. Thus, the topic of behaviour change in the Circular Economy domain has gained academic attention in the recent years. There is some increasing evidence of research into identifying barriers and drivers to the adoption of pro-circular behaviours by businesses (Ormazabal et al., 2018) and consumers' acceptance of products-as-service systems (Antikainen et al., 2015), refurbished products (van Weelden

et al., 2016) and remanufactured products (Jiménez-Parra et al., 2014). Despite this, most of this research has focused on the behaviours within the customer-to-business model.

This research aims to fill this gap of knowledge by proposing the methods for investigating and influencing pro-circular behaviours (discussed in Chapter 3), with a specific reference to business-to-business consumers (grocery retailers) and producers (RDCs Manufacturers) in the Retail Refrigeration Industry.

2.3.1. Behavioural barriers to the remanufacture of RDCs

The remanufacture of RDCs is uncommon (Centre for Remanufacturing and Reuse, 2009; Oakdene Hollins, 2004) and in the UK, remanufactured RDCs account for less than 12.5% of all RDC purchases. (Bibalou et al., 2011). Within the retail refrigeration, the behaviour of grocery retailers can influence the supply and demand of remanufactured RDCs. As product owners, they dictate the type of treatment their RDCs receive at the end-of-life (Monier et al., 2007) and they usually opt to dispose their RDCs rather than remanufacturing. This may be encouraged because the cost of disposing an end-of-life RDC is relatively low [usually 1% of the initial purchase price; Monier et al., 2007)].

However, grocery retailers can adopt pro-circular behaviours, namely the *purchase of remanufactured RDCs*. This involves components from their end-of life RDCs (50%+ of materials per unit; Bibalou et al., 2011) being reutilised as opposed to being disposed. Grocery retailers typically purchase RDCs that meet their specifications at the lowest possible price (Centre for Remanufacturing and Reuse, 2009; Monier et al., 2007). The price of a remanufactured RDC can be 30% cheaper than a new RDC (Centre for Remanufacturing and Reuse, 2009; Muranko et al., 2016). However, this saving will vary on the amount of remanufacturing required, which is particularly dependent on the condition and quality of end-of life core components. This financial uncertainty could negatively affect grocery retailers' attitudes towards purchasing remanufactured RDCs. In addition, the aesthetics (i.e. meeting design specifications) and performance (i.e. low energy consumption) of remanufactured RDCs are often perceived as inferior by grocery retailers. These perceptions can lead to the formation of unfavourable attitudes towards their potential purchase (All Party Parliamentary Sustainable Resource Group, 2014). The perceived complexity and length of the remanufacturing process can have the same effect. The remanufacturing process requires the removal and transportation of end-of-life RDCs from

the site of a grocery store to a factory. The removal of cabinets can disturb the day-to-day trade of a grocery store. To avoid disruption, grocery stores would either have to source temporary refrigeration equipment for the interim, or be able to draw on a stock of old RDCs (Muranko et al., 2016b). These complexities have led to many grocery retailers preferring the 'hassle-free' option of purchasing new RDCs and disposing end-of-life RDCs. (Centre for Remanufacturing and Reuse, 2009).

Manufacturers are the main distributors[30] of retail refrigeration equipment to grocery retailers (Monier et al., 2007), they can support and most importantly influence demand, through the supply and promotion of remanufactured RDCs. Currently most manufacturers produce brand-new RDCs (Oakdene Hollins, 2004) and only three[31] major RDC manufacturers in the Retail Refrigeration Industry currently sell remanufactured RDCs[32].

Manufacturers can adopt pro-circular behaviours, namely the *production of remanufactured RDCs*, which can be achieved by extending their current manufacturing processes to include remanufacturing steps such as inspection, cleaning and disassembly of end-of-life cores (European Remanufacturing Network, 2016). The choice to adopt practices such as remanufacture, is usually driven by manufactures commitment towards sustainability (Monier et al., 2007). However, unless grocery retailers actively show a demand to buy remanufactured RDCs, it is unlikely that manufacturers will provide the service. Therefore, the development of the Circular Economy through remanufacture requires inputs from both the producer and consumer, with consumer demand being a key instigator.

There is currently a lack of research into the factors that influence the adoption of pro-circular behaviours amongst grocery retailers and RDC manufacturers, specifically in relation to the *purchase* and *production of remanufactured RDCs.* To date most literature has focused on stakeholders' concerns about the life-cycle costs of RDCs, fuelled by their high energy consumption (Monier et al., 2007). Therefore, this research aims to identify the causes that can trigger remanufacturing behaviours amongst grocery retailers and RDC manufacturers.

[30] 70% of RDCs are sold by the manufacturers directly to the consumers. 30% is sold through manufacturers' representatives and third party equipment dealers (Monier et al, 2007).
[31] Carter Retail Equipment (2016), The Bond Group (2017) and George Barker (Epta UK, 2017).
[32] Remanufacturers typically include: Original Equipment Manufacturers (OEM) who remanufacture, Contracted Remanufacturers and Independent Remanufacturers (European Remanufacturing Network, 2016).

2.3.2. Benefits of remanufacturing behaviours in the Retail Refrigeration Industry

There are several environmental benefits to remanufacturing. For example, it requires less raw materials and energy[33] than new products and reduces the amount of discarded products placed in landfills (Örsdemir, et al., 2013; Subramoniam et al., 2010). Generally, the embodied carbon footprint of remanufactured products is 25% - 80% lower than that of new products (Oakdene Hollins, 2011) and estimates suggest that if the remanufacture of RDCs was practised across the entire UK Retail Refrigeration Sector, embodied carbon emissions would fall annually by as much as 144,000 tonnes[34]. The process of reusing steel[35] components (which account for most RDC's body) in remanufacturing reduces environmental impact by 96% compared with the use of raw steel (Waste and Resources Action Programme, 2008), the extraction of which can contribute to fuel depletion, toxicity to water, toxicity to air and climate change (Waste and Resources Action Programme, 2008). The reuse of steel is an alternative to disposal, which typically involves sending it to scrap before its eventual melting as part of the recycling process. With an average RDC containing approximately 500kg of steel, as much 250 kWh energy is required to melt each unit[36]. Comparatively, the reuse of steel is the more energy efficient and sustainable option.

The growth of remanufacturing businesses in the UK Retail Refrigeration Industry can also bring socio-economic benefits. Generally, remanufactured goods cost 40% to 65% less to produce (Giutini and Gaudette, 2003) and are sold up to 30% cheaper than brand-new products (Hauser and Lund, 2003). Similar discount is also achievable for remanufactured RDCs, which allows UK grocery retailers to significantly reduce their capital expenditure (Muranko et al., 2016). Currently many grocery retailers choose to import new RDCs from outside the UK (Centre for Remanufacturing and Reuse, 2009). This presents an opportunity for remanufacturers to tap into this market by encouraging grocery retailers to purchase domestically produced remanufactured RDCs instead. The remanufacturing market in the technical sector (including electrical machinery) is potentially lucrative, particularly for original

[33] Remanufacturing can use 15% of the energy used to make new products (Giutini and Gaudette, 2003).
[34] This is equivalent to the carbon footprint produced by 50,000 cars in a year (Centre for Remanufacturing and Reuse, 2009).
[35] This involves the removal of steel components from end-of-life cores and the repurposing (e.g. welding, respraying, cutting) for their reuse in remanufacturing.
[36] The energy required to melt a tonne of scrap steel is 500 kWh (Peaslee et al., 2004).

equipment manufacturers (Subramoniam et al., 2010), with estimates suggesting that its growth could add up to £8 billion annually to the UK economy (Lavery et al., 2013).

The growth of the remanufacturing market can also provide employment, through the introduction of new skilled job sector (European Environmental Agency, 2017; Gray and Charter, 2007). In 2015 approximately 68,000 RDCs were disposed of. Alternatively, if these were remanufactured it could provide for an estimated 3,500 jobs[37], which shows that there is an opportunity for manufacturers to train and recruit a workforce should there be a demand for remanufactured RDCs.

The strong environmental and socio-economic benefits that can result from remanufacturing, highlights the pressing need for research into the facilitators of pro-circular behaviours among grocery retailers and RDC manufacturers.

Summary

Despite the environmental and socio-economic benefits of remanufacturing RDCs, its practice remains uncommon in the Retail Refrigeration Industry. The adoption of remanufacturing relies on grocery retailers and manufacturers changing their purchasing and manufacturing behaviours. However, there is currently no substantive research available on this. Therefore, this research investigates the influencers of pro-circular behaviour in an effort to encourage the uptake of remanufacturing, beginning with the development of a Pro-Circular Change Model, which is discussed in the next chapter.

[37] Centre for Remanufacturing and Reuse (2009) estimated 3,000 jobs could be required for the annual remanufacture of 58,000 RDCs.

3. The Pro-Circular Change Model: design of a framework to support the adoption of pro-circular behaviours, particularly the remanufacturing of RDCs

Introduction

A Circular Economy in the Retail Refrigeration Industry remains underdeveloped, particularly for remanufacturing, which has the potential to increase the resource-efficiency of RDCs. The adoption of remanufacturing relies on grocery retailers and manufacturers practicing the model as part of their business operations. However, there is currently a lack of research available on the influencers of their remanufacturing behaviours. This chapter presents the Pro-Circular Change Model (PCCM) - a theoretical framework, developed to provide methods for investigating and influencing pro-circular behaviours, specifically in the context of *purchasing* and *producing remanufactured RDCs*. This model will be implemented throughout this thesis to answer the following research questions:

- *What are the factors that determine the Retailers' Behavioural Intentions to purchase remanufactured RDCs?* (in Chapter 5).
- *What are the factors that determine the Manufacturers' Behavioural Intentions to produce remanufactured RDCs?* (in Chapter 6).
- *Can Persuasive Communication be an effective tool to encourage pro-circular behaviours?* (in Chapter 4, 5, 6 and 8).

The PCCM is divided into two stages – investigation and intervention. The investigation stage (Figure 3, left) includes methods for investigating factors that drive an intention to perform a pro-circular behaviour. These factors are Behavioural Attitudes, Subjective Norms, Perceived Behavioural Controls, Actual Behavioural Controls, Product Perceptions and Pro-Circular Values. The intervention stage (Figure 3, right) aims to influence these factors using Persuasive Communication.

The chapter will begin by describing the pro-circular behaviours of the grocery retailers and manufacturers, before it moves to an explanation of the components included in the investigation and intervention stage of the PCCM.

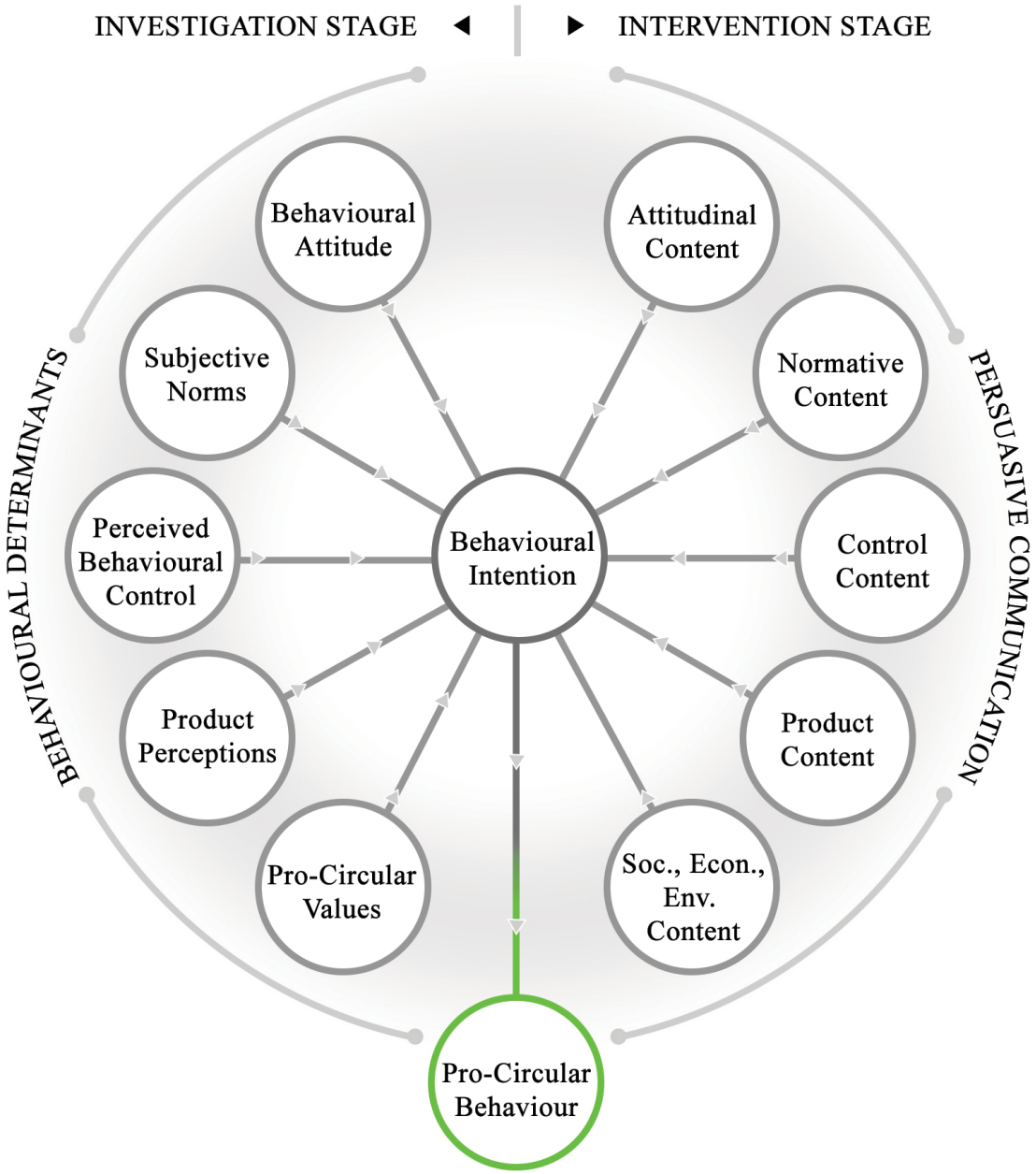


Figure 3. The Pro-Circular Change Model.

3.1. Purchase and production of remanufactured RDCs

The process of *purchasing* and *producing remanufactured* RDCs is multistep and varies from traditional buying. To purchase a remanufactured RDC, a grocery retailer usually approaches a RDC manufacturer directly or through a request of tender, in which the grocery retailers communicate their requirements (e.g. technical, dimensions and style). Following a sales process, a remanufacturer begins

the remanufacturing process. The production of remanufactured RDCs requires a stock of end-of-life RDCs. In most instances these are supplied by the grocery retailer themselves. They are typically transported to the remanufacturer's factory directly from a retail grocery store that is typically undergoing refurbishment or closure, or from the retailer's storage warehouse.

When an end-of-life RDC arrives at the manufacturer's factory it undergoes several industrial steps as part of the remanufacturing process (Centre for Remanufacturing and Reuse, 2009). Firstly, the RDC is inspected and disassembled. If the RDC requires any new replacement parts (i.e. fans, coils and electrical components), they are either manufactured in-house or via a third party. Component parts are extracted as part of the inspection process and any that are in poor condition are usually repaired (e.g. cleaned and recoated) for reuse. The remanufactured RDC is assembled using a combination of the brand-new and repaired parts, and performance is tested before being transported to the shop floor in a 'good-as-new' condition. The ability to remanufacture is somewhat dependent on the remanufacturer's physical capacity to store end-of life RDCs, particularly as the process is often done on a large scale. For example, remanufacture of 50 RDCs, which is the typical number required to furnish a standard supermarket, takes on average 6 weeks[38].

3.2. The Pro- Circular Change Model

3.2.1. Investigation stage

The investigation stage (Figure 3, left) contains six key determinants of pro-circular behaviour. The first four determinants, namely Behavioural Attitude, Subjective Norm, Perceived Behavioural Control and Actual Behavioural Control are taken from Ajzen's (1991) Theory of Planned Behaviour. The Theory of Planned Behaviour is a theoretical model applied to research on cognitive determinants of a behaviour, most commonly used to understand lifestyle/health, purchasing and consumption behaviours. The theory has also been applied to successfully assess the intentions to perform sustainable behaviours, such as energy saving (e.g. Greaves et al., 2013), household waste (e.g. Tonglet et al., 2004) and e-waste recycling (e.g. Kumar, 2019), and purchasing 'green' products (e.g. Joshi and Rahman, 2015). Several

[38] This ranges from when the purchase is initially agreed to the final delivery of remanufactured RDCs to the retail grocery store (Muranko et al., 2016b).

studies used the Theory of Planned Behaviour to investigate the consumers' intention to purchase remanufactured products in the B2C market (e.g. Burucuoglu and Erdogan, 2019; Khor and Hazen, 2016; Wang et al., 2013; Wang et al., 2019). However, there is a lack of studies that use the theory to investigate businesses intentions to purchase and produce remanufactured products in the B2B market. Nevertheless, the theory has been used to assess businesses intentions to purchase 'green' products in the B2B market for other products. For example, a study by Yang et al. (2019) investigated the intentions of real estate developers to purchase 'green' building materials in China. The theory has also been used to investigate other sustainable behaviours of businesses, such as reducing construction waste (Wu et al., 2017) and adopting 'clean' production technologies by manufacturers in China (Zhang et al.; 2013), as well as the innovation of 'clean' technologies by SMEs in Mexico (Montavalo, 2003). There has also been academic interest in applying the theory to investigate businesses readiness to adopt Circular Economy and perform pro-circular behaviours (Singh et al., 2018), however no substantive research has been carried out.

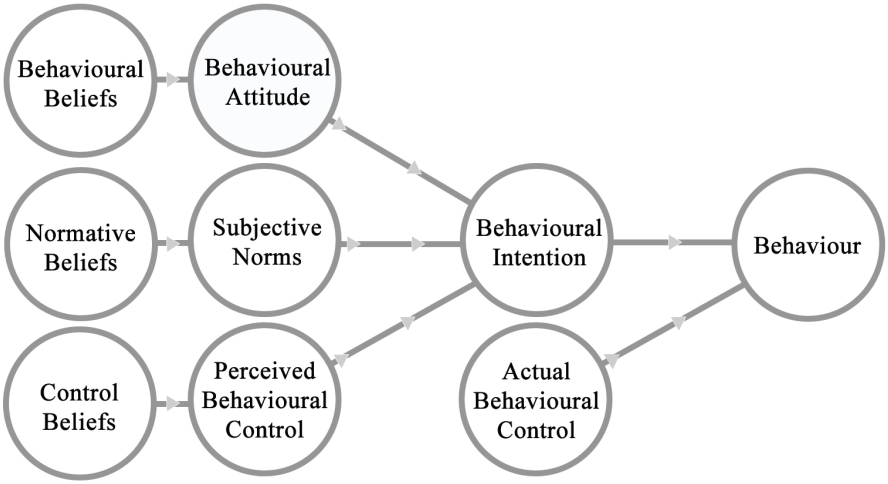


Figure 3.2.1. Theory of Planned Behaviour, adapted from Ajzen (2006).

According to the theory (Figure 3.2.1), the performance of a behaviour is initiated by the strength of a Behavioural Intention. The Behavioural Intention is formed by a combination of behavioural, normative and control beliefs. Behavioural beliefs are attributed to the perceived outcomes of a behaviour (Behavioural Attitudes). Normative beliefs result from the perceived expectations of others (Subjective Norms). Control beliefs concern the perceived presence of factors that enable a behaviour

(Perceived Behavioural Control). Moreover, the behaviour is directly affected by the presence of factors that enable the performance (Actual Behavioural Control).

There are several other behaviour change theories that are referenced in the sustainability domain, such as for example the Value-Belief-Norm theory[39] (Stern et al., 1999) and the Theory of Reasoned Action (Fishbein and Ajzen, 1975)[40]. The Theory of Planned Behaviour considers a wider range of determinants than the Value-Belief-Norm theory, and has shown to be considerably more reliable when assessing pro-environmental behaviours (Aguilar-Luzón et al., 2012; Kaiser et al., 2005). The omission of the Perceived Behavioural Control and the Actual Behavioural Control in the Theory of Reasoned Action, makes the Theory of Planned Behaviour a more comprehensive predictor of behaviours (Madden et al., 1992). As a result, the behavioural determinants from the Theory of Planned Behaviour can be considered the most suitable method for the investigation of pro-circular behaviours (as explained in Chapters 3.3.1 to 3.3.4).

Two additional determinants of pro-circular behaviour are included in the investigation stage of the PCCM, namely Product Perceptions (e.g. perceived quality and longevity) and Pro-Circular Values (i.e. intrinsic environmental, social and economic values). Both, perceptions and values can affect Behavioural Intention and be key drivers of pro-circular behaviours (as suggested by for e.g. Houston et al., 2018; Bastein et al., 2014; TNS Political & Social, 2013; Ritzén and Sandström, 2017; APPSRG and APPMG, 2014; Mont et al., 2017).

3.2.1.1. Behavioral Attitudes

The first construct of the Theory of Planned Behaviour is Attitude. Attitude is generally defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Eagly and Chaiken, 1993, p.1). Behavioural Attitudes are *learned* and changeable evaluations that ultimately influence behaviours (Dainton and Zelley, 2005). It is usual for a person who

[39] Supports social movement behaviours; proposes that "individuals who accept a movement's basic values, believe that valued objects are threatened, and believe that their actions can help restore those values experience an obligation (personal norm) for pro-movement action that creates a predisposition to provide support; the particular type of support that results, is dependent on the individual's capabilities and constraints" (Stern et al., 1999, p. 81).

[40] The Theory of Reasoned Action proposes that behaviour is a result of Behavioural Intentions that are influenced by Behavioural Attitudes and Subjective Norms.

holds a positive attitude towards a certain behaviour to perform the behaviour (Ajzen and Fishbein, 1977). Some examples of research on the Circular Economy show the important role of Attitudes in driving pro-circular behaviours, such as waste recycling (Guo et al., 2017) and the purchasing of 'green' products (Xue et al., 2010; Leonidou et al., 2010; Liu et al., 2012; Sreen et al., 2018). This study investigates whether Behavioural Attitudes could have a similar influence on grocery retailers' and RDC manufacturers' Behavioural Intentions to *purchase* and *produce remanufactured RDCs*.

3.2.1.2. Subjective Norms

The second construct of the Theory of Planned Behaviour are Subjective Norms. These norms are what a person believes their *important others* (e.g. family member, friend, boss) would think (either approve or disapprove) of them performing or not performing a certain behaviour (Ajzen, 1991). Ajzen (2006) divides Subjective Norms into two categories (injunctive and descriptive) of normative beliefs. Injunctive beliefs refer to a person's motivation to comply with others, while descriptive beliefs refer to a person's level of identification with others. Subjective Norms have been shown to be an important determinant of pro-circular behaviour, such as waste recycling (Wan et al., 2017; Greaves et al., 2013) and purchase of 'green' products (Lee, 2010; Salazar et al., 2013). To support the uptake of the Circular Economy in industries throughout the technical sector, pro-circular behaviours need to become 'the norm' (RWM and CIWM, 2014). This study investigates whether Subjective Norms could have an influence on grocery retailers' and RDC manufacturers' Behavioural Intentions to *purchase* and *produce remanufactured RDCs*.

3.2.1.3. Perceived Behavioral Control

The third construct of the Theory of Planned Behaviour is the Perceived Behavioural Control. The Perceived Behavioural Control details how easy or difficult people perceive it is to perform certain behaviours, based on their internal (i.e. self-efficacy) or external control factors (i.e. perceived barriers) (Ajzen, 1991). It is usual for a person who holds a positive control belief towards a certain behaviour to perform the behaviour (Ajzen, 1991). Some examples of research in the sustainability domain show that the Perceived Behavioural Control has a strong role in driving pro-circular behaviours, as evidenced in by an increasing intention to recycle e-waste (Lizin et al., 2017; Kumar, 2019) and the purchase of

'green' products (Sreen et al., 2018; Yang et al., 2019). This study investigates whether Perceived Behavioural Control could have an influence on grocery retailers' and RDC manufacturers' Behavioural Intentions to *purchase* and *produce remanufactured RDCs*.

3.2.1.4. Actual Behavioural Control

The last construct of the Theory of Planned Behaviour is the Actual Behavioural Control. The Actual Behavioural Control details the **actual ability** (i.e. availability of resources and opportunities) to perform a behaviour (Ajzen, 1991). If the resources and opportunities to perform a behaviour are available, it is the perceptions towards them (the **Perceived** Behavioural Control) that has a strong influence on a person's actions. However, the absence of these resources and opportunities (the **Actual** Behavioural Control) can directly prevent the performing of a behaviour. An example of an Actual Behavioural Control enabling grocery retailers to *purchase remanufactured RDCs* is having access to local and skilled RDC remanufacturers. An example of an Actual Behavioural Control enabling RDC manufacturers to *produce remanufactured RDCs* is a demand for remanufactured RDCs from grocery retailers.

3.2.1.5. Product Perceptions

The investigation stage includes an additional fifth construct, which is Product Perceptions. Product Perceptions are beliefs about a tangible *circular* product. These beliefs are usually formed based on the perceived characteristics of a product, such as its value and quality (Aaker, 1991) or its general utility (Zeithaml, 1998). Literature on Circular Economy often highlights the important role that Product Perceptions play in driving the uptake of pro-circular behaviours across various industries in the technical sector (APPSRG and APPMG, 2014; European Remanufacturing Network, 2016; Centre for Remanufacturing and Reuse, 2009). This study investigates whether Product Perceptions could have an influence on grocery retailers' and RDC manufacturers' Behavioural Intentions to *purchase* and *produce remanufactured RDCs*.

3.2.1.6. Pro-Circular Values

The final construct included in the investigation stage are Pro-Circular Values. Generally, values differ from individual to individual and convey what is important to people in their lives (Bardi & Schwartz, 2003). Like attitudes, beliefs and behaviours, values of an induvial can change throughout their lifetime and are considered an important influencer of behaviour (Stern, et al 1999; Bardi & Schwartz, 2003), especially when it comes to change on a large scale (Atherton, 2015). Generally, assessing values may help to underline the attitudes towards freedom, equality (Ajzen, 2012) and environmental protection (Crompton and McMahon, 2011). The literature on Circular Economy often highlights the important role values play in driving the uptake of pro-circular behaviours (Atherton, 2015). Examples include studies on the positive influence of environmental, individual and cultural values on the purchase of 'green' (Chen and Chang, 2012) and remanufactured products (Gaur et al., 2015).

Pro-Circular Values are a set of values that rate social, economic and environmental matters as important to oneself (Muranko et al., 2018). Commonly, values can reflect an individual's intrinsic and extrinsic goals. Intrinsic goals concern matters that that are 'bigger-than-self' (Chilton et al., 2012), whereas, extrinsic goals relate to issues such as power, wealth or social recognition (Crompton and McMahon, 2011). Intrinsic goals result in a greater motivation to act in line with the community or environment, and therefore are an important driver of the Circular Economy initiatives (Stec and Zwolinski, 2018). Matters related to Circular Economy are considered to be of 'bigger-than-self' importance, meaning that Pro-Circular Values are inherently intrinsic. This study investigates whether Pro-Circular Values could have an influence on grocery retailers' and RDC manufacturers' Behavioural Intentions to *purchase* and *produce remanufactured RDCs*.

3.2.1.7. Methods of investigation

The PCCM proposes and investigation of the Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Product Perceptions and Behavioural Intentions, in order to identify which of these may hinder the adoption of pro-circular behaviours. The model also suggests investigating Pro-Circular Values, to identify which intrinsic motivator (environmental, economic or environmental) is the

strongest and therefore more likely to be successful in encouraging the adoption of pro-circular behaviours. This information is vital to enable the design of effective Behaviour Change Interventions.

The investigation of the above behavioural determinants involves the development and application of appropriate research methods that are specific to the targeted consumers and producers. The most appropriate research methods usually involve quantitative methods, such as structured surveys which allow for statistical analysis of behavioural predictors. Examples of the appropriate research methods selected in this study to investigate the performance of pro-circular behaviours in the Retail Refrigeration Industry (among grocery retailers and RDC manufacturers), are presented in the Methodology sections of Chapters 5 and 6.

3.2.2. Intervention stage

The intervention stage (Figure 3, right) uses Persuasive Communication, which is a type of Behaviour Change Intervention that intends to "shape, reinforce, or change the responses of (…) [an individual]" (Miller, 1980, p. 11). Persuasive Communication uses messages and visuals to influence the beliefs, values, attitudes, perceptions and behaviours of an individual (Simons, 1976; The World Bank, 2010; Fife-Schaw et al., 2007). Persuasive Communication has been successfully implemented in studies to positively influence consumers' attitudes and intentions towards resource-efficient (Warren et al., 2016) and sustainable behaviours (Pelletier and Sharp, 2008; O'Shaughnessy and O'Shaughnessy, 2003; McKenzie-Mohr, 2000). This has involved use of Persuasive Communication to advocate an environmental or socio-economic value in the context of encouraging water conservation (Seyranian et al., 2015) and the purchase of 'green' (Kong and Zhang, 2014) and remanufactured products (Michaud and Llerena, 2010). In addition, informing consumers about the benefits of purchasing remanufactured products (such as the environmental benefits) can lead to a more positive perception about the value of such products (Michaud and Llerena; 2011). Persuasive Communication has also been commonly used alongside with Theory of Planned Behaviour (Ajzen, 2006b; Abraham and Michie, 2008).

3.2.2.1. Methods of intervention

The PCCM suggests using persuasive messages and visuals to influence Behavioural Attitudes, Subjective Norms, Perceived Behavioural Controls, Product Perceptions and Pro-Circular Values, to

create a positive intention to perform a pro-circular behaviour. Persuasive messages involve the use of written or spoken words and typically hold three key components: (I) *an advocated position* - which outlines a particular problem or recommends a specific behaviour, (II) *an argument* - which provides reasoning for the adoption of the advocated position and (III) *factual evidence* - which reinforces the argument (Ajzen, 1991). The PCCM suggests using Pro-Circular Values in persuasive messages by highlighting the environmental, social or economic outcomes of performing or not performing a pro-circular behaviour. This involves including the Pro-Circular value in the *advocated position, argument* or *factual evidence* of the message. Examples of persuasive messages are shown in Chapter 4, 5 and 6.

Persuasive visuals involve the use of graphic communication to reinforce a particular argument (Suh, 1999). Graphic communication can take on several visual forms such as symbols, maps, graphs, diagrams, illustrations, renders (realistic or abstract), photographs, motion pictures and 3D models or objects (Saunders, 1994). The PCCM suggests using persuasive visuals in combination with the persuasive message to corroborate the *advocated position, argument* or *factual evidence* of the message. Example of effective persuasive visuals are shown in Chapter 4, 5 and 6.

Within the Retail Refrigeration Industry, the use of tailored Persuasive Communication could be adopted in the marketing of RDC manufacturers to successfully influence grocery retailer's intentions to perform pro-circular behaviours, namely the *purchase of remanufactured RDCs*, on large scale. Similarly, it could also be used by governmental and professional bodies [e.g. European Remanufacturing Network (2017), Carbon Trust (2018), Institute of Refrigeration (2018)] in campaigns to influence RDC manufacturers intentions to *produce remanufactured RDCs*. Nevertheless, to date there is a lack of research on how marketing could be used to promote the Circular Economy (De Jesus and Mendonna, 2017; Gould, 2016), particularly within the Retail Refrigeration Industry.

Summary

This PCCM can be used as a tool to encourage the adoption of pro-circular behaviours. It will be implemented in this study to investigate the *factors that determine the Behavioural Intentions to purchase* (Chapter 5) and *produce* (Chapter 6) *remanufactured RDCs.* It will also be applied in the design of *Persuasive Communication to effectively encourage the positive intention to perform those pro-circular behaviours* (Chapters 4, 5 And 6).

4. Influencing Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs

Introduction

This chapter presents a study which used selected constructs of the Pro-Circular Change Model (Figure 4) to investigate how effective the use of Persuasive Communication could be in influencing the Behavioural Attitudes, Product Perceptions and Behavioural Beliefs towards the purchase of remanufactured RDCs. Participants in this study were individuals from the Food and Retail Refrigeration Industry, including engineers and academic experts of food and retail refrigeration equipment who work directly and indirectly with RDCs. This study was conducted as a pilot to provide an insight into how effective this type of intervention could be if developed further to generate consumer demand for remanufactured RDCs among the grocery retailers, as investigated later in Chapter 5.

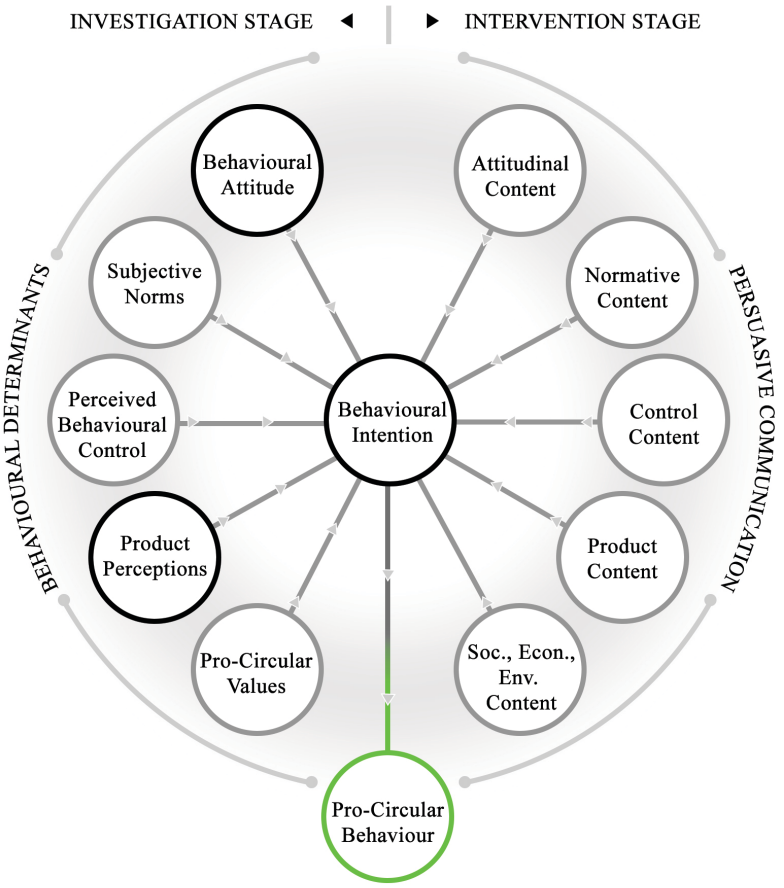


Figure 4. The Pro-Circular Change Model - selected constructs.

The chapter will begin by outlining the methodology, which provides a summary of the examined population sample and details the research procedures, before it moves to an analysis and discussion of the results.

4.1. Research methodology

The data investigated in this study were collected from questions embedded in structured surveys. The questions were designed to evaluate the impact that the Behaviour Change Intervention had on the Behavioural Attitudes, Product Perceptions and Behavioural Beliefs of the population sample to perform a pro-circular behaviour - defined as *'buying remanufactured RDCs'*. The study was carried out in three consecutive stages in which participants' Behavioural Attitudes, Product Perceptions and Behavioural Beliefs were assessed both, before and after the Behaviour Change Intervention.

The short span of participant availability meant that only a small number of constructs from the model could be investigated in this study. The researcher was allowed 15 minutes to conduct the surveys and issue the intervention. Nevertheless, the chosen constructs allowed for investigation into the impacts of the persuasive communication targeting the most common behavioural motivators of attitudes and perceptions.

This study has been granted ethical approval by the School of Engineering Ethics Committee at London South Bank University. A letter of approval is attached in Appendix G [41].

4.1.1. Population sample

The study was conducted at an industry meeting in April 2017 on energy consumption in the Food and Retail Refrigeration Industry. The attendees (N=47) were invited to take part in the study by the lead researcher directly at the meeting. Participants of this study were identified based on the meeting attendees list which indicated their area of work and the extent of their involvement with RDCs in their roles. It was important that the participants were familiar with RDCs in terms of their function and performance.

[41] A single ethics application covering studies in Chapters 4, 5, 6 and 7 was submitted.

The population sample contained 26 individuals. As per the demographic data collected in Part 1 Questionnaire (Table 4.1.3.1.), the sample included four industry professionals with experience in buying, producing and selling refrigeration equipment and 22 academic experts who worked on research and product development related to both, food and retail refrigeration equipment.

4.1.2. Research procedure

The study was carried out in three consecutive stages, as illustrated in Figure 4.1.2. In the first stage, the study was introduced directly by the lead researcher to all participants to ensure they understood what type of pro-circular behaviour was being investigated. Following the introduction, participants completed the Part 1 Questionnaire (described in section 4.1.3.1.a) on paper, immediately before the intervention, which recorded their Behavioural Attitudes, Product Perceptions and Behavioural Beliefs towards purchasing remanufactured RDCs. In the second stage, participants were exposed to the Behaviour Change Intervention (described in section 4.1.3.2) which was the Persuasive Communication in the form of an oral/slide presentation, performed by the lead researcher that lasted for approximately 8 minutes. In the third stage, immediately after the intervention, participants completed an on-paper Part 2 Questionnaire (described in section 4.1.3.1.b) which assessed the impact of the Behaviour Change Intervention on their Behavioural Attitudes, Product Perceptions and Behavioural Beliefs towards the pro-circular behaviour.

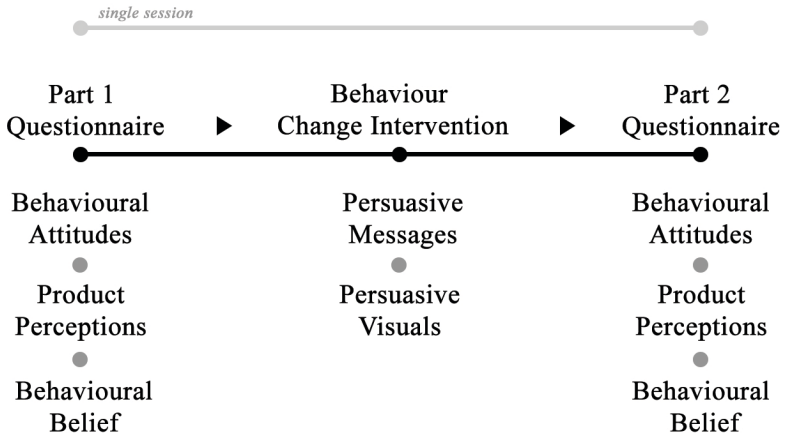


Figure 4.1.2. Study procedure.

4.1.3. Study design

The Behaviour Change Intervention was designed using Persuasive Communication. The influence of the intervention on the participants' responses was assessed using a structured survey (Appendix A). The survey aimed to record the participants current Behavioural Attitudes, Product Perceptions and Behavioural Beliefs towards performing the pro-circular behaviour and to evaluate the influence of the Behaviour Change Intervention thereafter. Both, the survey and the intervention items were developed with the support of two industry experts who were employed by the industrial partner – 1) a Refrigeration Engineer and 2) a RDC Manufacturing Manager, both had knowledge of RDCs and the retail refrigeration market.

4.1.3.1. Survey development

The questionnaire items for both parts of the survey - pre-intervention (*Part 1 Questionnaire*) and post-intervention (*Part 2 Questionnaire*), together with the scales are summarised in Table 4.1.3.1 and are explained further in Sections *a* and *b*.

Table 4.1.3.1. Questionnaire Items and Scales: Part 1 and Part 2 Questionnaire.

Variable	**Q.**	Questions	Scales Items	Scale Type
Questionnaire Part 1				
Demographic	**1**	*Which of the following best describes you?*	*I buy RDCs/produce /sell RDCs/other refrigeration equipment,* *I work with RDCs/ in retail refrigeration industry/in research/in food industry/on product development,* *Other (please specify)*	Multiple selection
Behavioural Belief	**2**	*In your opinion, if a retailer needed to buy 50 fridges to furnish their supermarket, which type of RDCs would be better to buy?*	*50 new fridges (RDCs),* *50 factory-remanufactured,* *I Don't know*	Single-choice
Product Perceptions	**3**	*In your opinion, and based on the following characteristics, please compare [quality, performance, appearance, longevity and warranty of]*	*Better than new,* *The same as new,* *Worse than new,*	3-point Likert

		factory-remanufactured RDCs with new RDCs.		
Behavioural Attitudes	**4**	*In your opinion, buying factory-remanufactured RDCs could be... [good - bad, convenient - inconvenient, necessary - unnecessary, profitable - expensive]*	*Extremely, Moderately, Slightly, Neither*	7-point Likert
Questionnaire Part 2				
Behavioural Awareness	**5**	*Prior to this presentation, were you aware that RDCs can be factory-remanufactured?*	*Yes, No*	Single-choice
Behavioural Belief	**6**	*If a retailer needed to buy a number of fridges to furnish their supermarket, which type of RDCs would be better to buy?*	*New, Factory-remanufactured, I Don't know*	Single-choice
Product Perceptions	**7**	*Based on the following characteristics, please compare [quality, performance, appearance, longevity and warranty of] factory-remanufactured RDCs with new RDCs.*	*Better than new, The same as new, Worse than new*	3-point Likert
Behavioural Attitudes	**8**	*Buying factory-remanufactured RDCs is... [good - bad, convenient - inconvenient, necessary - unnecessary, profitable – expensive]*	*Extremely, Moderately, Slightly, Neither*	7-point Likert

a) Part 1 Questionnaire

The Part 1 Questionnaire begins with an introduction to the study followed by a *demographic* measure (question 1, Table 4.1). Multiple-choice items are combined with an open-ended answer, giving each participant the opportunity to specify their role within the industry. In question 2, a direct measure of Behavioural Belief was developed to investigate participants' beliefs about whether the grocery retailers should or should not purchase remanufactured RDCs. This measure was assessed using single-choice responses, enabling participants to specify their beliefs. Measures of Product Perceptions followed in question 3. The question was accompanied by a three-point Likert (1932) scale, which enabled participants to express their perceptions towards the *quality, performance, appearance,*

longevity and *warranty* of remanufactured RDCs by comparing them with new RDCs. A reliability analysis was carried out on the Product Perceptions listed - Cronbach's alpha[42] showed these perceptions had a good reliability *(α=0.85).* The final question in Part 1 Questionnaire (question 4) measured participants' Behavioural Attitudes [developed as per Ajzen's recommendations (Ajzen, 2006)] towards performing the pro-circular behaviour. The question was accompanied by seven-point Likert scale, which enabled participants to indicate their behavioural beliefs about how *good-bad*, *convenient-inconvenient*, *necessary-unnecessary* and *profitable-expensive* it is to buy remanufactured RDCs. Cronbach's alpha showed the measures of Behavioural Attitudes also reached an acceptable reliability *(α =0.76).*

b) Part 2 Questionnaire

The Part 2 Questionnaire began by asking participants to indicate their *awareness* of remanufacturing RDCs prior to the intervention (question 5). This question was accompanied by a *yes-no* dichotomous option, which were provided to clearly distinguish the participants' answers. This question was followed by the repeated measures (equivalent to those included in the Part 1 Questionnaire*)* of Behavioural Beliefs in question 6, Product Perceptions *(α= 0.82)* in question 7 and Behavioural Attitudes *(α=0.93)* in question 8.

4.1.3.2. Behaviour Change Intervention design

The Behaviour Change Intervention was delivered by the lead researcher through a presentation which included Persuasive Communication (Appendix B). The presentation began with an introduction to RDCs with emphasis on their design, material content and size. Then, the process of remanufacturing RDCs was explained (to minimise any confusion about the process, remanufacture was compared and distinguished from refurbishment, as both processes are often mistaken to be the same). The Persuasive Communication items are summarised in Table 4.1.3.2 and are explained further in sections a) and b) below.

[42] Cronbach's alpha (Cronbach, 1951) is a measure of the internal consistency of a scale. Cronbach's alpha describes the extent to which all the items in a test (e.g. items of Behavioural Attitude) measure the same construct (e.g. the Behavioural Attitude). It is expressed as a number between 0 and 1, with an acceptable value of alpha typically ranging from 0.60 to 0.95 (Taber, 2017).

Table 4.1.3.2. Persuasive Communication items.

Targeted Variables	Type	Content
Behavioural Attitudes [a]	Environmental messages	*Message with intrinsic value*; emphasis on the behaviour contributing to reduction of waste form the disposal of refrigerated display cabinets *Message with extrinsic value;* emphasis on the reducing the company's carbon footprint
	Economic messages	*Message with intrinsic value*; emphasis on the behaviour helping local manufacturing businesses grow *Message with extrinsic value*; emphasis on profits associated with the purchase of remanufactured refrigerated display cabinets
	Social messages	*Message with intrinsic value*; emphasis on preforming of the behaviour contributing to skilled jobs and training opportunities in manufacturing sector *Message with extrinsic value*; emphasis on the behaviour contributing to company's Corporate Social Responsibility[43] goals
Product Perceptions [b]	Graphics	*Illustration:* emphasis on the effects of remanufacture on an example of a graphic illustration a 'before and after' refrigerated display cabinet *Photographs:* emphasis on the effects of remanufacture on an example of images (x2) containing a factual representation of a 'before and after fridge'; images (x2) of components used in remanufacture of an RDCs; images (x2) of fridges – comparison one of a remanufactured RDC, and one of a new RDC

[a] Behavioural Attitudes were targeted by delivering persuasive messages verbally and visually by the lead researcher.
[b] Product Perceptions were targeted by delivering visual persuasion, in the form of graphics in the presentation.

a) Targeting Behavioural Attitudes

The persuasive messages used in this study were designed to positively influence the participants' Behavioural Attitudes and ultimately change their Behavioural Beliefs towards the purchase of remanufactured RDCs. The presentation included six messages (as described in Table 4.1.3.2 and shown in Appendix B). Three messages were developed to comprise of intrinsic (pro-circular) values associated with the environmental, economic and social benefits of remanufacturing RDCs. Three additional

[43] Corporate Social Responsibility reports describe retailers' business approach that contributes to sustainable development by delivering social (as well as economic and environmental) benefits for all stakeholders.

messages were developed to comprise of extrinsic values associated with the environmental, social and economic benefits of remanufacturing RDCs to the retail grocery retailers.

The Persuasive Communication messages used in the presentation were designed as per Ajzen's (1992) recommendations. A typographical representation was also considered in the design of messages. As per the recommendations of Husband and Hellier (2011), the colours of fonts were manipulated to enhance the key parts of messages (i.e. red font was used to highlight the negative parts of the messages, whereas green and blue fonts were used to highlight the positive parts of the messages). An enlarged font size was also used to draw the participants' attention to the important parts of the message. For example, a Persuasive Communication message comprising of intrinsic value and potential environmental benefits attributed to buying remanufactured RDCs, was defined and presented as:

Did you know that if a grocery retailer purchased 50 remanufactured RDCs, they could save 12.5 tonnes of reusable parts and material from entering the waste-stream? (advocated position)
FACT#3 In 2015 there were 69,000 RDCs in the UK at their end-of-life available to be remanufactured. (argument)
Due to a low demand for remanufactured RDCs, they were disposed of and generated 34,000 tonnes of waste. (argument)
(source: Centre for Remanufacture and Reuse). (factual evidence)
A greater demand for remanufactured RDC's could help to reduce waste. (argument)

b) Targeting Product Perceptions

Visual persuasion was implemented to influence the participants' perceptions about remanufactured RDCs. The presentation included one illustration and six photographs (as described in Table 4.1.3.2; and shown in Appendix B). The illustration (Figure 4.1.3.2.a.) was a RDC split into two – one half illustrating the condition of an end-of-life RDC and the other half illustrating a remanufactured RDC. Participants were exposed to the illustration for at least two minutes during the presentation (the illustration appeared on several occasions during the presentation).

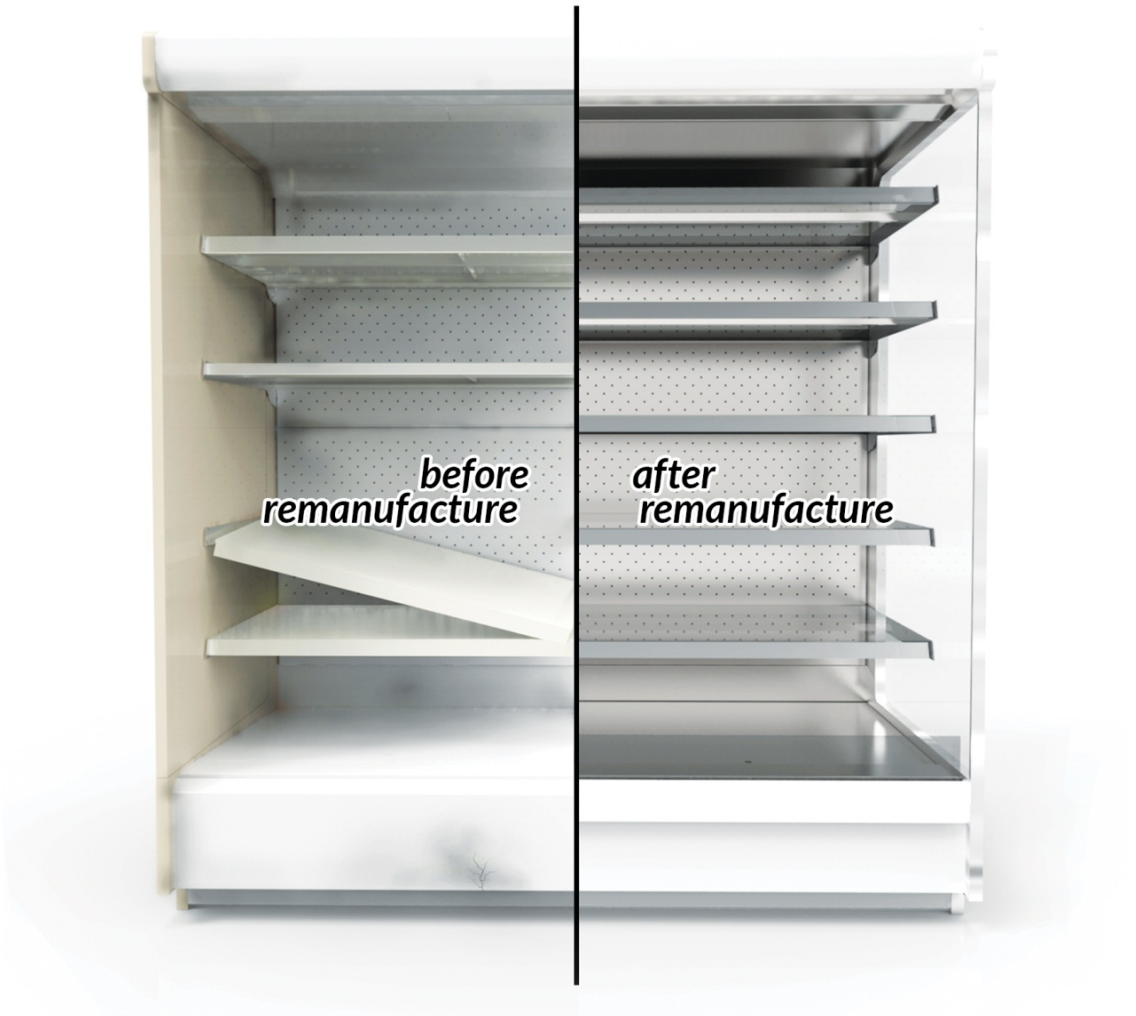


Figure 4.1.3.2.a. The Before and After Fridge.

The photographs (Figure 4.1.3.2.b.) showed pre-and post-remanufactured RDCs. This first pair of images showed an eleven-year-old RDC before remanufacture (a) and after remanufacture (b). To emphasize the high standard of the remanufacture, the second pair of images showed the new coil (c) and energy efficient fans (d) that were installed. The final pair of photographs showed two models of RDCs (e and f). Despite both RDCs looking like brand-new products, one was remanufactured (f). The aim of this visual persuasion was to influence the perception of the participant to consider remanufactured RDCs to be like brand-new products. Both, the illustration and photographs were displayed during the presentation alongside keywords (such as *before* or *after remanufacture* or *new components*). The lead researcher also verbally emphasised the quality, performance and longevity of remanufactured RDCs.

a. b.

c. d.

e. f.

Figure 4.1.3.2.b. Visual Persuasion – photographs of RDCs (source: The Bond Group).

4.2. Results

This section presents a descriptive and inferential statistical analysis of the participants' Behavioural Attitudes, Product Perceptions and Behavioural Beliefs towards the purchase of remanufactured RDCs before and after the influence of the Behaviour Change Intervention. First, sample means were calculated to estimate the central tendency of data. Secondly, standard deviations were calculated to indicate the dispersion of data from the sample mean. Lastly, standard errors were calculated to indicate the precision of the estimated means in the study. Frequency histograms are also provided to illustrate the distribution of data. The participants' awareness of remanufacturing RDCs prior to the intervention is also explored.

Inferential statistics were used to further analyse the impact of the Behaviour Change Intervention. A paired sample t-test was used to determine whether the means of the Behavioural Attitudes and Product Perceptions influenced by the presence of the Behaviour Change Interventions, differed significantly from the means of Behavioural Attitudes and Product Perceptions held by the participants prior to the intervention. Pearson's chi-square statistic was used to examine the significance of differences in the distribution of data, particularly for the Behavioural Beliefs before and after the Behaviour Change Intervention. In addition, a correlation analysis was carried out to understand the relationship between the Behavioural Beliefs, Behavioural Attitudes and Product Perceptions held by the participants.

4.2.1. Behavioural awareness

As illustrated in Figure 4.2.1, before the intervention, 58% (N= 15) of the sample were aware that RDCs can be remanufactured. 44% (N=11) of the sample were not aware that RDCs can be remanufactured.

Figure 4.2.1. Frequency distribution of participants' awareness of remanufacturing RDCs before the Behaviour Change Intervention.

4.2.2. Behavioural Attitudes

The analysis of results presented in Table 4.2.2.a, show that before the Behaviour Change Intervention the overall Behavioural Attitudes of the participants towards the purchase of remanufactured RDCs were relatively positive. Participants reported that they perceived the purchase of remanufactured RDCs to be *good, convenient* and *profitable*. More neutral responses were given to

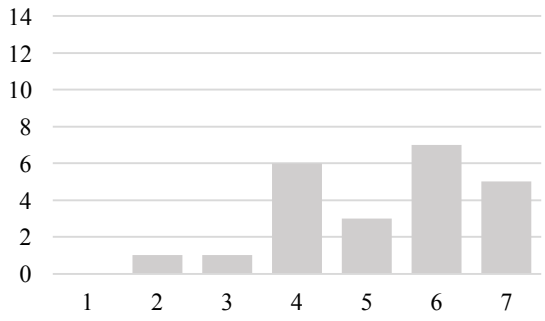
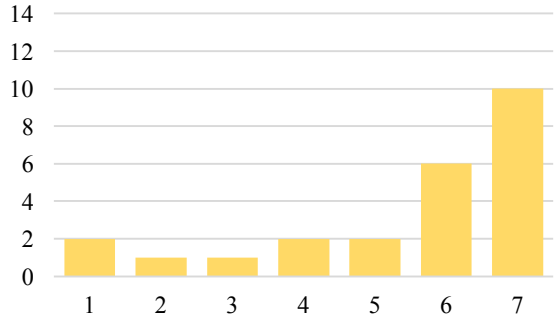
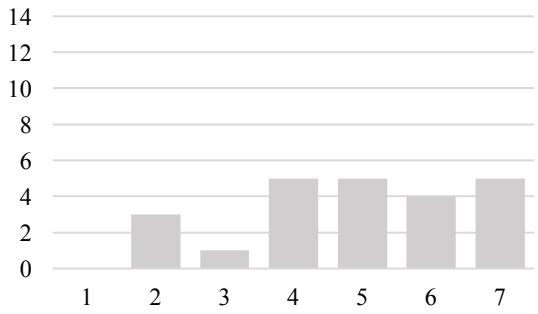
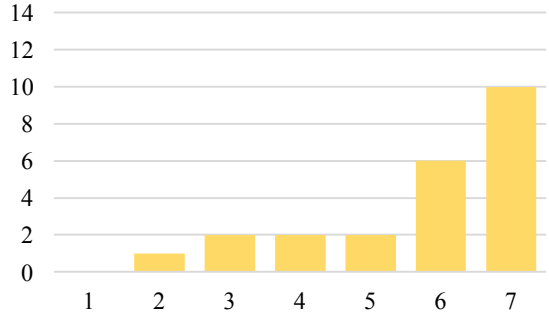
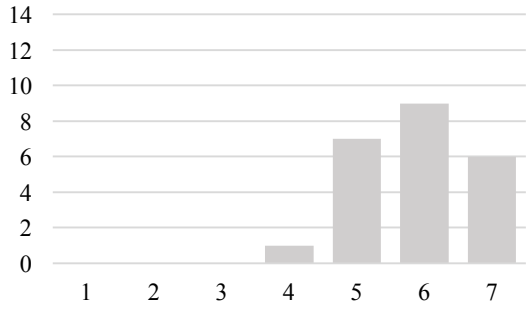
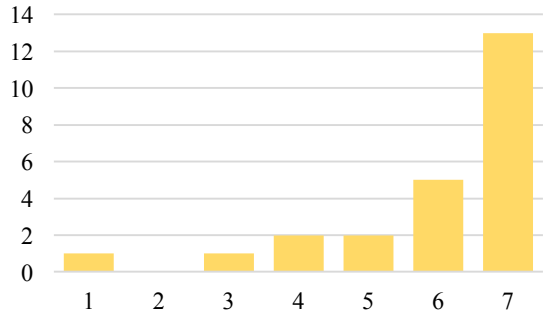
their Behavioural Attitudes towards the *necessity* of performing the pro-circular behaviour. The Behavioural Attitudes recorded after the Behaviour Change Intervention scored slightly higher.

Table 4.2.2.a. Behavioural Attitudes (BA) before and after Behaviour Change Intervention (BCI).

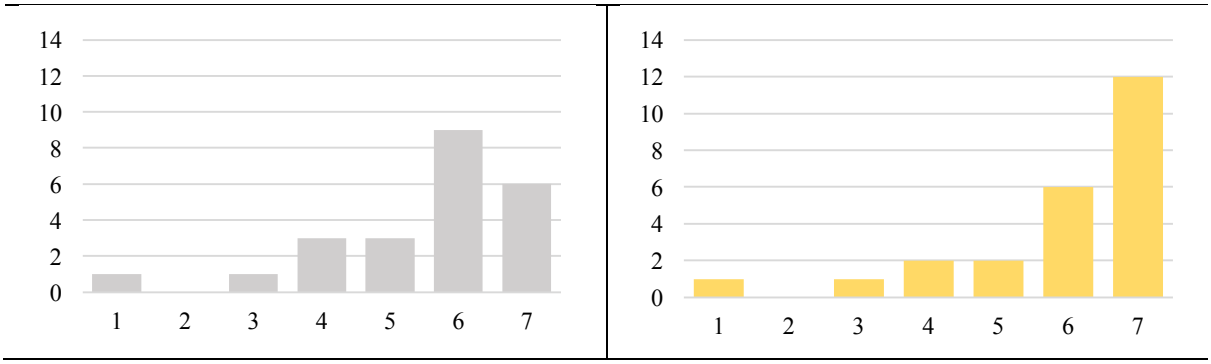
	N	$\bar{x}$	*SD*	*SE*	minimum	maximum
BA good - bad						
Before BCI	23	**5.52**	*1.50*	*0.31*	1.00	7.00
After BCI	24	**5.92**	*1.56*	*0.32*	1.00	7.00
BA convenient - inconvenient						
Before BCI	23	**5.26**	*1.42*	*0.30*	1.00	7.00
After BCI	24	**5.46**	*1.96*	*0.40*	1.00	7.00
BA necessary - unnecessary						
Before BCI	23	**4.91**	*1.65*	*0.34*	2.00	7.00
After BCI	23	**5.74**	*1.54*	*0.32*	2.00	7.00
BA profitable - expensive						
Before BCI	23	**5.87**	*.87*	*0.18*	2.00	7.00
After BCI	24	**5.96**	*1.57*	*0.32*	1.00	7.00
BA mean						
Before BCI	-	**5.39**	*1.06*	*0.22*	-	-
After BCI	-	**5.78**	*1.51*	*0.31*	-	-

The frequency distributions of scores for the participants' Behavioural Attitudes recorded before and after the Behaviour Change Intervention are shown in Table 4.2.2.b. The results recorded before the intervention show an inconsistent pattern of skewness and kurtosis in the distribution of scores for all Behavioural Attitudes. The results recorded after the Behaviour Change Intervention, show a consistent pattern of skewness in distribution of scores directed to the left of the scale.

Table 4.2.2.b. Frequency Distribution of Behavioural Attitudes before (left) and after (right) the Behaviour Change Intervention (*response ratings: 1- strongly negative, 2 - moderately negative, 3 - slightly negative, 4 – neutral, 5- slightly positive, 6 – moderately positive, 7 – strongly positive*).

Before BCI	After BCI
BA inconvenient – convenient	
	
BA unnecessary – necessary	
	
BA expensive - profitable	
	

BA bad - good



The results of the paired sample t-test on Behavioural Attitudes recorded before and after intervention are presented in Table 4.2.2.c. A substantial and statistically significant difference was only recorded between the Behavioural Attitudes towards the purchase of remanufactured RDCs being *necessary*. There were no statistically significant differences between the means of Behavioural Attitudes towards the pro-circular behaviour being *good*, *convenient* and *profitable*.

Table 4.2.2.c. Summary of paired sample t-test on Behavioural Attitudes (BA) before and after the Behaviour Change Intervention (BCI).

	t	df	*p*
BA good before BCI - BA good after BCI	**1.433**	21	*0.083*
BA convenient BCI - BA convenient after BCI	**1.064**	21	*0.150*
BA necessary BCI – BA necessary after BCI	**3.382**	21	*0.001**
BA profitable BCI - BA profitable after BCI	**0.508**	21	*0.309*

Hypothesis: BA before < BA after
* Significance: p<0.05
Note: Student t-test

4.2.3. Product Perceptions

The analysis of results presented in Table 4.2.3.a shows that before the Behaviour Change Intervention, the overall Product Perceptions of participants towards remanufactured RDCs were relatively neutral (means ≥ *2* were considered positive). The majority of participants perceived remanufactured RDCs to be of the same *quality* and *performance* as new RDCs. However, for other Product Perceptions, namely *appearance, longevity* and *warranty,* a large proportion of participants indicated that remanufactured RDCs are worse than new RDCs. The Product Perceptions recorded after the Behaviour Change Intervention scored slightly higher.

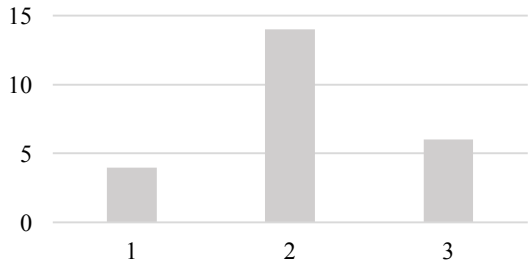
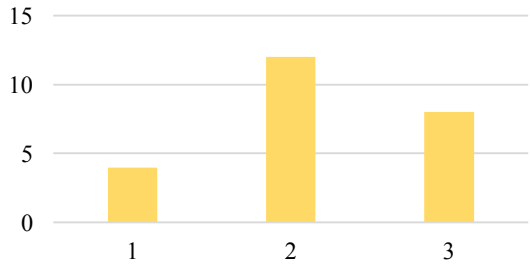
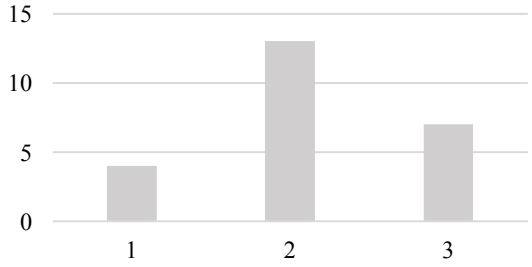
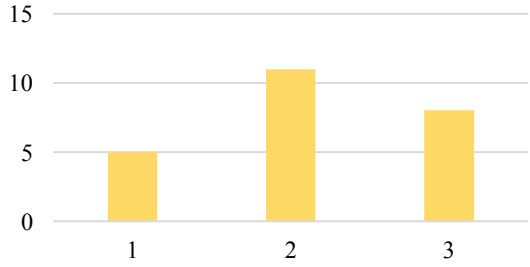
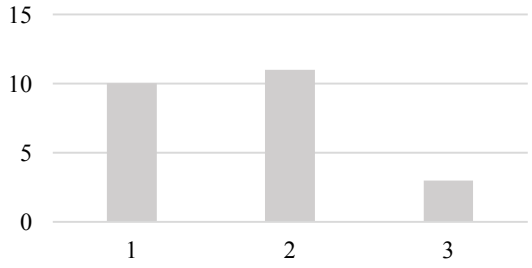
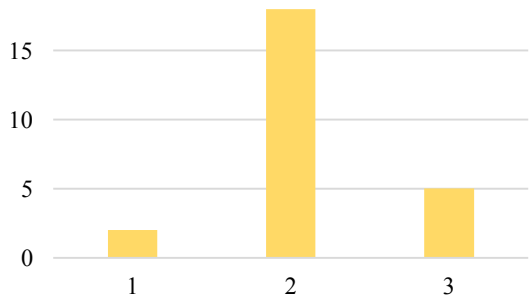
Table 4.2.3.a Product Perceptions (PP) before and after Behaviour Change Intervention (BCI).

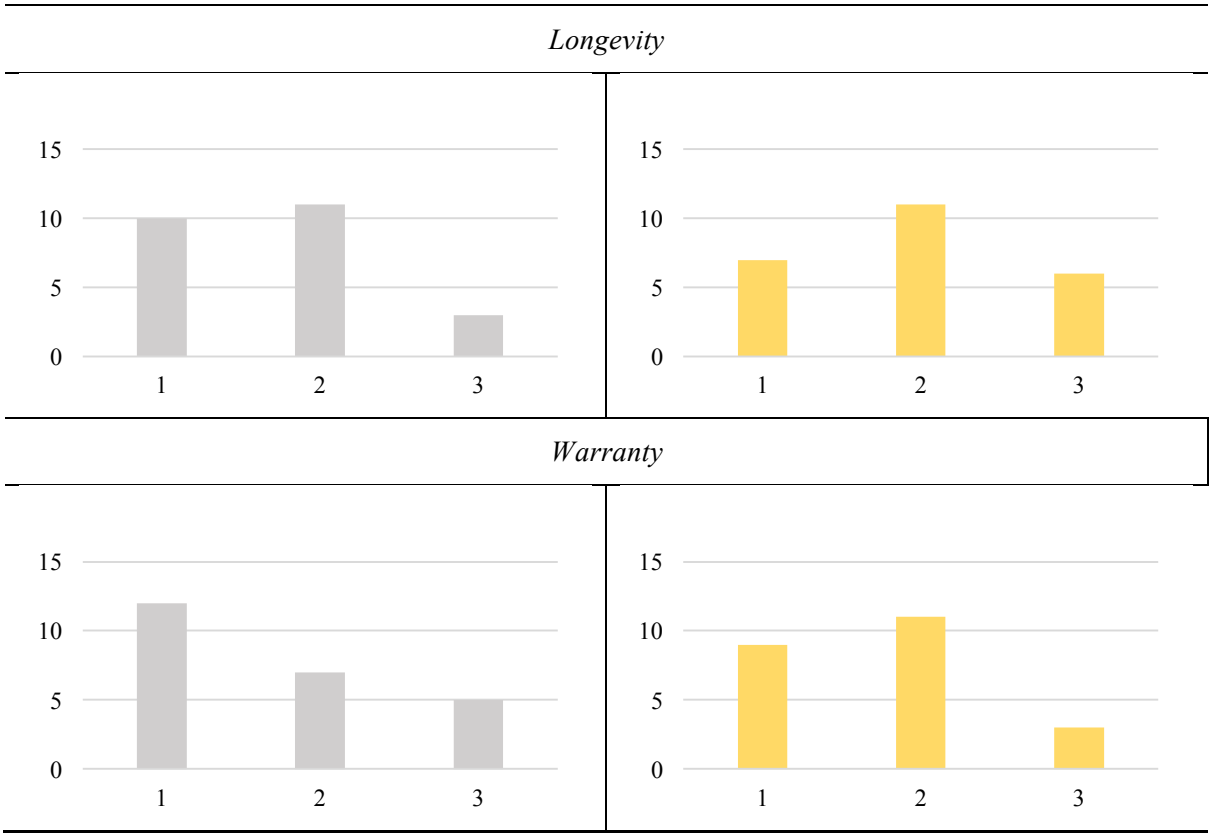
	N	$\bar{x}$	*SD*	*SE*	minimum	maximum
PP quality						
Before BCI	24	**2.08**	*.65*	*0.13*	1.00	3.00
After BCI	24	**2.17**	*.70*	*0.14*	1.00	3.00
PP performance						
Before BCI	24	**2.13**	*.68*	*0.14*	1.00	3.00
After BCI	24	**2.13**	*.74*	*0.15*	1.00	3.00
PP appearance						
Before BCI	24	**1.71**	*.69*	*0.14*	1.00	3.00
After BCI	25	**2.12**	*.53*	*0.11*	1.00	3.00
PP longevity						
Before BCI	24	**1.71**	*.69*	*0.14*	1.00	3.00
After BCI	24	**1.96**	*.75*	*0.15*	1.00	3.00
PP warranty						
Before BCI	24	**1.71**	*.81*	*0.16*	1.00	3.00
After BCI	23	**1.74**	*.69*	*0.14*	1.00	3.00
PP mean						
Before BCI	-	**1.87**	*.56*	*0.11*	-	-
After BCI	-	**2.02**	*.51*	*0.11*	-	-

The frequency distributions of scores for participants' Product Perceptions before and after the Behaviour Change Intervention are shown in Table 4.2.3.b. The results recorded before the intervention show an inconsistent pattern of skewness and kurtosis in the distribution for all Product Perceptions (for *quality* and *performance* - *a* mesokurtic distribution was found with most scores falling on the positive side of the scale*;* for *appearance, longevity* and *warranty* – there were mixed distributions, with the majority of scores falling on the negative side of the scale). The results recorded after the Behaviour Change Intervention showed a change in the distribution of scores for most Product Perceptions towards remanufactured RDCs. There was a decrease in negative perceptions towards the *appearance, longevity and warranty* of remanufactured RDCs. There was little or no change in the distribution of scores for

the *quality* and *performance* of remanufactured RDCs, with scores remaining on the positive side of scale.

Table 4.2.3.b. Frequency Distribution of Product Perceptions before (left) and after (right) the Behaviour Change Intervention (*response ratings: 1- 'worse than new RDCs', 2 – 'the same and new RDCs', 3 – 'better than new RDCs'*).

Before BCI	After BCI
Quality	
	
Performance	
	
Appearance	
	



The results of the t-test on Product Perception recorded before and after intervention are shown in Table 4.2.3.c. It shows substantial and statistically significant differences were only recorded between the Product Perceptions towards the *appearance* of remanufactured RDCs. There were no statistically significant differences between the means of Product Perceptions towards the *quality*, *performance*, *longevity* and *warranty* of remanufactured RDCs.

Table 4.2.3.c. Summary of paired sample t-test on Product Perceptions (PP) before and after Behaviour Change Intervention (BCI).

	t	df	*p*
PP quality before BCI – PP quality after BCI	**0.526**	23	*0.302*
PP performance before BCI – PP performance after BCI	**0.000**	23	*0.500*
PP appearance before BCI – PP appearance after BCI	**2.460**	23	*0.011**
PP longevity before BCI – PP longevity after BCI	**1.661**	23	*0.055*
PP warranty before BCI – PP warranty after BCI	**0.272**	22	*0.394*

Hypothesis: PP before < PP after
* Significance: p<0.05*
Note: Student t-test

4.2.4. Behavioural Beliefs

The analysis of results presented in Table 4.2.4.a shows that before the Behaviour Change Intervention, the overall Behavioural Beliefs of participants towards the purchase of remanufactured RDCs were neutral. However, after the intervention, the Behavioural Beliefs towards performing the pro-circular behaviour scored considerably higher.

Table 4.2.4.a. Behavioural Beliefs before and after Behaviour Change Intervention (BCI).

	N	$\bar{x}$	*SD*	*SE*	minimum	maximum
BI before BCI	26	**2.08**	*.80*	*0.16*	1.00	3.00
BI after BCI	26	**2.58**	*.76*	*0.15*	1.00	3.00

As illustrated in Figure 4.2.4.a, after the intervention the number of participants who decided that purchase of new RDCs is a better option, decreased from 27% to 15% (by N=3). The number of participants who were undecided about their decisions also decreased from 38% to 12% (by N=7). Moreover, the number of participants who had positive Behavioural Beliefs towards the purchase of remanufactured RDCs more than doubled, from 35% to 73% (by N=10).

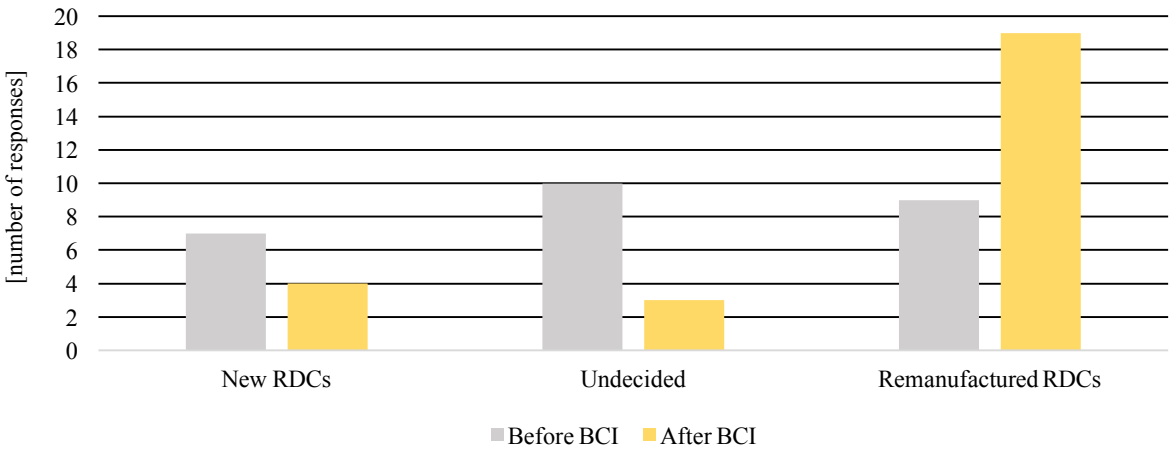
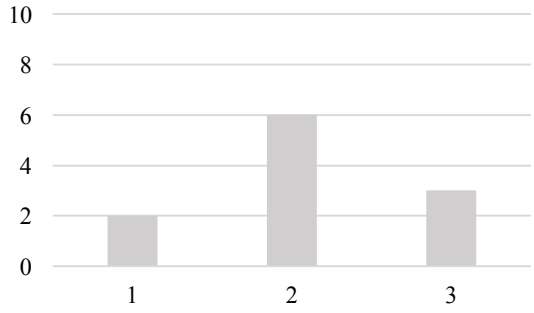
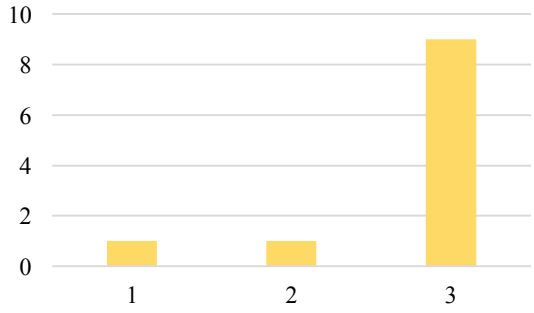
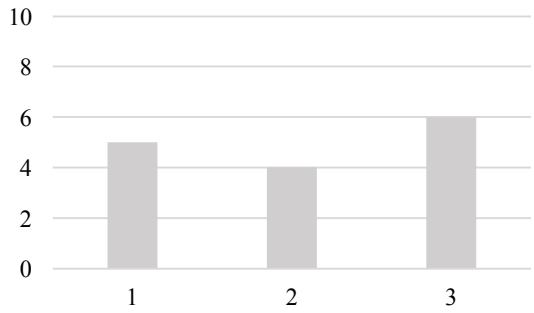
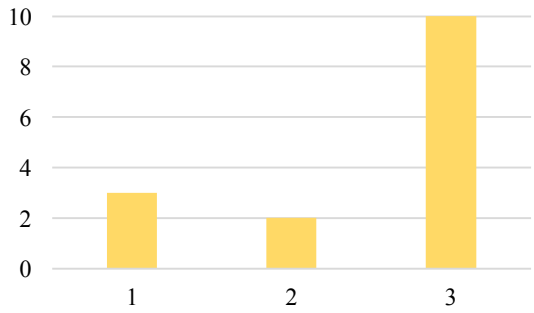


Figure 4.2.4.a. Frequency distribution of Behavioural Beliefs before and after Behaviour Change Intervention.

The distribution of scores on the participants' awareness of remanufactured RDCs before and after the intervention are illustrated in Table 4.2.4.b. The majority of participants who were not familiar with the remanufacture of RDCs, were undecided about their beliefs towards purchase remanufactured

RDCs. Following the Behaviour Change Intervention, the majority of these undecided beliefs changed positively. In addition, a large number of participants who were familiar with the remanufacture of RDCs before the intervention, held undecided or negative beliefs towards the purchase of remanufactured RDCs. This trend changed considerably following the Behaviour Change Intervention, with the reduction of undecided and negative Behavioural Beliefs, corresponding with an increase in positive Behavioural Beliefs towards the purchase of remanufactured RDCs.

Table 4.2.4.b. Frequency Distribution of Behavioural Beliefs before and after the Behaviour Change Intervention split by participants' awareness of remanufacturing RDCs prior to the intervention (*response ratings: 1- 'New RDCs', 2 – 'undecided', 3 – 'remanufactured RDCs'*).

Before BCI	After BCI
Participants who did not know about RDCs being remanufactured	
	
Participants who knew about RDCs being remanufactured	
	

Pearson's chi-square statistic was used to evaluate the statistical significance of difference in data distribution between Behavioural Beliefs before and after the Behaviour Change Intervention. The analysis of results presented in Table 4.2.4.c shows this difference in distribution ($x^2=8.16$, $p=0.017$) to

be statistically significant. This shows that the Behaviour Change Intervention had a positive influence on the participants' Behavioural Beliefs to purchase remanufactured RDCs.

Table 4.2.4.c. Summary of chi-square statistic on Behavioural Beliefs (BB) before and after Behaviour Change Intervention (BCI).

	N	*'new'*	*'uncertain'*	*'remanufactured'*
BB before BCI	**26**	7	10	9
BB after BCI	**26**	4	3	19

x^2=8.16; p<0.05, p=0.017

4.2.5. Relationship between the Behavioural Beliefs with Behavioural Attitudes and Product Perceptions.

A correlation analysis was carried out after intervention, to investigate the relationship between Behavioural Beliefs and both, Behavioural Attitudes and Product Perceptions. As summarised in Table 4.2.5, moderately positive relationships were found between the Behavioural Beliefs and Behavioural Attitudes towards the purchase of remanufactured RDCs being *good (r=0.559, p=0.004)*, *convenient (r=0.692, p<0.001)* and *necessary (r=0.638, p=0.001).* Strongly positive relationships were recorded between the Behavioural Beliefs and Production Perceptions towards the *profitability (r=0.724, p<0.001)* of remanufactured RDCs. Moderately positive correlations were also found between Behavioural Beliefs and some of the Product Perceptions, particularly for perceptions towards the *quality (r = 0.543, p = 0.006)* and *performance (r=0.48, p = 0.018)* of remanufactured RDCs.

Table 4.2.5. Summary of Pearson's correlation of Behavioural Beliefs (BB) with Behavioural Attitudes (BA) and Product Perceptions (PP) after Behaviour Change Intervention.

	BB	
	r	*p*
BI	**-**	-
BA good - bad	**0.559**	*0.004**
BA convenient - inconvenient	**0.692**	*<.001**
BA necessary - unnecessary	**0.638**	*0.001**
BA profitable – expensive	**0.724**	*<.001**
PP quality	**0.543**	*0.006**
PP performance	**0.480**	*0.018**

PP appearance	**0.136**	*0.516*
PP longevity	**0.115**	*0.594*
PP warranty	**0.345**	*0.107*

CI 95%
*Significance: p<0.05

4.3. Discussion

4.3.1. Influencing Behavioural Attitudes towards the purchase of remanufactured RDCs

Literature on Circular Economy suggests there is a positive relationship Behavioural Attitudes and the Behavioural Beliefs (e.g. if an individual holds a positive attitude towards the purchase of 'green' products, they are likely to purchase 'green' products; Maichum et al., 2016). Influencing Behavioural Attitudes is therefore a key component in driving behavioural changes. Persuasive Communication can be used as an effective tool for influencing Behavioural Attitudes (Ajzen, 1992).

As a result, this study used Persuasive Communication as a Behaviour Change Intervention to trigger positive Behavioural Attitudes towards the purchase of remanufactured RDCs. The results presented in section 4.2.2. show that following the Behaviour Change Intervention there was a slight increase in the overall mean for Behavioural Attitudes (*from $\bar{x}$=5.39 to $\bar{x}$=5.78).* The standard deviations also increased *(from SD=1.06 to SD=1.51)* and remained large, which indicated that the given scores were far from the mean, falling on both the negative and positive sides of the scale. However, the frequency distribution plots indicated that the majority of scores for all of the Behavioural Attitudes (towards the performance of the behaviour being *good, convenient, necessary* and *profitable*) recorded after the intervention fell on the positive side of the scale, with a highly-skewed distribution of scores. The standard error increased slightly *(from 0.28 to 0.31*) but remained low, which suggests that the investigated sample could potentially be illustrative of a larger population. However, as the test was conducted on small sample this cannot be said with certainty. To increase the confidence of these findings, further testing on a larger sample would be required.

The only statistically significant influence of the intervention was observed in the change of Behavioural Attitudes towards the *necessity* of performing the behaviour (*before intervention: $\bar{x}$=4.91; after intervention: $\bar{x}$=5.74),* as illustrated in the results of the paired sample t-test [*t(21)=3.38, p=0.001*]. This shows that the tailored Behaviour Change Intervention used in this study is likely to have a similarly

positive influence on the attitudes of a larger population towards the *necessity* of purchasing remanufactured RDCs. This includes refrigeration engineers who work directly and indirectly with RDCs across the food and retail refrigeration sectors. Interestingly, the written and verbal messages used in the Persuasive Communication did not emphasise or imply the *necessity* of purchasing the remanufactured RDCs[44]. This suggests that the intervention led participants to draw their own conclusions and positively influenced them to believe that the performing of the behaviour is important.

4.3.2. Influencing Product Perceptions towards remanufactured RDCs

A Product Perception is an individuals' belief about a product's characteristics, such as its appearance, performance or quality. Product Perception of remanufactured goods is poorer than that of new goods, because quality of those products is perceived to be lower. Consequently, such misconceptions can lead to individuals generally having adverse Behavioural Beliefs towards the purchase of remanufactured products (APPSRG and APPMG, 2014). Promoting remanufactured products, particularly by appeasing concerns about their appearance, performance and quality is important to instigate more positive beliefs towards their purchase.

This study investigated the impact that Persuasive Communication, as a Behaviour Change Intervention, can have on the Product Perceptions of remanufactured RDCs. The results in Section 4.2.3 show that following the Behaviour Change Intervention there was a small increase in the overall means for Product Perceptions (*from* $\bar{x}$*=1.87 to* $\bar{x}$*=2.02).* The standard deviations decreased slightly *(from SD=0.56 to SD=0.51)* but remained large, which indicated that some of the given scores fell on the negative side of the scale. The overall standard error remained consistently low *(SE=0.11*) after the intervention, which indicated a low spread in the sampling distribution. These results suggest that the investigated sample could potentially be representative of a larger population. Again, as the test was conducted on small sample this cannot be said with certainty. Despite the increase of overall means being small, the frequency distribution plots showed there was a considerable increase of positive responses regarding the remanufactured RDCs having the same *appearance, longevity and warranty* as new RDCs. However, the only statistically significant influence of the intervention was observed in the

[44] The Persuasive Communication did not include any suggestive phrases, such as 'necessary', 'essential' or 'important'.

change of Product Perceptions towards the *appearance of* remanufactured RDCs (*before intervention: $\bar{x}$=4.91, after intervention: $\bar{x}$=5.74),* as shown in the results of the paired sample t-test [*t(23)=2.46, p=0.011*]. These results imply the use of persuasive visuals in particular, had a positive influence on the participants perceived *appearance* of remanufactured RDCs. This suggests that using persuasive visuals to emphasise that the appearance of remanufactured RDCs is the same as brand-new RDCs could be equally effective on the attitudes of a larger population.

4.3.3. Changing Behavioural Beliefs towards the purchase of remanufactured RDCs

This study explored the influence of the Behaviour Change Intervention on the participants' Behavioural Beliefs about whether the grocery retailers should or should not purchase remanufactured RDCs. The results in section 4.2.4 suggest that the intervention instigated a positive increase of means for Behavioural Beliefs (*from $\bar{x}$=2.08 to $\bar{x}$=2.58),* which demonstrates the efficacy of the intervention in changing beliefs towards the purchase of more sustainable products. The standard deviations slightly decreased *(from SD=0.80 to SD=0.76)* but remained relatively large, which indicated that some of the given ratings were falling on the negative side of the scale. However, the frequency distribution plots indicated there was a considerable increase of positive responses (which resulted in decrease of negative and neutral responses - 35% of participants before the intervention to 73% of participants after the intervention choosing the purchase of remanufactured RDCs). Furthermore, the results of chi-square statistics showed that the differences in the distribution of data were also statistically significant (x^2*=8.16, p=0.017*). This indicates that the Behaviour Change Intervention had a substantial effect on the participants' Behavioural Beliefs to purchase remanufactured RDCs. The standard error also decreased *(from SE=0.16 to SE=0.15*) and remained low which suggests that the investigated sample could be representative of a larger population. However, to increase the confidence of these findings, further testing on a larger sample would be required.

The Behavioural Beliefs of participants who were and were not aware of the ability to remanufacture RDCs prior to the intervention were equally influenced. This suggests that the intervention had two functions. The primary function was persuasion, shifting the beliefs of participants from unfavourable to favourable. The secondary function was education, providing the participants with the relevant knowledge about the remanufacturing process and its outcomes, thereby influencing their

beliefs towards the purchase of remanufactured RDCs. These results suggest that the Behaviour Change Intervention used in this study can have a similar influence on the behaviours of individuals working in the industry, whether it is to educate them or change their existing beliefs about the purchase of remanufactured RDCs.

This study also investigated the relationship between participants Behavioural Beliefs with both, Behavioural Attitudes and Product Perceptions (Section 4.2.5). The results of Pearson's correlation indicated that an increase in positive attitudes (particularly towards the performing of the behaviour being *good, convenient, necessary and profitable*) and perceptions (particularly towards the *quality and performance* of the remanufactured RDCs), leads to more positive Behavioural Beliefs towards the purchase of remanufactured RDCs.

Furthermore, literature on survey research often centres the effects of social desirability bias, specifically in reporting people's attitudes, beliefs and behaviours (Kaminska and Foulsham, 2013). The most common cause of social desirability bias is due to the respondent not feeling comfortable enough to provide honest responses. It is possible that some participants in this study consciously provided what they perceived as more socially desirable answers, both before and after the intervention. However, the influence of social desirability bias in this study was reduced due to several factors. Firstly, the study was anonymous, giving the participants the opportunity to respond to the survey without being identified. Secondly, most participants' jobs did not involve directly purchasing RDCs, therefore they were less subject to the biases that come with a procurement role (such as previous sales experience, company procurement strategies, favourable relationships with manufacturers etc.). In addition, since the design was fully within-subject, any socially desirable responses would be illustrated with a participant's scores before and after the intervention being slightly positive. Nevertheless, any positive change in the scores (either slight or large) still suggest that intervention had an impact.

4.3.4. Using persuasion in marketing to influence the adoption of pro-circular behaviours

Marketing is used to encourage consumers to purchase a product or service, most often by communicating its benefits. In order to effectively promote pro-circular behaviours, identifying the appropriate marketing tools is important (Gould, 2016). In the context of promoting the purchase of 'green' (Kong and Zhang, 2014) and remanufactured (Michaud and Llerena, 2010) products, the use of

tailored and specific marketing communications has had a positive influence on consumers' attitudes and intentions in the past. Moreover, Persuasive Communication has also been successfully implemented in marketing strategies to promote sustainable behaviours (e.g. O'Shaughnessy and O'Shaughnessy, 2003).

This study contributes to research on Circular Economy and behaviour change. It reinforces that Persuasive Communication can be effective intervention to change people's attitudes, perceptions and beliefs. The relatively short Persuasive Communication delivered in this study had an immediate impact, suggesting that a similar intervention could be implemented in business and consumer marketing programmes across the Retail Refrigeration Industry (and other technical sectors); if sustained, they would be likely to successfully influence and generate demand for *circular* products and services. The impact of Persuasive Communication on the intention of grocery retailers and RDC manufacturers to *purchase* and *produce remanufactured* RDCs is detailed in Chapter 5 and 6.

The study described in this chapter implemented a single intervention that included a combination of persuasive messages and visuals. Due to the format of the intervention however, this study was unable to ascertain which specific types of Persuasive Communication (e.g. persuasive messages with intrinsic or extrinsic value, persuasive messages with environmental, economic or social content, or persuasive images of products that were remanufactured etc.) were most effective in influencing pro-circular behaviours. This is investigated further in Chapters 5 and 6.

4.3.5. Limitations

This study did not use control groups when investigating the impact of the behavioural interventions. This was due to the difficultly securing participants of the same demographic to repeat the study. Participants in this study were recruited face-to-face at an industry meeting and finding another opportunity to repeat the study with participants of a similar demographic was challenging. Should there been an opportunity to do so, the design of the questionnaires would remain the same, however the intervention would have included non-persuasive content. This would have allowed for a comparative analysis of responses from both groups. Any differences found in the responses of the participants and the control group would have strengthened the assumption that the intervention was successful (Warren et al., 2016).

Despite the sample population in this study sharing some characteristics that are typical of grocery retailers (knowledge about RDCs technology), only a minority of the sample population had purchased RDCs in the past – which is the key behaviour investigated. Therefore, the positive impact of the intervention cannot be said to be representative of grocery retailers themselves – this is investigated in Chapter 5.

In addition, the inconsistency of questions could also be considered a limitation in survey-based studies (Choi and Pak, 2005). Questions in Part 1 of the survey, opened specifically by asking the participants their opinion, i.e. "In your opinion, (…)". Whereas, questions in Part 2 of the survey (which measured the same variables) excluded this wording. This could have guided respondents to evaluate their beliefs differently in both questionnaires, such as by giving them scope to answer from different perspectives e.g. from the grocery retailers' perspective and not their own. Therefore, keeping the terminology consistent across all questions would have provided assurance as to the consistency of measures. Nevertheless, at the introduction of the study, the lead researcher emphasised that participants should answer questions based on their personal beliefs, in an attempt to mitigate this limitation.

Summary

This study used a selection of constructs from the Pro-Circular Change Model to influence the pro-circular behaviour of individuals from the Food and Retail Refrigeration Industry towards the *purchase of remanufactured RDCs*. This study showed that Persuasive Communication had a significant influence on the individuals:

- **Behavioural Attitudes** – resulting in positive attitudes towards the *necessity* to *purchase of remanufactured RDCs,*
- **Product Perceptions –** resulting in positive perceptions towards the *appearance* of remanufactured RDCs,
- **Behavioural Beliefs –** resulting in positive beliefs towards the *purchase of remanufactured RDCs.*

Due to the success of this study, the influence of Persuasive Communication on the intention to *purchase* RDCs by the grocery retailers is investigated further in the next chapter.

5. Investigating and Influencing Grocery Retailers' Pro-Circular Behaviours: Purchasing Remanufactured RDCs

Introduction

Despite growing calls in the industrial sector for more resource-efficient practices (European Commission 2015a; Department for Environment, Food and Rural Affairs, 2015; HM Government, 2018), *circular* business models remain underdeveloped and their low adoption has been attributed to a lack of demand for *circular* products (Ritzén and Sandström, 2017; Mont et al., 2017). In the retail refrigeration sector there has been a lack of research on consumer behaviour (Watson, 2008), namely on the purchasing behaviours of grocery retailers towards remanufactured RDCs. This chapter presents a study which used selected constructs of the Pro-Circular Change Model (Figure 5) to investigate and influence grocery retailers' pro-circular behaviours – defined as *purchasing remanufactured RDCs.* This chapter will aim to establish:

- Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Past Behaviour and Behavioural Intentions currently held by the grocery retailers towards the *purchase of remanufactured RDCs*, as well as relationships between these behavioural determinants and Behavioural Intentions to purchase of remanufactured RDCs,
- Product Perceptions towards remanufactured RDCs currently held by the grocery retailers, and the relationship between Product Perceptions and Behavioural Intention to *purchase of remanufactured RDCs,*
- Pro-Circular Values currently held by the grocery retailers, and the relationship between Pro-Circular Values and Behavioural Intention to *purchase of remanufactured RDCs,*
- the influence of the Persuasive Communication on grocery retailers' Behavioural Intentions to *purchase remanufactured RDCs.*

Due to the efficacy of the intervention used in Chapter 4, its key components (namely the persuasive messages and graphics) were replicated to investigate whether these methods could have a similarly positive influence on the pro-circular behaviours of grocery retailers. The design of the intervention is detailed in section 5.1.1.4.

This chapter will begin by outlining the methodology, which provides a summary of the examined population sample and details the research procedures. It also provides a description of the investigated factors and an explanation of how they were embedded into the survey, before it moves to an analysis and discussion of the results.

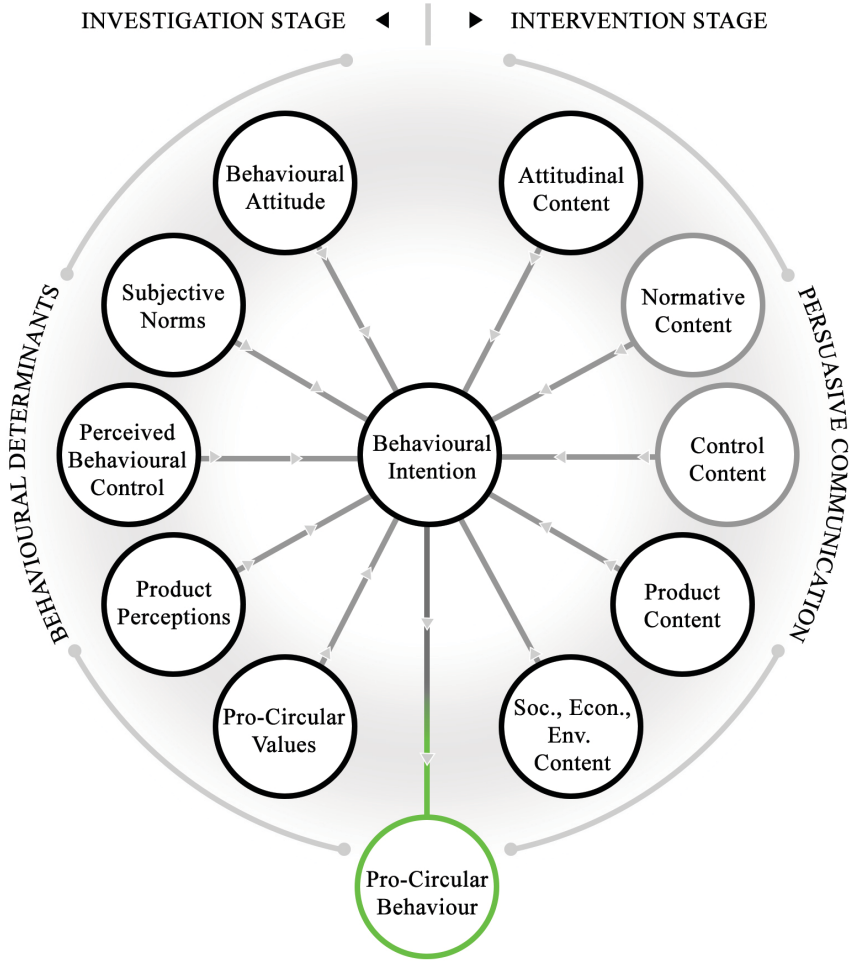


Figure 5. Pro-Circular Change Model - Selected Constructs.

5.1. Research methodology

All behavioural constructs included in the investigation stage of the Pro-Circular Change Model were explored in this study to provide a comprehensive overview of the beliefs, perceptions and values of grocery retailers. The data investigated in this study were collected from structured surveys. The surveys were designed to evaluate the Behavioural Attitudes, Subjective Norms (Injunctive and Descriptive), Perceived Behavioural Control and Behavioural Intentions (in line with the Theory of Planned Behaviour) of grocery retailers towards the purchase of remanufactured RDCs' (Chapter

5.1.4.1). Other determinants investigated in the survey were Product Perceptions towards the remanufactured RDCs (Chapter 5.1.4.2) and Pro-Circular Values (Chapter 5.1.4.3) towards socio-economic and environmental issues. In addition to these constructs, Past Behaviours were also investigated, as explained further in Chapter 5.1.4.1. The influence of the Persuasive Communication on the Behavioural Intentions of grocery retailers to purchase remanufactured RDCs was also evaluated (Chapter 5.1.4.4).

This study has been granted ethical approval by the School of Engineering Ethics Committee at London South Bank University. A letter of approval is attached in Appendix G.

5.1.1. Population sample and procedure

The population sample included individuals who purchase RDCs for UK grocery stores, defined in this study as the Retailers. The sample was carefully selected through collaborating with an industrial partner (the UK manufacturer of RDCs). To ensure consistency and accuracy within the sample, the selected participants had to comply with specific criteria:

- work for the UK retail grocery brands,
- have an influence on purchasing decisions, specifically in relation to buying RDCs,
- have a working relationship with manufacturers of RDCs.

Fifty-nine individuals who met these criteria were invited to take part in the study either electronically or in person. All participants were recruited by the lead researcher electronically and in person at industry meetings. Those participants who were invited electronically, were sent an e-mail which contained a recruitment message with Participant Information Sheet (Appendix C) and a link to an on-line survey. Participants who were invited in person, were briefed about the study and provided with a paper copy of the Participant Information Sheet and Survey (Appendix D). Data collection took place between April and September 2017.

As shown in Table 5.1.1, twenty participants from 15 retail grocery brands took part in the study, including key decision makers from leading supermarket chains (N=4) and convenience stores (N=9), as well as several independent shops (N=4). All participants were purchasers of RDCs who worked in executive roles. The majority of participants were based in upper management roles (N=11), followed

by a number of mid-level (N=7) and junior (N=2) managers. Ages ranged from 26 to 65 ($\bar{x}$=*46*) and the majority of participants were male (90%). To ensure confidentiality the participants' names, as well as their associated retail brands are not disclosed. However, an approximation of how many stores each participants' brand currently has in the UK is provided.

Table 5.1.1. Characteristics of population sample (N=20): Participant number, gender, age, position, retail category and number of stores (estimated UK market share).

Participant No.	Gender	Age	Position	Retail Category [a]	*Stores No.* [b]
R1	M	56-65	Upper Management	Convenience	*< 10*
R2	M	46-55	Upper Management	Convenience	*< 10*
R3	M	46-55	Middle Management	Convenience	*< 10*
R4	M	46-55	Upper Management	Convenience	*1000+*
R5	M	36-45	Middle Management	Convenience	*< 10*
R6	M	36-45	Middle Management	Convenience	*100-500*
R7	M	56-65	Upper Management	Convenience	*100-500*
R8	M	46-55	Upper Management	Supermarkets	*500-1000*
R9	M	46-55	Upper Management	Supermarkets	*500-1000*
R10	M	36-45	Middle Management	Convenience	*1000+*
R11	M	36-45	Junior Management	Supermarkets, Convenience	*500-1000*
R12	M	46-55	Upper Management	Hypermarkets, Supermarkets, Convenience	*500-1000*
R13	M	36-45	Upper Management	Convenience	*1000+*
R14	M	36-45	Upper Management	Hypermarkets, Supermarkets, Convenience	*500-1000*
R15	M	36-55	Upper Management	Convenience	*1000+*
R16	M	46-55	Upper Management	Convenience	*1000+*
R17	F	36-45	Junior Management	Convenience	*500-1000*

R18	M	36-45	Middle Management	Hypermarkets, Supermarkets, Convenience	*1000+*
R19	F	46-55	Middle Management	Convenience	*100-500*
R20	M	26-35	Middle Management	Convenience	*1000+*

[a] *Hypermarket* - a very large self-service store, that combines offerings of a supermarket (e.g. food, beverages and household items) and department store (e.g. clothes, hardware and electrical goods); normally located out of town.
Supermarket - a large self-service store, that sells food, beverages and household items; normally located in town.
Convenience store – a small self-service store, that sells a limited range of food, beverages and household items, typically accessible outside working hours; normally located in residential areas.
[b] This data has been sourced from the grocery retailers' websites. To ensure confidentiality, these websites have not been disclosed and data ranges have been provided (i.e. <10, 10-100, 100-500, 500-1000, 1000+).

5.1.2. Survey design

The stakeholders' pro-circular behaviour was investigated using the appropriate survey measures. As illustrated in Figure 5.1.2, the survey was divided in two parts. The first part of the survey was the investigation stage and it comprised of three questionnaires. The first questionnaire *(TPB Questionnaire)* used the constructs of the Theory of Planned Behaviour (Ajzen, 1991) to record the Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Behavioural Intentions towards the purchase of remanufactured RDCs; Past Behaviour was also recorded. The second questionnaire *(PP Questionnaire)* measured the Product Perceptions towards the *circular* product associated with the behaviour - the remanufactured RDCs. The third questionnaire *(P-CVs Questionnaire)* identified the level of Pro-Circular Values held by participants. The questionnaires were introduced at the beginning of the survey because it was important to ensure the participants responses were impartial to the effect of the Behaviour Change Intervention.

The second part of the survey contained the Behaviour Change Intervention. The Behavioural Change Intervention (the Persuasive Communication) was supplemented with questionnaire items, which aimed to record the extent to which the intervention had influenced the participants' Behavioural Intentions to *purchase remanufacture RDCs*.

The survey was developed with the support of three industry experts (two R&D refrigeration engineers and one RDC sales executive, all with over 15 years' experience of producing and selling RDCs and working closely with the Retailers). Their involvement helped to:

- indicate the salient beliefs of grocery retailers towards the purchasing remanufactured RDCs (i.e. consequences, norms and perceived abilities). This supported the development of the Theory of Planned Behaviour Questionnaire),
- identify the key perceptions that underlie the views of grocery retailers about remanufactured RDCs (i.e. product characteristics, performance, associated costs). This supported the development of the Product Perceptions Questionnaire,
- evaluate the intrinsic and extrinsic motivation that underlie the socio-economic and environmental values held by grocery retailers. This supported the development of the Pro-Circular Values Questionnaire and the Behaviour Change Intervention.

The questionnaires and the Behaviour Change Intervention are described further in the sections below.

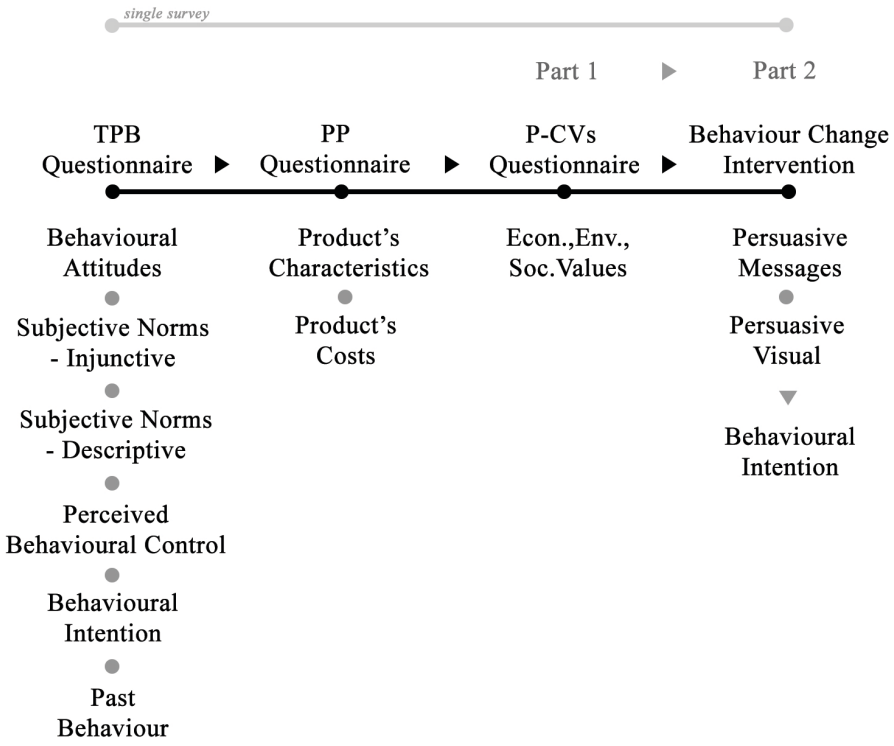


Figure 5.1.2. Retailers' survey - outline.

5.1.3. Pilot test

Following the development of the survey, the questionnaires and the Behaviour Change Intervention were piloted on seven individuals, including five random contributors (two professionals

and three academics, all working in engineering disciplines) and two industry experts (one R&D refrigeration engineer and an RDC manufacturing executive, who had expertise similar to the target population). Two individuals completed the questionnaire electronically and five on paper. Their comments and suggestions were used to simplify the instructions, improve the questions and shorten the survey. Following the revisions, the full study was conducted. The revised questionnaire items used in this study are presented below.

5.1.4. Questionnaire items

5.1.4.1. The Theory of Planned Behaviour

In this study, the Theory of Planned Behaviour questionnaire was designed per Ajzen's (2006) recommendations to identify Behavioural Attitudes, Subjective Norms (Descriptive and Injunctive), Perceived Behavioural Control and Behavioural Intention towards *purchasing remanufactured RDCs*. Past Behaviour, namely the experience of having performed a certain action, can be considered as an influential factor when it comes to performing a behaviour in the future (Conner and Armitage, 1998; Hagger et al., 2002). Therefore, in addition to evaluating the behavioural constructs proposed by the Theory of Planned Behaviour, Past Behaviour was also assessed to identify the Retailers' previous involvement in *purchasing remanufactured RDCs.* Investigating Past Behaviour allowed the study to ascertain whether it is a strong determinant of the participant's groups behavioural beliefs.

As per Ajzen's (2006) instructions, the Theory of Planned Behaviour questionnaire items were designed in accordance with Target, Action, Context, Time (TACT) elements. For example, a questionnaire item measuring the Behavioural Attitude towards purchasing remanufactured RDCs, would be drafted as "*Buying remanufactured RDCs for stores in the next 12 months, would be…".* In this item the TACT elements are as below:

- Target is "remanufactured RDCs" (the object to which the action is performed),
- Action is "buying", (the performing behaviour),
- Context is "stores" (where the action is performed), and
- Time is "in the next year" (if appropriate, the timescale for performed the action)

Similar TACT elements were applied to the remaining questions.

To enable participants to express their behavioural beliefs, a seven-point Likert (1932) scale was applied alongside each questionnaire item. The scale was labelled with a description of ratings, where a higher score indicated a more positive attitude towards the pro-circular behaviour. For example, the questionnaire item measuring the Behavioural Attitude towards purchasing remanufactured RDCs, could be scored as being either *extremely good (7), moderately good (6), slightly good (5), neither good or bad (4), slightly bad (3), moderately bad (2) or extremely bad (1).*

The questionnaire items for each of the behavioural determinants are summarised in Table 5.1.4.1 and are explained further in the sections below.

Table 5.1.4.1. The Theory of Planned Behaviour questionnaire items.

Measures	**Behavioural Determinant**	***Questions***	**Scale Items** [a]
Direct Measures	Behavioural Attitude	*I believe, that buying factory-remanufactured refrigerated display cabinets (RDCs) for stores is/would be.*	Good- Bad Convenient - Inconvenient Necessary - Unnecessary Profitable - Expensive
	Subjective Norms - Injunctive	*It is expected of me to buy factory-remanufactured RDCs for stores.*	Agree - Disagree
	Subjective Norms - Descriptive	*A lot of people like me buy factory-remanufactured RDCs for stores.*	Agree - Disagree
	Perceived Behavioural Control	*If I wanted to, I would be able to buy some factory-remanufactured RDCs for stores this year.*	Agree - Disagree
	Behavioural Intention	*I would like to buy some factory-remanufactured RDCs for stores this year.*	Agree - Disagree
	Past Behaviour	*I bought some factory-remanufacture RDCs for stores in the past year.*	Yes – No
Indirect Measures	Behavioural Belief	*For my business, buying factory-remanufactured RDCs is/would be.*	Good- Bad
	Outcome Evaluation	*Buying factory-remanufactured RDCs can/could benefit my business.*	Agree - Disagree
	Injunctive Normative Belief	*Manufacturers think, that I should buy factory-remanufactured RDCs for stores.*	Agree - Disagree
	Motivation to Comply	*When it comes to buying factory-remanufactured RDCs for stores, do you care what manufacturers think you should do?*	Agree - Disagree

Descriptive Normative Belief	*I believe, that other retailers in the UK buy factory-remanufactured RDCs for stores.*	Agree - Disagree
Identification with referent	*When it comes to buying factory-remanufactured cabinets I think it would be good to do as other retailers do.*	Agree - Disagree
Control Belief	*How often are you given an opportunity to buy factory-remanufactured RDCs?*	Often - Never
Influence of Control Belief	*I would buy factory-remanufactured RDCs, if I was given an opportunity to.*	Agree - Disagree

[a] All scales are 7-point Likert except measure of Past Behaviour, which has dichotomous *yes-no* answer.

a) Behavioural Attitudes

The Behavioural Attitudes were assessed using four direct measures (as in Chapter 4) and two indirect measures of behavioural beliefs. The four direct measures assessed the participants' beliefs about how *good – bad, necessary – unnecessary, easy – difficult,* and *profitable – expensive* they perceive the purchase of remanufactured RDCs is. The two indirect measures - the Behavioural Belief and Outcome Evaluation, were introduced to measure the participants' beliefs specifically about how they perceive the purchase of remanufactured RDCs impacting their business. Using the six measures above, a reliability analysis was conducted. Cronbach's alpha showed all the measures of Behavioural Attitudes had a strong reliability *(α=0.85).*

b) Injunctive Subjective Norm

Two kinds of Subjective Norms – injunctive and descriptive were assessed in this study. Injunctive Subjective Norms are associated with the participants' motivation to comply with *important others* when performing a behaviour (Ajzen, 2006). This includes the manufacturers that they purchase remanufactured RDCs from. The injunctive Subjective Norms were assessed using one direct and two indirect measures. The direct measure assessed the extent participants believed they were expected to purchase remanufacture RDCs. Whereas, the two indirect measures – the injunctive Normative Belief and Motivation to Comply, assessed what the participants perceive the manufacturers expect of them, in relation to performing a behaviour. Using the three measures above, a reliability analysis was

conducted. Cronbach's alpha showed all the measures of Injunctive Subjective Norms had a strong reliability *(α=0.70).*

c) Descriptive Subjective Norms

The descriptive Subjective Norms refer to the level at which participants identify themselves with a certain individual or group (Ajzen, 2006). The measures of descriptive Subjective Norms were assessed using one direct and two indirect statements. The direct measure assessed what the participants perceived to be the norm in relation to the purchase of remanufactured RDCs. The two indirect measures - the descriptive Normative Beliefs and Identification with the referent, assessed what the participants perceived to be the norm in relation to other retailers purchasing remanufactured RDC's. Using the three measures above, a reliability analysis was conducted. Cronbach's alpha showed all the measures of descriptive Subjective Norms had a strong reliability *(α=0.73).*

d) Perceived Behavioural Control

The Perceived Behavioural Control refers to the extent to which participants believe they are able to perform a behaviour (Ajzen, 2006). The Perceived Behavioural Control was assessed using one direct and two indirect measures of control beliefs. The direct measure assessed the participants' general beliefs about their ability to buy remanufactured RDCs. The two indirect measures - Control Belief and the Influence of Control Belief, were introduced to assess the participants' beliefs based on an opportunity to purchase remanufactured RDCs. Using the three measures above, a reliability analysis was conducted. Cronbach's alpha showed all the measures of descriptive Perceived Behavioural Control had a satisfactory reliability *(α=0.57;* Taber, 2017).

e) Behavioural Intention

The participants Behavioural Intention to purchase remanufactured RDCs was measured with a single direct statement indicating the participants' willingness to perform the behaviour. A reliability analysis was carried out on the Behavioural Intentions, including the current Behavioural Intention and seven other measures of Behavioural Intention that was influenced by the Behaviour Change

Intervention (as investigated in Chapter 5.1.4.4). Cronbach's alpha showed all measures of Behavioural Intention had a strong reliability *(α=0.91)*.

f) Past Behaviour

A direct measure of Past Behaviour was introduced to identify the participants' previous experience of performing the behaviour. As a result, the population sample was categorised into two groups – those that have purchased remanufactured RDCs in the recent past (Group A) and those that have not (Group B).

5.1.4.2. Product Perceptions

Product Perceptions, particularly regarding the price, aesthetics and performance (i.e. energy consumption) of RDCs are key factors that influence the purchasing decisions of grocery retailers (Monier et al., 2007). To effectively investigate the participants' perceptions towards remanufactured RDCs, a questionnaire was designed to include quantitative measures of Product Perceptions.

The Product Perceptions questionnaire contained eight questionnaire items that were designed to measure the participants' perceptions towards the characteristics of remanufactured RDCs, namely *quality, performance, appearance, longevity* and *warranty* (the same measures were used in Chapter 4). The questionnaire items also assessed the participants' perceptions about the costs associated with the purchase of remanufactured RDCs, such as the product *price*, *maintenance* services and *energy* usage. All questionnaire items included a 3-point Likert scale to allow the participants to provide their perceptions of remanufactured RDCs by comparing them to new RDCs. The Likert scale allowed the participants to rate remanufactured RDCs as *worse than new / more expensive than new (1), the same as new (2)* and *better than new / cheaper than new (3)*. A reliability analysis was carried out on the Product Perceptions including the above RDCs characteristics (*quality, appearance, performance, warranty and longevity; α=0.66*) and associated costs (*price, maintenance costs and energy costs α=0.54*). Cronbach's alpha showed both measures of Product Perceptions had an acceptable reliability. A summary of the questionnaire is presented in Table 5.1.4.2.

Table 5.1.4.2. Product Perceptions: questionnaire items.

Variable	*Questions*	Scale Items[a]
Quality Performance Appearance Longevity Warranty	*Based on the following characteristics, please compare factory-remanufactured against new RDCs.*	Worse than new The same as new Better than new
Price Maintenance Energy	*Based on the associated costs, please compare factory-remanufactured against new RDCs.*	More expensive than new The same as new Cheaper than new

[a] All scales are 3-point Likert scale

5.1.4.3. Pro-Circular Values

Pro-Circular Values are a *set of* intrinsic *"values that rate social, economic and environmental matters as important to oneself"* (Muranko et al., 2018). Intrinsic values can be measured effectively by evaluating people's responses to quantitative questions about the 'bigger-than-self' goals, rather than their individual goals (e.g. Schwartz, 2012). To effectively investigate the participants' perceptions towards remanufactured RDCs, a questionnaire was designed that included quantitative measures of Pro-Circular Values.

The Pro-Circular Values questionnaire grouped nine questionnaire items into three groups of values – *economic, environmental and social.* To enable participants to express their Pro-Circular Values, a five-point Likert (1932) scale was applied alongside each questionnaire item. The scale was labelled with a description of ratings, where a higher score indicated a more positive value towards the pro-circular behaviour. For example, the Likert scale allowed participants to rate their *environmental* value towards a '*clean and sustainable living environment*' as not *important (1), slightly important (2), moderately important (3), important* (4) or *very important* (5). A reliability analysis was carried out on the Pro-Circular Values including the above nine items. Cronbach's alpha showed the measures of Pro-Circular Values had a strong reliability ($\alpha=0.83$). The questionnaire items are summarised in Table 5.1.4.3.

Table 5.1.4.3. Pro-Circular Values: questionnaire items.

Values	Question [a]	
Economic Values	*How important are the following to you?*	National economic growth National resource security and resilience Prosperity and growth of local businesses in the UK
Social Values		More education & training opportunities the UK More skilled job opportunities in the UK Nation's health and well-being
Environmental Values		Clean and sustainable living environment Reduction of waste & air, water and soil pollution Reduction of carbon emissions

[a] All scales are 5-point Likert

5.1.4.4. Behaviour Change Intervention

The Behavioural Change Intervention was the Persuasive Communication delivered in the survey. The intervention included persuasive messages as in Chapter 4 and an illustration as shown in Table 5.1.4.4. Persuasive messages used in this study were designed to target the participants' attitudes and positively influence their Behavioural Intentions towards the purchase of remanufactured RDCs. As described in Chapter 4., the persuasive messages were structured as per Ajzen's (1992) recommendations. A typographical representation was also considered in the design of messages (as shown in Appendix D, Retailers' Survey, p. 16-18), as per the recommendations of Husband and Hellier (2011). The survey included six messages that were developed to comprise of both extrinsic and intrinsic values associated with the environmental, economic and social benefits of remanufacturing RDCs.

Visual persuasion was used to target the participants' perceptions about remanufactured RDCs and positively influence their Behavioural Intentions towards the purchase remanufactured RDCs. The survey included an illustration (as shown in Appendix D, Retailers' Survey, p. 19; similar was used in Chapter 4) of a RDC split into two – one half showing the condition of an end-of-life RDC and the other half showing the condition of a newly remanufactured RDC. The aim of the illustration was to influence the perception of participants to consider remanufactured RDCs to be like brand-new products.

Each item of Persuasive Communication was supplemented with a questionnaire item that recorded the influence the intervention had on the participants' Behavioural Intentions to purchase remanufactured RDCs. The questionnaire items used the a 7-point Likert scale – same as used to measure the Behavioural Intentions of participants before the intervention (in the Theory of Planned

Behaviour questionnaire; section 5.1.4.1.e). A reliability analysis was carried out on the Behavioural Intentions that included all seven measures of the influenced Behavioural Intention. Cronbach's alpha showed the measures reached a strong reliability ($\alpha=0.91$).

Table 5.1.4.4. Persuasive Communication items.

Type	Content
Environmental messages	*Message with intrinsic value;* emphasis on behaviour contributing to the reduction of waste form the disposal of RDCs *Message with extrinsic value;* emphasis on reduction of the retailers carbon footprint
Economic messages	*Message with intrinsic value;* emphasis on behaviour helping local manufacturing businesses grow *Message with extrinsic value;* emphasis on profits associated with the purchase of remanufactured RDCs
Social messages	*Message with intrinsic value;* emphasis on behaviour contributing to skilled jobs and training opportunities in the manufacturing sector *Message with extrinsic value;* emphasis on behaviour contributing to the retailers Corporate Social Responsibility[45] goals
Visual persuasion	*Illustration:* emphasis on the positive outcome of remanufacturing RDCs

5.2. Results

5.2.1. Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Past Behaviour and Behavioural Intentions towards the purchase of remanufactured RDCs

This section initially presents a descriptive statistical analysis of data derived from the Theory of Planned Behaviour questionnaire (Chapter 5.1.4.1). The analysis includes sample means (calculated to estimate the central tendency of data), standard deviations (calculated to indicate dispersion of data from the sample mean), standard errors (calculated to indicate the precision of the estimated means).

This section also presents an inferential statistical analysis of data derived from the Theory of Planned Behaviour questionnaire. The analysis includes an independent sample t-test (conducted to identify the differences between the behavioural beliefs held by participants who did and did not perform the behaviour in the past), a paired sample t-test (conducted to understand the impact the Behaviour Change Intervention had on the Behavioural Intentions), correlation analysis (conducted to reveal any

[45] Corporate Social Responsibility reports describe retailers' business approach that contributes to sustainable development by delivering social (as well as economic and environmental) benefits for all stakeholders.

significant relationships between the behavioural determinants) and multiple hierarchical regression analysis (conducted to identify which of the behavioural determinants had the strongest impact on the intention to purchase remanufactured RDCs).

5.2.1.1. Past Behaviours

As illustrated in Figure 5.2.1.1, Retailers who have purchased remanufactured RDCs in the past (Group A) accounted for 20% (N=4) of the population sample. The remaining 80% (N=16) had not purchased remanufactured RDCs in the recent past (Group B). Some differences were observed between the behavioural beliefs of both groups. These are described in the following sections.

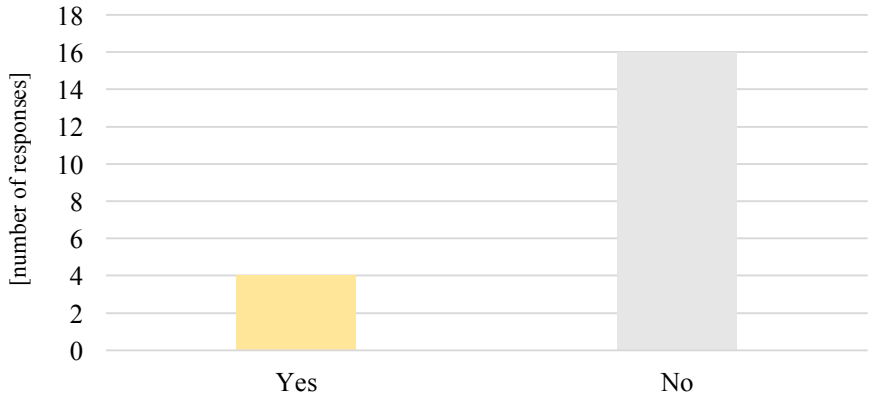


Figure 5.2.1.1. Frequency distribution of participants' Past Behaviours.

5.2.1.2. Behavioural Attitudes

The analysis of results in Table 5.2.1.2. shows that the overall Behavioural Attitudes of the Retailers towards the purchase of remanufactured RDCs were slightly positive and did not differ significantly between Retailers who have purchased remanufactured RDCs in the past (in **Group A**) and Retailers who had not purchased remanufactured RDCs in the past (in **Group B**).

Looking at the individual Behavioural Attitudes in turn, all Retailers recorded that they perceived the purchase of remanufactured RDCs to be slightly *good* and slightly *profitable.* All Retailers also recorded that the purchase of remanufactured RDCs was slightly *good* for their businesses *(Behavioural Belief)* and can *benefit their businesses (Outcome Evaluation).* More neutral responses were given towards the *necessity* and *convenience* of purchasing remanufactured RDCs. Five out of the six

investigated Behavioural Attitudes did not show significantly different results between Retailers in Group A and Retailers in Group B. The independent sample t-test showed the only statistically significant *[t(17)=1.83, p=0.043]* differences were between the Behavioural Attitudes towards the purchase of remanufactured RDCs being *necessary*, with the means of scores varying from strongly positive for Retailers in Group A to neutral for Retailers in Group B.

Table 5.2.1.2. Retailers' Behavioural Attitudes (BA): mean, standard error, standard deviation and t-test.

Behavioural Attitudes	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Good – Bad	All	20	**5.6**	*.34*	*1.54*	**.944**	18	*0.179*
	A	4	**6.2**	*.75*	*1.5*			
	B	16	**5.4**	*.39*	*1.55*			
Convenient – Inconvenient	All	19	**4.1**	*.42*	*1.82*	**.788**	17	*0.221*
	A	4	**4.7**	*.75*	*1.5*			
	B	15	**3.9**	*.49*	*1.9*			
Necessary – Unnecessary	All	19	**4.8**	*.36*	*1.58*	**1.829**	17	*0.043**
	A	4	**6.0**	*.71*	*1.41*			
	B	15	**4.5**	*.39*	*1.51*			
Profitable – Expensive	All	20	**5.2**	*.24*	*1.06*	NaN[b]	-	-
	A	4	**5.3**	*.30*	*1.18*			
	B	16	**5.0**	*.0*	*.0*			
Behavioural Belief	All	20	**5.2**	*.33*	*1.47*	**.446**	18	*0.331*
	A	4	**5.5**	*.65*	*1.29*			
	B	16	**5.1**	*.39*	*1.54*			
Outcome Evaluation	All	20	**5.5**	*.21*	*0.94*	**0.115**	18	*0.545*
	A	4	**5.5**	*.29*	*0.58*			
	B	16	**5.6**	*.26*	*1.03*			
BA Mean	All	20	**5.1**	*.24*	*1.08*	**.833**	18	*0.208*
	A	4	**5.5**	*.40*	*0.81*			
	B	16	**5.0**	*.28*	*1.13*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour
* Significance: $p<0.05$

5.2.1.3. Injunctive Subjective Norms

The analysis of results in Table 5.2.1.3 shows that the overall Injunctive Subjective Norms of all Retailers towards the purchase of remanufactured RDCs were negative. The difference between the responses of Retailers who have purchased remanufactured RDCs in the past (in Group A) and Retailers who had not purchased remanufactured RDCs in the past (in Group B) marginally missed the statistical significance threshold *[t(18)=1.52, p=0.073]*. Further inspection of the overall Injunctive Subjective Norms indicated that the majority of Retailers in Group A held neutral normative beliefs, whereas the majority of Retailers in Group B held negative normative beliefs.

Looking at the individual Injunctive Subjective Norms in turn, all Retailers recorded the belief that it was *not expected of them to buy remanufactured RDCs (Subjective Norm - Injunctive).* All Retailers recorded that they believe that *manufacturers of RDCs do not think that they should purchase remanufactured RDCs (Injunctive Normative Belief).* On the other hand, all Retailers recorded that they *do not care what manufacturers think they should do (Motivation to Comply).* All three investigated Injunctive Subjective Norms did not show significantly different results between Retailers in Group A and Retailers in Group B.

Table 5.2.1.3. Retailers' Injunctive Subjective Norms (ISN): mean, standard error, standard deviation and t-test.

Injunctive Subjective Norms	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Subjective Norms - Injunctive	All	20	**3.1**	*.45*	*2.02*	**1.293**	18	*0.106*
	A	4	**4.3**	*.48*	*0.96*			
	B	16	**2.8**	*.53*	*2.14*			
Injunctive Normative Belief	All	20	**3.0**	*.38*	*1.71*	**1.328**	18	*0.100*
	A	4	**4.0**	*.71*	*1.41*			
	B	16	**2.8**	*.43*	*1.73*			
Motivation to Comply	All	20	**3.2**	*.52*	*2.34*	**.955**	18	*0.176*
	A	4	**4.3**	*1.32*	*2.63*			
	B	16	**3.0**	*.57*	*2.28*			
ISN Mean	All	20	**3.1**	*.36*	*1.59*			

	A	4	**4.2**	*.80*	*1.60*	**1.523**	18	*0.073*
	B	16	**2.9**	*.38*	*1.53*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*

5.2.1.4. Descriptive Subjective Norms

The analysis of results in Table 5.2.1.4 shows that the overall Descriptive Subjective Norms of all Retailers towards the purchase of remanufactured RDCs were negative and differed significantly *[t(18)=1.99, p=0.031]* between Retailers who have purchased remanufactured RDCs in the past (in Group A) and Retailers in who had not purchased remanufactured RDCs in the past (in Group B). Further inspection of the Descriptive Subjective Norms indicated that the majority of Retailers who have purchased remanufactured RDCs in the past (in Group A) held positive normative beliefs, whereas the majority of Retailers who had not purchased remanufactured RDCs in the past (in Group B) held negative normative beliefs.

Looking at the individual Descriptive Subjective Norms in turn, all Retailers recorded they believed *a lot of people like them do not buy remanufactured RDCs (Subjective Norms - Descriptive).* All Retailers gave a neutral response when recorded their beliefs about whether *other retailers in the UK buy factory-remanufactured RDCs (Descriptive Normative Belief*). Conversely, all Retailers recorded that they disagree with the statement that it *would be good to do as other retailers do* in relation to purchasing remanufactured RDCs *(Identification with Referent*).

The scores across all three investigated Descriptive Subjective Norms were considerably higher among the Retailers in Group A than the Retailers in Group B. The independent sample t-test showed a statistically significant difference between the Descriptive Subjective Norms of Retailers in both groups *[t(18)=1.86, p<0.05, p=0.039]*. Retailers in Group A responded positively to the statement that *a lot of people like them buying remanufactured RDCs, whereas* Retailers in Group B responded negatively. The difference between Retailers in Group A and Group B relating to the normative belief that *other retailers in the UK buy factory-remanufactured RDCs* marginally missed the significance threshold *[t(18)=1.69, p=0.054; Descriptive Normative Belief]*. No significant differences were found for the normative belief regarding Retailers' Identification with Referent.

Table 5.2.1.4. Retailers' Descriptive Subjective Norms (DSN): mean, standard error, standard deviation and t-test.

Descriptive Subjective Norms	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Subjective Norm - Descriptive	All	20	**3.5**	*.41*	*1.84*	**1.864**	18	*0.039**
	A	4	**5.0**	*.41*	*.82*			
	B	16	**3.2**	*.47*	*1.87*			
Descriptive Normative Belief	All	20	**4.5**	*.39*	*1.73*	**1.691**	18	*0.054*
	A	4	**5.8**	*.48*	*.96*			
	B	16	**4.2**	*.44*	*1.75*			
Identification with Referent	All	20	**3.8**	*.43*	*1.91*	**1.121**	18	*0.139*
	A	4	**4.7**	*1.11*	*2.22*			
	B	16	**3.6**	*.46*	*1.82*			
DSN Mean	All	20	**3.9**	*.33*	*1.47*	**1.986**	18	*0.031**
	A	4	**5.2**	*.62*	*1.23*			
	B	16	**3.6**	*.35*	*1.40*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
* Significance: p<0.05

5.2.1.5. Perceived Behavioural Control

The analysis of results in Table 5.2.1.5 shows that the overall Perceived Behavioural Control of all Retailers towards the purchase of remanufactured RDCs was neutral. Further inspection of the overall Perceived Behavioural Control indicated that the majority of Retailers who have purchased remanufactured RDCs in the past (in Group A) held positive control beliefs, whereas the majority of Retailers who had not purchased remanufactured RDCs in the past (in Group B) held negative control beliefs. Nevertheless the difference between the overall control beliefs of both groups marginally missed the statistical significance threshold *[t(18)=1.51, p=0.074]*.

Looking at the Perceived Behavioural Controls in turn individually, all Retailers gave a neutral response to the statement, that *if they wanted to, they would be able to buy remanufactured RDCs (Perceived Behavioural Control - Direct).* All Retailers recorded they *very rarely are given an opportunity to buy remanufactured RDCs (Control Belief).* However, all Retailers responded positively

that if they *were given an opportunity to, they would buy remanufactured RDCs (Influence of Control Belief).*

The average scores across all three Perceived Behavioural Controls were consistently higher among the Retailers in Group A than in Group B. The biggest difference in the control beliefs of Retailers was the direct measure of Perceived Behavioural Control. The Retailers in Group A responded positively to the statement that *they would be able to buy remanufactured RDCs, if they wanted to*, whereas the Retailers in Group B provided neutral responses towards the same statement. Nevertheless the difference between the control beliefs of both groups marginally missed the statistical significance threshold *[t(18)=1.57, p=0.067; Perceived Behavioural Control Direct]*. No significant differences were found for the Control Belief and the Influence of Control Belief.

Table 5.2.1.5. Retailers' Perceived Behavioural Control (PCB): mean, standard error, standard deviation and t-test.

Perceived Behavioural Control	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Perceived Behavioural Control - Direct	All	20	**4.7**	*.43*	*1.92*	**1.569**	18	*0.067*
	A	4	**6.0**	*.58*	*1.15*			
	B	16	**4.4**	*.49*	*1.96*			
Control Belief	All	20	**2.6**	*.38*	*1.72*	**1.108**	18	*0.141*
	A	4	**3.5**	*.87*	*1.73*			
	B	16	**2.4**	*.43*	*1.71*			
Influence of Control Belief	All	20	**5.0**	*.30*	*1.33*	**.409**	18	*0.344*
	A	4	**5.2**	*.63*	*1.26*			
	B	16	**4.9**	*.35*	*1.39*			
PBC Mean	All	20	**4.1**	*.24*	*1.08*	**1.509**	18	*0.074*
	A	4	**4.9**	*.58*	*1.17*			
	B	16	**3.9**	*.30*	*1.19*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*

5.2.1.6. Behavioural Intention

The analysis of results in Table 5.2.1.6 shows that the overall Behavioural Intentions of Retailers towards the purchase of remanufactured RDCs were neutral. The Behavioural Intentions of Retailers who have purchased remanufactured RDCs in the past (in Group A) were positive, compared to those who had not purchased remanufactured RDCs in the past (in Group B) whose intentions were neutral. The statistical difference between the two groups of Retailers was highly significant *[t(18)=2.12, p=0.024]*.

Table 5.2.1.6. Retailers' Behavioural Intention (BI): mean, standard error, standard deviation and t-test.

Population	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
					t	df	*p*
All sample population	20	**4.5**	*.32*	*1.43*			
Bought in the past (Group A)	4	**5.7**	*.48*	*.96*	**2.123**	18	*0.024**
Did not buy in the past (Group B)	16	**4.2**	*.34*	*1.38*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
* Significance: p<0.05

5.2.1.7. Relationships between Behavioural Intention and Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Past Behaviour

The Retailers' Behavioural Intentions to purchase remanufactured RDCs were analysed with each of the behavioural determinants to identify any positive correlations. These are shown in Table 5.2.1.7. A highly positive and significant correlation was identified between the Behavioural Intention and both, the Injunctive Subjective Norms *(r=0.626, p=0.002)* and Perceived Behavioural Control *(r=0.695, p<0.001)*. A moderately positive and significant correlation was identified between the Behavioural Intentions and both, the Descriptive Subjective Norms *(r=0.412, p=0.036)* and Past Behaviour *(r=0.448, p=0.024)*. Lastly, a slightly positive correlation was identified between Behavioural Intention and Behavioural Attitudes, although it narrowly missed the statistical significance threshold *(r=0.360, p=0.060)*.

Table 5.2.1.7. Pearson's correlation: relationships between the Retailers' Behavioural Intention (BI) and the determinants of Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.), Perceived Behavioural Control (PCB) and Past Behaviour (PB).

Variable		BI	BA	SN inj.	SN desc.	PBC	PB
Behavioural Intention (BI)	r	—					
	p	—					
Behavioural Attitude (BA)	r	**0.360**	—				
	p	***0.060***	—				
Injunctive Subjective Norms (SN inj.)	r	**0.626***	0.659*	—			
	p	***0.002***	*< .001*	—			
Descriptive Subjective Norms (SN desc.)	r	**0.412***	0.329	0.703*	—		
	p	***0.036***	*0.078*	*< .001*	—		
Perceived Behavioural Control (PBC)	r	**0.695***	0.588*	0.708*	0.529*	—	
	p	***< .001***	*0.003*	*< .001*	*0.008*	—	
Past Behaviour (PB)	r	**0.448***	0.193	0.338	0.424*	0.335	—
	p	***0.024***	*0.208*	*0.073*	*0.031*	*0.074*	—

CI 95%
* Significance: p<0.05
Note: all tests one-tailed, for positive correlation.

5.2.1.8. Predicting the Behavioural Intention

A hierarchal linear regression analysis was performed to identify whether the behavioural determinants of Behavioural Attitudes, Subjective Norms (Injunctive and Descriptive), Perceived Behavioural Control and Past Behaviour *(independent variables)* were reliable predictors of Retailers' Behavioural Intention *(dependent variable)* to purchase remanufactured RDCs. The hierarchal linear regression was based on five models of data, as shown in Table 5.2.1.8. The models used the *enter* method. The above *independent variables* were individually entered in the model to identify how much variance was contributed to the Behavioural Intention by each of them.

The results in Model 1 show that the Perceived Behavioural Control is the main predictor of all Retailers Behavioural Intentions *(R^2=0.48, F=16.8, p=0.001)*, accounting for 48% of the variance in the Retailers intention to purchase remanufactured RDCs. The results show that the addition of

Behavioural Attitudes, Injunctive Subjective Norms, Descriptive Subjective Norms and Past Behaviour (in Model 5) increases the prediction of Behavioural Intention to 61% *(R^2=0.61, F=1.3, p=0.014)*.

Table 5.2.1.8. Multiple Linear Regression correlation: Predictors of Retailers' Behavioural Intention.

Model	R sq.	Adjusted R sq.	R sq. change	F change
1 [a]	.483 *p=0.001*	.454	.483	16.800 *p=0.001*
2 [b]	.519 *p=0.002*	.462	.036	1.269 *p=0.276*
3 [c]	.559 *p=0.004*	.477	.041	1.476 *p=0.242*
4 [d]	.574 *p=0.009*	.461	.015	.519 *p=0.482*
5 [e]	.606 *p=0.014*	.465	.032	1.129 *p=0.306*

Dependent variable: Behavioural Intention
[a] Predictors: (Constant), Perceived Behavioural Control.
[b] Predictors: (Constant), Perceived Behavioural Control, Injunctive Subjective Norms.
[c] Predictors: (Constant), Perceived Behavioural Control, Injunctive Subjective Norms, Past Behaviour.
[d] Predictors: (Constant), Perceived Behavioural Control, Injunctive Subjective Norms, Past Behaviour, Descriptive Subjective Norms.
[e] Predictors: (Constant), Perceived Behavioural Control, Injunctive Subjective Norms, Past Behaviour, Descriptive Subjective Norms, Behavioural Attitudes

5.2.2. Product Perceptions

This section presents an analysis of data derived from the Product Perception questionnaire (Chapter 5.1.4.2). It presents a descriptive statistical analysis of the Retailers' perceptions towards the characteristics and costs of remanufactured RDCs and it includes sample means, standard deviations and standard errors. In addition, a correlation analysis is conducted to investigate the relationship between Product Perceptions and other behavioural determinants, including Behavioural Attitudes, Injunctive and Descriptive Subjective Norms, Perceived Behavioural Control, Behavioural Intention and Past Behaviour.

5.2.2.1. Perceptions about characteristics of remanufactured RDCs

The analysis of results in Table 5.2.2.1. shows that the overall perceptions about remanufactured RDCs were negative and did not differ significantly between the Retailers who have purchased remanufactured RDCs in the past (in Group A) and the Retailers who had not purchased remanufactured RDCs in the past (in Group B). Looking at each of the Product Perceptions in turn, all Retailers

perceived the *quality, performance, appearance, longevity* and *warranty* of remanufactured RDCs to be less than brand-new RDCs. The only positive perception Product Perception was recorded for appearance, where the Retailers in Group A recorded that remanufactured RDCs look the same as brand-new RDCs *($\bar{x}$=2.0, SD=0.0, SE=0.0)*. An independent sample t-test was conducted on all the Product Perceptions above. It did not show any statistically significant differences among the Retailers in Group A and B.

Table 5.2.2.1. Retailers' Product Perceptions (PP) about Characteristics of Remanufactured RDCs: mean, standard error, standard deviation and t-test.

Variable	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Quality	All	16	**1.6**	*.15*	*.62*	**.454**	14	*0.672*
	A	4	**1.5**	*.29*	*.58*			
	B	12	**1.7**	*.19*	*.65*			
Performance	All	16	**1.4**	*.13*	*.51*	**.273**	14	*0.394*
	A	4	**1.5**	*.29*	*.58*			
	B	12	**1.4**	*.15*	*.52*			
Appearance	All	16	**1.7**	*.12*	*.45*	NaN [b]		
	A	4	**2.0**	*.0*	*.0*			
	B	12	**1.6**	*.15*	*.52*			
Longevity	All	16	**1.2**	*.11*	*.48*	**0**	14	*0.500*
	A	4	**1.3**	*.25*	*.50*			
	B	12	**1.3**	*.13*	*.45*			
Warranty	All	16	**1.3**	*.11*	*.48*	**.292**	14	*0.613*
	A	4	**1.3**	*.23*	*.50*			
	B	12	**1.3**	*.14*	*.49*			
PP Mean	All	16	**1.5**	*.08*	*.33*	**.365**	14	*0.361*
	A	4	**1.5**	*.17*	*.35*			
	B	12	**1.5**	*.10*	*.34*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

5.2.2.2. Perceptions about Costs associated with remanufactured RDCs

The analysis of results presented in Table 5.2.2.2. show that the overall perceptions about the costs associated with remanufactured RDCs were positive and did not differ significantly *[t(15)=0.857, p=0.202]* between Retailers who have purchased remanufactured RDCs in the past (in Group A) and the Retailers who had not purchased remanufactured RDCs in the past (in Group B).

Looking at each of the Product Perceptions in turn, all Retailers perceived the *price* of remanufactured RDCs to be better (lower) than the price of brand-new RDCs. However, Retailers perceived the costs associated with *energy* and *maintenance* of remanufactured RDCs to be worse (higher) than brand-new RDCs. An independent sample t-test was conducted on all the Product Perceptions above. It did not show any statistically significant differences among the Retailers in Group A and B.

Table 5.2.2.2. Retailers' Product Perceptions (PP) about Costs of Remanufactured RDCs: mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Price	All	17	**2.9**	*.12*	*.49*	NaN [b]		
	A	4	**3**	*.0*	*.0*			
	B	13	**2.8**	*.15*	*.55*			
Energy Cost	All	17	**1.6**	*.17*	*.70*	**0.326**	15	*0.374*
	A	4	**1.8**	*.25*	*.50*			
	B	13	**1.6**	*.21*	*.77*			
Maintenance Cost	All	17	**1.5**	*.15*	*.62*	**1.025**	15	*0.161*
	A	4	**1.8**	*.25*	*.50*			
	B	13	**1.4**	*.18*	*.65*			
PP Mean	All	20	**2.0**	*.11*	*.44*	**.857**	15	*0.202*
	A	4	**2.2**	*.17*	*.47*			
	B	13	**2**	*.13*	*.33*			

[a] Hypothesis: Group A > Group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

5.2.2.3. Relationship between the overall Product Perceptions and Behavioural Intention

The Retailers' Product Perceptions[46] of remanufactured RDCs were analysed with each of the behavioural determinants to identify any positive correlations. The results are shown in Table 5.2.2.3. No significant correlations were identified between the Product Perceptions and Behavioural Intentions *(r=-0.078, p=0.617)*. However, a positive and statistically significant correlation was found between the Product Perceptions and Behavioural Attitudes *(r=0.455, p=0.033)*.

Table 5.2.2.3. Pearson's correlation: Relationships between the Retailers' overall Product Perception (PP) and Behavioural Determinants of Behavioural Intention (BI), Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.) and Past Behaviour (PB).

Variables		BI	BA	SN inj.	SN desc.	PBC	PB
Product Perceptions	r	**-0.078**	0.455*	0.156	0.024	0.093	0.093
	p	***0.617***	*0.033*	*0.275*	*0.463*	*0.361*	*0.361*

CI 95%
* Significance: p<0.05
Note: all tests one-tailed, for positive correlation.

5.2.3. Pro-Circular Values

This section presents an analysis of data derived from the Pro-Circular Values questionnaire (Chapter 5.1.4.3). It presents a descriptive statistical analysis of the participants' values towards socio-economic and environmental goals. It includes sample means, standard deviations and standard errors. In addition, a correlation analysis is conducted to investigate the relationship between Pro-Circular Values and the other behavioural determinants, including Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Behavioural Intention and Past Behaviour.

5.2.3.1. Pro-Circular Values of the Retailers

The analysis of results in Table 5.2.3.1. shows that the overall Pro-Circular Values were positive and did not differ significantly *[t(17)=0.658, p=0.260]* between Retailers the Retailers who have purchased remanufactured RDCs in the past (in Group A) and the Retailers who had not purchased remanufactured RDCs in the past (in Group B).

[46] These included the Retailers overall perceptions of costs and characteristics of remanufactured RDCs.

Looking at each of the Pro-Circular Values in turn, all Retailers recorded the *economic, environmental* and *social* goals as important. An independent sample t-test was conducted on all the Pro-Circular Values above. It did not show any statistically significant differences among the Retailers in Group A and B.

Table 5.2.3.1. Retailers' Pro-Circular Values (P-CVs): mean, standard error, standard deviation and t-test.

Variable	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Economic	All	19	**4.1**	*.16*	*.68*	**1.522**	17	*0.146*
	A	4	**4.6**	*.32*	*.63*			
	B	15	**4.0**	*.17*	*.66*			
Environmental	All	19	**4.4**	*.13*	*.56*	**0.787**	17	*0.442*
	A	4	**4.6**	*.25*	*.50*			
	B	15	**4.3**	*.15*	*.58*			
Social	All	19	**4.3**	*.15*	*.67*	**0.717**	17	*0.483*
	A	4	**4.1**	*.41*	*.83*			
	B	15	**4.4**	*.16*	*.64*			
P-CVs Mean	All	19	**4.3**	*.11*	*.48*	**.658**	17	*0.260*
	A	4	**4.4**	*.28*	*.57*			
	B	15	**4.2**	*.12*	*.46*			

[a] Hypothesis: Group A ≠ Group B.
Note: Student t-test

5.2.3.2. Relationship between Pro-Circular Values and Behavioural Intention

The Retailers' Pro-Circular Values[47] were analysed with each of the behavioural determinants to identify any positive relationships. The results are shown in Table 5.2.3.2. No significant relationships were identified between the Pro-Circular Values and Behavioural Intention *(r=-0.108, p>0.05, p=0.330)*. However, a positive and statistically significant correlation was found between the Pro-Circular Values and the Descriptive Subjective Norms *(r=0.465, p=0.022)*.

[47] These included the Retailers social, economic and environment of values.

Table 5.2.3.2. Pearson's correlation: Relationships between the Retailers' overall Pro-Circular Values (P-CV) and Behavioural Determinants of Behavioural Intention (BI), Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.) and Past Behaviour (PB).

Variables		BI	BA	SN inj.	SN desc.	PBC	PB
Pro-Circular Values	r	**0.108**	0.323	0.357	0.465*	0.155	0.157
	p	***0.330***	*0.089*	*0.067*	*0.022*	*0.263*	*0.260*

CI 95%
* Significance: p<0.05
Note: all tests one-tailed, for positive correlation.

5.2.4. Behaviour Change Intervention

This section presents an analysis of data derived from the Behaviour Change Intervention questionnaire (Chapter 5.1.4.4). It presents a descriptive statistical analysis of the impact the intervention had on the Retailers' Behavioural Intentions to purchase remanufactured RDCs. It includes sample means, standard deviations, standard errors. The analysis includes a paired sample t-test, which was used to identify whether the Behavioural Intentions of the Retailers after the Behaviour Change Interventions differed significantly from their Behavioural Intentions prior to the intervention.

5.2.4.1. Influence of the Behaviour Change Intervention on Behavioural Intention

The results presented in Table 5.2.4.1.a shows that all Behavioural Intentions influenced by the Behaviour Change Intervention of all Retailers were positive. The results of the independent sample t-test show there were no statistically significant differences between the overall Behavioural Intentions influenced by the intervention between the Retailers in Group A and the Retailers in Group B.

Looking at the individual items, the biggest shift in Behavioural Intention was recorded against the intervention that included an *economic message* with *extrinsic* value. The smallest shift in Behavioural Intentions was recorded against the intervention that included a *social* message with *intrinsic* value. The descriptive statistics indicate that the interventions that included an *economic* message with *extrinsic* value *(Group A: $\bar{x}$=6.5; Group B: $\bar{x}$=5.7)*, and a *social* message with *intrinsic* value *(Group A: $\bar{x}$=5.8; Group B= $\bar{x}$=4.9)* had a stronger impact on the Retailers in Group A than Group B. Nevertheless, the

results of the independent sample t-test show that the differences between the impact of these two interventions on both groups of Retailers marginally missed the statistical significance threshold.

However, a statistically significant difference was recorded for the Behavioural Intentions influenced by the intervention that contained *persuasive illustration [t(7)=2.11, p=0.036]*. After being exposed to the *persuasive illustration*, the Retailers in Group A recorded positive intentions to purchase remanufactured RDCs, whereas and the Retailers in Group B recorded neutral intentions.

Table 5.2.4.1.a. Retailers' Behavioural Intentions (BI) influenced by the Behaviour Change Intervention (BCI): mean, standard error, standard deviation and t-test.

Intervention Type	group	N	$\bar{x}$	*SE*	SD	t-test [a]		
						t[b]	df	*p*
Economic Message								
Extrinsic value	All	19	**5.9**	*.20*	*.88*			
	A	4	**6.5**	*.29*	*.58*	**1.626**	17	*0.061*
	B	15	**5.7**	*.23*	*.88*			
Intrinsic value	All	19	**5.4**	*.23*	*1.01*			
	A	4	**5.5**	*.29*	*.58*	**0.285**	17	*0.398*
	B	15	**5.3**	*.29*	*1.11*			
Environmental Message								
Extrinsic value	All	19	**5.6**	*.17*	*.76*			
	A	4	**6**	*0*	*0*	NaN [b]		
	B	15	**5.5**	*.22*	*.83*			
Intrinsic value	All	19	**5.5**	*.23*	*1.02*			
	A	4	**6**	*.41*	*.82*	**1.173**	17	*0.128*
	B	15	**5.3**	*.27*	*1.05*			
Social Message								
Extrinsic value	All	19	**5.4**	*.20*	*.76*			
	A	4	**5.8**	*.25*	*.50*	**0.957**	17	*0.176*
	B	15	**5.3**	*.25*	*.96*			
Intrinsic value	All	19	**5.1**	*.21*	*.94*			
	A	4	**5.8**	*.25*	*.50*	**1.618**	17	*0.062*
	B	15	**4.9**	*.25*	*.96*			
Illustration								
	All	9	**5.2**	*0.52*	*1.56*			
	A	4	**6.2**	*.48*	*.96*	**2.111**	7	*0.036**
	B	5	**4.4**	*.68*	*1.52*			

[a] Hypothesis: Group A > Group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

The results of paired sample t-test in Table 5.2.4.1.b show the impact the Behaviour Change Intervention had on the Behavioural Intentions of all Retailers. All forms of Persuasive Communication that included *economic, environmental* and *social* messages with *extrinsic* values, had a positive and statistically significant influence on the Retailers Behavioural Intentions. The *economic, environmental* and *social* messages that included *intrinsic* values had a similarly positive and statistically significant impact. In addition, the Persuasive Illustration used showed to have a positive and statistically significant impact on all Retailers' Behavioural Intentions to purchase remanufactured RDCs.

Table 5.2.4.1.b. Paired sample t-test on Retailers' Behavioural Intentions (BI) before and after the Behaviour Change Intervention (BCI).

	t	df	*p*
BI before BCI - BI after intrinsic economic PC	**2.509**	18	*0.011**
BI before BCI - BI after intrinsic environmental PC	**3.508**	18	*0.001**
BI before BCI - BI after intrinsic social PC	**1.874**	18	*0.039**
BI before BCI - BI after extrinsic economic PC	**6.245**	18	*<.001**
BI before BCI - BI after extrinsic environmental PC	**4.595**	18	*<.001**
BI before BCI - BI after extrinsic social PC	**3.281**	18	*0.002**
BI before BCI - BI after graphic persuasion	**2.309**	8	*0.025**

Hypothesis: BI before BCI < BI after BCI. *Note: Student t-test*
* Significance: p<0.05*

5.3. Discussion

5.3.1. Retailers' Behavioural Attitudes towards the purchase of remanufactured RDCs

Overall the Behavioural Attitudes of the Retailers towards the purchase remanufactured RDCs analysed in Chapter 5.2.1.2 were slightly positive. This was demonstrated by their responses to the questionnaire items falling on the positive side of the scale ($\bar{x}$ *= 5.1 on the scale of 7*). The majority of these responses fell close the mean, resulting in a low standard deviation (*SD=1.08*). The small variance in scores suggests that all Retailers, regardless of their store sizes, business culture and expenditure levels, shared similarly positive Behavioural Attitudes towards the purchase of remanufactured RDCs. Furthermore, the small standard error of the mean *(SE=0.24*) suggests that these positive Behavioural

Attitudes could potentially be representative of a larger population of Retailers. However, as the test was conducted on small sample this cannot be said with certainty. To increase the confidence of these findings, further testing on a larger sample would be required.

Despite all Retailers in the study holding positive Behavioural Attitudes, only 20% had previously purchased a remanufactured RDC. For the 80% who had not previously purchased a remanufactured RDC, there may have been other more influential behavioural determinants that superseded their positive Behavioural Attitude. Moreover, the positive Behavioural Attitudes scored in this study, may not be high enough to offset any residing negative factors, that prevent the uptake of the pro-circular behaviour. This suggests that the threshold for what is considered a positive Behavioural Attitude score for particular Retailers may need to be higher or that other factors have a stronger power in driving the purchasing behaviours of Retailers.

The overall Behavioural Attitudes of the Retailers who previously purchased remanufactured RDCs did not significantly differ *[t(18)=0.83; p=0.208]* from those Retailers who had. However, Retailers who had purchased RDCs held a significantly more positive *[t(17)=1.83, p=0.043]* behavioural belief towards the *necessity* of purchasing these products. What constitutes a necessity can vary hugely depending on each Retailers' circumstances. For example, a Retailer may have pro-circular behaviours embedded into their procurement practices that are driven by a strong understanding of the socio-economic and environmental benefits of purchasing remanufactured RDCs, as suggested by Monier et al. (2007). On the other hand, the Retailers who are typically driven the price of RDCs (Centre for Remanufacturing and Reuse, 2009), having purchased remanufactured RDCs in the past may have an understanding of the financial advantage remanufacturing brings, therefore perceiving it an essential part of their business strategy. Equally, some Retailers may prioritise energy efficiency when considering the purchase of retail refrigeration equipment (Monier et al., 2007; Centre for Remanufacturing and Reuse, 2009), which due to typically having adverse perceptions towards the energy-performance of remanufactured products (All Party Parliamentary Sustainable Resource Group, 2014), can result in new technologies in brand-new RDCs being purchased instead of end-of-life RDCs being remanufactured. At an executive level, other more strategic objectives of the retail grocery store may be perceived as more necessary than the purchase of remanufactured RDCs, such as branding,

product development and sales – all of which are viewed as more conventional ways of gaining a competitive advantage.

5.3.2. Retailers' beliefs about the norms associated with the purchase of remanufactured RDCs

a) Injunctive Subjective Norms

Chapter 5.2.1.3 explored the Injunctive and the Descriptive Subjective Norms of Retailers' towards the purchase of remanufactured RDCs. The Injunctive Subjective Norms were investigated to understand the willingness of Retailers to comply with the Manufacturers' expectations, namely whether Retailers should/should not purchase remanufactured RDCs instead of brand-new RDCs.

Overall the Subjective Norms of Retailers towards the purchase of remanufactured RDCs were negative for both the Injunctive *($\bar{x}$=3.1)* and Descriptive ($\bar{x}$=*3.9*) Subjective Norms. The responses fell slightly far from the mean, resulting in a slightly large standard deviation (for I*njunctive beliefs, SD=1.59; Descriptive beliefs, SD=1.47*). Despite a slightly large variance, the Retailers in this study shared a consensus about what is perceived as the norm when considering the purchase of remanufactured RDCs. Furthermore, the moderately small standard error of mean *(Injunctive beliefs, SE=0.36; Descriptive beliefs, SE=0.33*) suggests that these negative Subjective Norms could potentially be representative of a larger population of Retailers. To increase the confidence of these findings, further testing on a larger sample would be required.

The Retailers believed that it is not expected of them to buy remanufactured RDCs. The Retailers also reported that manufacturers of RDCs do not think that they (the Retailers) should purchase remanufactured RDCs. This could imply that Retailers' believe that Manufacturers are prioritising the sales of new RDCs at the expense of remanufacturing. The statement also suggests that Retailers may believe that Manufactures are hesitant about accepting potential requests to remanufacture due to them considering the remanufacturing process as complex, for example (All Party Parliamentary Sustainable Resource Group, 2014). The Retailers also reported that they do not care what Manufacturers think they (the Retailers) should do, which suggests that Manufacturers do not have a strong influence on the purchasing decisions of their customers, which may be a result of ineffective marketing strategies within the retail refrigeration market. The results of the independent-sample t-test showed no significant

differences in the injunctive normative beliefs between the Retailers who had and had not purchased remanufactured RDCs in the past. The lack of significant differences could be attributed to the small sample size in this study. A larger sample size would be required to reveal if past behaviour is a core determinant of injunctive normative beliefs.

b) Descriptive Subjective Norms

The Descriptive Subjective Norms of Retailers were also investigated to understand the extent to which they identify themselves with other Retailers within the industry (in Chapter 5.2.1.4). Retailers reported they believe that *a lot of people like them do not buy remanufactured RDCs.* This perceived norm goes some way to explaining that the Retail Refrigeration Industry lacks pro-circular behaviours. However, when considering whether *other retailers in the UK buy factory-remanufactured RDCs for their stores,* Retailers provided slightly mixed, though overall neutral responses ($\bar{x}$*=4.5, SD=1.73, SE=0.39*). This perception shows that some Retailers are not mindful of their competitor's practices, which can prevent them from benchmarking and potentially adopting similar procurement practices in the future. This perception is reinforced by most Retailers in the study, disagreeing with the statement that *it is good to do as other retailers do* in relation to purchasing remanufactured RDCs*,* which suggests the Retailers in the Food retail industry are unlikely to follow perceived industry norms. However, with the perceived deficiency in the engagement in purchase of remanufactured equipment by the UK grocery retailers, this paints a potentially positive context for the introduction of pro-circular behaviours, with Retailers in the industry being open to atypical choices.

The results of the t-test revealed that Retailers who had purchased remanufactured RDCs in the past held significantly positive descriptive normative beliefs, whereas those Retailers who had not, held significantly negative descriptive normative beliefs towards the purchase of remanufactured RDCs *[t(18)=1.99, p=0.031]*. When broken down into individual descriptive normative beliefs, one showed statistically significant differences *[t(18)=1.86, p=0.039]* between the Retailers' groups; those Retailers who purchased remanufactured RDCs in the past scored the statement that *people like them buy remanufactured RDCs* considerably higher than those who Retailers who had not. This suggests that both groups of Retailers believe that their current behaviours reflect the industry norms, and reinforces the consideration of past behaviour being a core determinant of descriptive normative beliefs.

5.3.3. Retailers' perceived ability to purchase remanufactured RDCs

Overall the Perceived Behavioural Control of Retailers towards the purchase of remanufactured analysed in Chapter 5.2.1.5 was neutral *($\bar{x}$=4.1)*. The majority of these responses fell close to the mean resulting in a low standard deviation (*SD=1.08*) and this small variance in scores suggests that the majority all Retailers perceived that the opportunity to purchase remanufactures RDCs was not feasible. This could be a result of RDC manufacturers not offering their remanufacturing services to Retailers, instead choosing to focus on the sales of brand-new RDCs. Furthermore, the small standard error of the mean *(SE=0.24*) suggests that these neutral Behavioural Controls could potentially be representative of a larger population of Retailers. Again, as the test was conducted on small sample this cannot be said with certainty.

All Retailers' in the study strongly agreed that they are very rarely given an opportunity to buy remanufactured RDCs. However, they also agreed that if given an opportunity, they would buy remanufactured RDCs. This suggests that there is a potential market for the sales of remanufactured RDC. Should manufacturers actively engage with Retailers there is a strong possibility that they would generate demand, by targeting their control beliefs.

The Retailers who had not purchased remanufactured RDCs in the past held slightly more negative control beliefs, than those Retailers who had, which indicates that having purchased remanufactured RDCs in the past, the Retailers were confident that they can do again. This could be due to them being familiar with the process of buying remanufactured RDCs and aware of RDC manufacturers who offer remanufacturing. However, the results of t-tests for both groups of Retailers marginally missed the statistical significance threshold. The lack of significant differences in the t-test could be attributed to the small sample size in this study. A larger sample size would be required to reveal if past behaviour is a core determinant of control beliefs.

5.3.4. Behavioural Intention: Retailers' intentions to purchase remanufactured RDCs

Overall the Behavioural Intentions of Retailers towards the purchase of remanufactured RDCs analysed in Chapter 5.2.1.6 were neutral *($\bar{x}$=4.5)*. The majority of these responses fell close to the mean resulting in a relatively low standard deviation (*SD=1.43*). The small variance in scores suggests that

the majority of Retailers lacked positive intentions to purchase remanufactured RDCs. These neutral Behavioural Intentions could potentially be representative of a larger population of Retailers *(SE=0.32*). However, to increase the confidence of these findings, further testing on a larger sample would be required.

The Retailers who had purchased remanufactured RDCs in the past held significantly more positive Behavioural Intentions *(t(18)=2.12, p=0.024)*, whereas those Retailers who had not, were significantly lacking the intention to purchase remanufactured RDCs. This suggests that Retailers who purchase remanufactured RDCs are generally satisfied with the product and/or the purchasing process. This level of approval can instigate a sense of product loyalty which in turn can lead to Retailers forming a positive Behavioural Intention to the future purchase of remanufactured RDCs.

The correlation between the Retailers' Behavioural Attitudes and Behavioural Intentions was slightly positive, however it marginally missed the significance level *(r=0.36, p=0.063)*. This result requires further testing on a larger population sample to validate the strength of this correlation. Positive and statistically significant correlations were found between the Retailers' Behavioural Intentions and the behavioural determinants of their Subjective Norms - both, Injunctive *(r=0.626, p=0.002)* and Descriptive *(r=0.412, p=0.036)*, Perceived Behavioural Control *(r=0.695, p<0.001)* and Past Behaviour *(r=0.448, p=0.024)*. A multiple-linear regression analysis found these behavioural determinants accounted for 61% of the total variance in the Behavioural Intentions of Retailers. Approximately 48% of this variance in the Retailers Behavioural Intentions was influenced by the Perceived Behavioural Control *(R^2=0.48, F=16.8, p=0.001),* making it the most reliable and strongest predictor of Behavioural Intention, as already supported in the correlation analysis detailed above. In comparison, only 7% of variance in the Retailers Behavioural Intentions was influenced by Behavioural Attitudes and both, Injunctive and Descriptive Subjective Norms. The final behavioural determinant in this study, Past Behaviour accounted for only 5% of variance. The outstanding 40% of variance in the Retailers' Behavioural Intentions was influenced by factors that were not considered in this study. These results suggest that targeting the control beliefs of Retailers (in the form of marketing or business-business communications) could be the most effective way of positively impacting their intentions to purchase remanufactured RDCs. In addition, this study was limited to analysing only four cases of data

per predictor. A regression analysis requires at least ten cases of data for each predictor in a model (Field, 2009). A small sample can lead to the regression analysis embellishing the predictors' true influence (Field, 2009) Nevertheless, a multicollinearity analysis of the data used in the regression suggests that using four cases provided an appropriate amount of data to ensure the results were significant.

Studies that use the Theory of Planned Behaviour in investigating sustainable purchasing behaviours, and specifically the purchase remanufactured products often focus on B2C consumers. In this context research shows that the role of Perceived Behavioural Control in influencing behaviour varies widely. For example, a study by Burucuoglu and Erdogan (2019) found the Perceived Behavioural Control to have had no influence on the Behavioural Intentions of students in Turkey to purchase remanufactured products. Instead, their Behavioural Attitudes and Subjective Norms were found to be the strongest influencers of their Behavioural Intentions (Burucuoglu and Erdogan; 2019). Similar results were found by Khor and Hazen (2017) on a study which investigated the intentions of consumers in Malaysia to purchase remanufactured products. The low impact of the Perceived Behavioural Control in these studies could be attributed to the participants lacking knowledge and familiarity of remanufactured products (Khor and Hanzen, 2017). Interestingly, other studies on consumer intentions to purchase remanufactured products in China by Wang et al., (2013) and Wang et al. (2018) provide contrasting results, suggesting that the Perceived Behavioural Control (together with Attitudes), is the key behavioural influencer. These opposing results suggest the geographical locations of participants can have an impact on their purchasing behaviours. For example, with China's (Zhu et al., 2018) Circular Economy agenda rapidly expanding, it is possible that Chinese consumers are being actively encouraged to engage in more sustainable practices, meaning that are more likely to be aware of the opportunity to purchase remanufactured products.

While there is a lack of studies that use the Theory of Planned Behaviour to specifically investigate the purchase of remanufactured equipment by businesses (B2B consumers), some studies suggest that the Perceived Behavioural Control is a key motivator of other, yet similar, sustainable behaviours. For example, a study by Yang et al. (2019) that investigated sustainable procurement practices in the construction industry found the Perceived Behavioural Control to be highly influential on intentions of

real estate developers to purchase 'green' building materials in China. In another study by Corral (2003) the willingness of SMEs to innovate in 'clean' technologies in Mexico was investigated. The findings similarly found the Perceived Behavioural Control to be a strong influencing factor, as did Zhang et al. (2013) in a study on the willingness of businesses to adopt clean production technologies in China.

In general, poor control beliefs are seen to be the primary barrier to industries moving to a Circular Economy and adopting more resource-efficient practices (Singh et al., 2018). The results in this chapter align with current literature on sustainable behaviours of businesses, and contribute to the findings that businesses perceptions towards their ability to perform certain sustainable behaviours are strong predictors of them adopting certain sustainable behaviours.

5.3.5. Product Perceptions: Retailers' perceptions about remanufactured RDCs

The Retailers overall perceptions about the **characteristics** of remanufactured RDCs, namely the *quality, performance, appearance, longevity* and *warranty* were negative (Chapter 5.2.2.1). This was demonstrated by the small mean of responses *($\bar{x}$=1.5 with values below 2 being negative)*. A small standard deviation (*SD=0.33*) confirmed that most Retailers shared the same negative perceptions. Moreover, a small standard error *(SE=0.08*) indicated that these results could potentially be representative of a larger population of Retailers. These results support the assertions in literature that consumers perceive the characteristics of remanufactured products as inferior to brand-new products (APPSRG and APPMG, 2014), despite remanufactured products being sold as 'good-as-new'. To change these perceptions of Retailers, a tailored marketing campaign emphasising the 'good-as-new' characteristics of remanufactured RDCs could be an effective tool.

The Retailers overall perceptions about the **costs** associated with remanufactured RDCs, namely products' *price, energy* and *maintenance* costs, were positive (Chapter 5.2.2.2). This was demonstrated by the large mean of responses *($\bar{x}$=2.0 with values above 2 considered positive)*. However, the large standard deviation (*SD=0.44)* confirmed there was a large variance in the responses of Retailers, this was a result of a range of scores being given towards the individual product perceptions. For example, perceptions towards the *energy* (*$\bar{x}$=1.6, SD=0.70, SE=0.17)* and *maintenance costs ($\bar{x}$=1.5, SD=0.62, SE=0.15)* of remanufactured RDCs were slightly negative. This contrasted with their perceptions about the *price ($\bar{x}$=2.9, SD=0.49, SE=0.12),* which were strongly positive, which reflects the industry norm

of remanufactured RDC's being priced substantially lower than brand-new RDCs (Centre for Remanufacturing and Reuse, 2009). Nevertheless, the overall positive perception towards the costs associated with remanufactured RDCs needs to be viewed with caution. It is possible that individual Retailers may prioritise *energy* and *maintenance* costs over the purchase *price* when considering the purchase of remanufactured RDCs. This may be due to the *energy* and *maintenance* costs of running an RDC, typically being the biggest financial outlay. A combination of these costs over the lifespan of an RDC can be significantly higher than the initial purchase price[48], which can result in Retailer preferring the purchase of brand-new RDCs. The negative perceptions about *energy* costs may stem from the Retailers' beliefs that remanufactured RDCs are reused and contain old, energy-inefficient technologies. However, the remanufacturing process involves an RDCs individual components being technically upgraded, which commonly results in them mirroring the energy efficiency of brand-new RDCs. The negative perceptions about *maintenance* costs may stem from the Retailers beliefs that remanufactured RDCs are old and therefore prone to deteriorating faster than new RDCs. However, the remanufacturing of an RDC typically involves the individual components being reviewed and either partially of fully replaced, which commonly results in them mirroring the longevity of brand-new RDCs (Walsh, 2009). A lack of knowledge about the remanufacturing process among Retailers can lead to the perceptions of the *characteristics* and *costs* of remanufactured RDCs being inferior. To change these perceptions among Retailers, a tailored marketing campaign emphasising the energy efficiency and longevity of remanufactured RDCs could be an effective tool.

A correlation analysis showed the relationship between the Retailers' Product Perceptions and Behavioural Intentions to be statistically non-significant. However, a statistically significant and positive correlation was observed between the Retailers' Product Perceptions and Behavioural Attitudes *(r=0.455, p=0.033)*. As previously explored in Chapter 5.2.1.2, Behavioural Attitudes can potentially have a strong on influence Behavioural Intentions. A mapping of the relationships between the above behavioural determinants, shows that Product Perceptions can directly influence Behavioural Attitudes, which in turn directly influences Behavioural Intentions. This shows that Product Perceptions can have

[48] On average a single RDC in a retail grocery store can consume £3000 worth of energy per year (Monier at al., 2007).

an indirect influence on Behavioural Intentions. Therefore, it is important for remanufacturers not to neglect targeting the Product Perceptions of Retailers when marketing remanufactured RDCs.

Furthermore, in this study, Retailers who had purchased remanufactured RDCs recorded slightly more positive perceptions towards remanufactured RDCs than those Retailers who had not. However, the results of t-test showed these differences to be statistically non-significant. Therefore, further investigation on a larger population sample would be required to validate whether past behaviour is a genuine determinant of Retailers Product Perception.

5.3.6. Pro-Circular Values: Retailers' 'bigger-than-self' goals

The Retailers' overall Pro-Circular Values towards the 'bigger-than-self' *economic, environmental and social* goals were positive. This was demonstrated by the mean of Retailer's scores being large ($\bar{x}$*=4.3 on a 5-point scale*). A small standard deviation (*SD=0.48*) confirmed that most Retailers shared the same positive values. A small standard error *(SE=0.11*) suggests that these results could potentially be representative of a larger population of Retailers. Although, due to the test being conducted on a small sample, this cannot be said with certainty. Nevertheless, these results imply that the Retailers in the sample regard socio-economic and environmental issues as important.

Despite all Retailers recording positive Pro-Circular Values, the majority (80%) of them had not purchased a remanufactured RDC before (Chapter 5.2.1.1), and displayed a lack of positive Intention to do so in the future (Chapter 5.2.1.6). This could be a result of Retailers not associating the purchase of a remanufactured RDC as having a positive socio-economic and environmental impact. This was confirmed by a correlation analysis, which found a statistically non-significant relationship between the Retailers' Pro-Circular Values, and both their Past Behaviours and Behavioural Intentions.

However, a statistically significant and positive correlation was observed between the Retailers' Pro-Circular Values and Descriptive Subjective Norms *(r=0.626, p=0.002*). As explored in Chapter 5.2.1.7, Descriptive Subjective Norms have a strong relationship with Behavioural Intentions. This shows that Pro-Circular Values can have an indirect influence on Behavioural Intentions. The correlation analysis also showed a slightly positive relationship between Pro-Circular Values and both, Injunctive Subjective Norms and Behavioural Attitudes, although they marginally missed the significance levels. Further testing on a larger population sample would be required to validate this

result. These results show a tailored marketing campaign emphasising the positive socio-economic and environmental impacts of remanufactured RDCs could be an effective in influencing Retailers' Intentions to purchase remanufactured RDCs.

5.3.7. Influence of the Behaviour Change Intervention on Retailer's intentions to purchase remanufactured RDCs

After being exposed to the Behaviour Change Intervention, there was a positive shift in the Behavioural Intentions of Retailers, from neutral to positive (Chapter 5.2.4). This was demonstrated by the means of the Retailers scores improving after the intervention (*from $\bar{x}$=4.5 to $\bar{x}$=5.1 and above*). The standard deviations decreased for some of the Behavioural Intentions and remained low (*Table 5.2.4.1.a)*, which indicates that the Retailers responses were mostly consistent with each other. The standard error also decreased slightly and remained small, which suggests these results could potentially be representative of a larger population of Retailers. However, to increase the confidence of these findings, further testing on a larger sample would be required.

The results of the paired sample t-test showed that the differences between the means of Behavioural Intentions recorded before and after the intervention were substantial and statistically significant for all intervention items. This confirms that the Intervention had a positive effect on the Retailers Behavioural Intentions to purchase remanufactured RDCs. The biggest change in Behavioural Intention was triggered by the economic persuasive communication message with extrinsic goals *(from $\bar{x}$=4.5 to $\bar{x}$=5.9).* The message highlighted the financial savings of purchasing a remanufactured RDC over a brand-new RDC. This reinforces the assertion that *price* is an important driver of Retailers' purchasing decisions (Centre for Remanufacturing and Reuse, 20019; Monier et al., 2007).

The impact of the persuasive illustration (Appendix D, Retailers' Survey, p. 19) was unique as it had a stronger influence on the Behavioural Intentions of Retailers who purchased remanufactured RDCs in the past than on those Retailers who did not. This difference was suggested to be statistically significant *[t(7)=2.11, p=0.036].* The illustration depicted the improvements made to an RDC that was remanufactured. Retailers who had not purchased a remanufactured RDC before may have perceived the persuasive illustration as exaggerated and not credible. This could be due to the illustration being a graphical render, opposed to a real-life photograph. The latter could have given the intervention more

authenticity, particularly among Retailers who had not purchased RDCs before and were unfamiliar with the effects of remanufacturing. In contrast, persuasive messages were more influential among those who have not previously performed the behaviour. This may have been due to them being accompanied by reference sources, which added credibility to the advocated statements. This goes some way to explaining why these intervention items were successful for all Retailers, regardless of their Past Behaviour.

The study in Chapter 4 also recorded similarly positive results, where the intervention had improved the participants' beliefs towards pro-circular behaviours. The findings in both Chapter 4 and 5, suggest that Persuasive Communication could successfully influence behavioural change among the grocery retailers in relation to the purchase of remanufactured equipment. In particular, the results of this study suggest that if developed into a sustained marketing programme, the use of tailored Persuasive Communication has the potential to positively influence the Behavioural Intentions of Retailers. Incidentally, following the Intervention a Retailer who participated in the study and had not purchased remanufactured RDCs in the past, enquired about procuring remanufactured RDCs in the future. Thereby proving the Intervention had an immediate impact on the Retailer's Behaviour Intention. This demonstrates that the Persuasive Communication generates real demand for remanufactured RDCs. The tool could be similarly adopted to promote other *circular* products and services across the Retail Refrigeration Industry. An increased demand for remanufactured products could lead to the development of product-specific remanufacturing standards, particularly regarding quality. This would add further credibility to the advocated statements in the persuasive messages and help sustain pro-circular behaviours among Retailers.

Summary

This study used a selection of constructs from the Pro-Circular Change Model to investigate and influence Retailers' pro-circular behaviour, namely the purchase of remanufactured RDCs. The results of this study are summarised below:

1. The Retailers very rarely *purchase remanufactured RDCs*. The results of this study showed that only 20% of the sample population have recently done so.
2. The study showed that all Retailers held:

- **slightly positive Behavioural Attitudes** towards *the purchase of remanufactured RDCs,*
- **negative Injunctive Subjective Norms and Descriptive Subjective Norms -** believing that the *purchase of remanufactured RDCs* is not an industry norm and is not something they are expected to do,
- **neutral Perceived Behavioural Control** - believing they lack the opportunity and resources to *purchase remanufactured RDCs,*
- **neutral Behavioural Intentions** – lacking positive intentions *to purchase remanufactured RDCs,*
- **negative Product Perceptions** – believing the characteristics and costs associated with remanufactured RDCs are poor,
- **positive Pro-Circular Values -** rating 'bigger-than-self' socio-economic and environmental matters as important to them.

3. The Retailers who have purchased remanufactured RDCs in the past held:
   - significantly **more positive Descriptive Subjective Norms** than those Retailers who had not - believing that *the purchase of remanufactured RDCs* is an industry norm,
   - significantly **more positive Behavioural Intention** than those Retailers who had not – showing a greater inclination to *purchase of remanufactured RDCs* in the future.
4. Positive correlations were found between the following behavioural determinants of Retailers' pro-circular behaviour:
   - **Behavioural Intentions** and Subjective Norms (Injunctive and Descriptive), Perceived Behavioural Control and Past Behaviour,
   - **Product Perceptions** and Behavioural Attitudes,
   - **Pro-Circular Values** and Descriptive Subjective Norms.
5. The key predictor of the Retailers' Behavioural Intentions to *purchase remanufactured RDCs* is their **Perceived Behavioural Control.**
6. The Persuasive Communication has positively influenced the Retailer's Behavioural Intentions to *purchase remanufactured RDCs.*

The study in this chapter suggests that grocery retailers' Behavioural Intention to *purchase remanufactured RDCs* is largely hindered by their perceived lack of opportunity to do so (Perceived Behavioural Control). Therefore, the willingness of RDC manufacturers to *produce remanufactured* RDCs is investigated further in the next chapter.

6. Manufacturers' pro-circular behaviours: producing remanufactured Refrigerated Display Cabinets

Introduction

To enable the adoption of pro-circular behaviours within the grocery retail sector, RDC Manufacturers must at a minimum offer grocery retailers the opportunity to purchase remanufactured RDCs. Chapter 5 revealed that the Perceived Behavioural Control is the strongest influencer of Retailer's Behavioural Intentions, and that Retailers believe they are currently unable to purchase remanufactured RDCs. This is attributed to a perceived lack of availability in the market and access to skilled and local remanufacturer. This perception is supported by only a limited number of RDC manufacturers offering remanufactured products[49], which demonstrates a lack of Actual Behavioural Control in relation to *purchase of remanufactured RDCs* within the grocery retail sector.

So far, there has been limited research into understanding why most manufactures do not include remanufacturing into their business models. This chapter presents a study which used selected constructs of the Pro-Circular Change Model (Figure 6.1.) to investigate and influence pro-circular behaviours among RDC manufacturers – defined as *producing remanufactured RDCs.* This chapter establishes:

- the Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Past Behaviours and Behavioural Intentions of RDC manufacturers towards the *production of remanufactured RDCs*, as well as relationships between these behavioural determinants and Behavioural Intentions to produce remanufactured RDCs,
- the Perceptions of RDC manufacturers towards remanufactured RDCs and the relationship between Perceptions and the Behavioural Intention to *produce remanufactured RDCs,*
- the Pro-Circular Values of RDCs manufacturers and the relationship between Pro-Circular Values and Behavioural Intention to *produce remanufactured RDCs.*
- the influence of the Persuasive Communication on RDC manufacturers' Behavioural Intentions to *produce remanufactured RDCs.*

[49] Only three manufacturers [Carter Retail Equipment (2016), The Bond Group (2017) and George Barker (Epta UK, 2017)] are known to currently produce remanufactured RDCs in the UK.

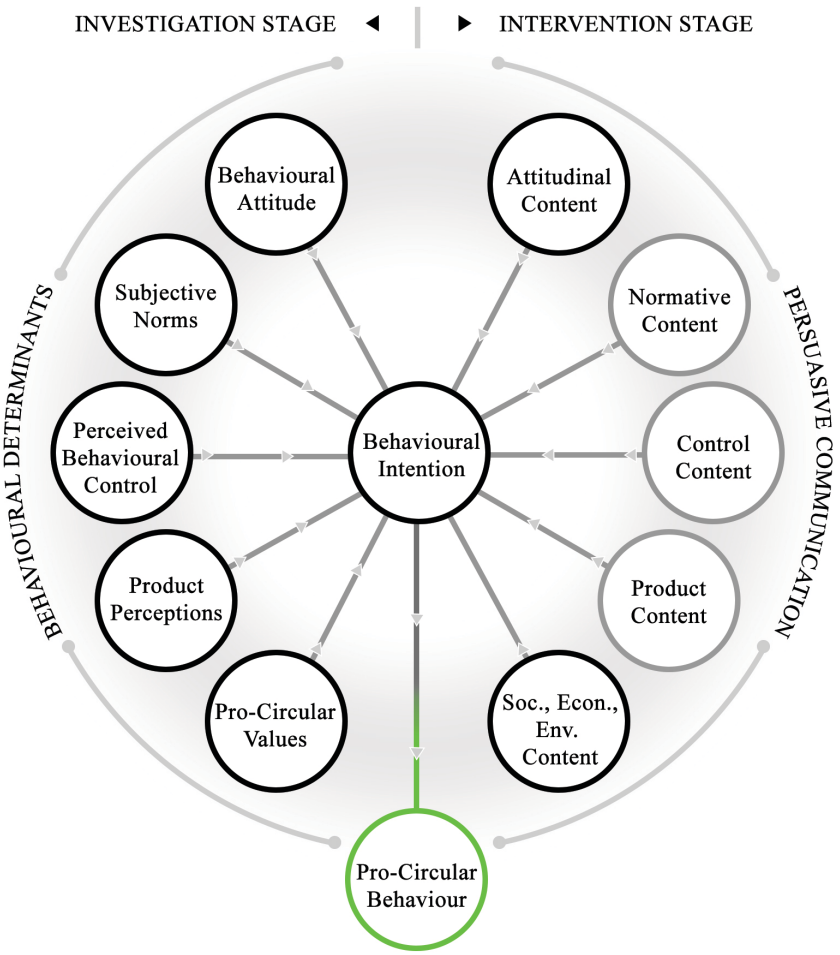


Figure 6.1. Pro-Circular Change Model – selected constructs.

The chapter will begin by outlining the methodology, which provides a summary of the examined population sample and details the research procedures. It also provides an outline of the investigated factors and survey design, before presenting an analysis and discussion of the results.

6.1. Research methodology

This study uses the same research methodology as in Chapter 5, in order to find out whether the beliefs, values and perceptions of grocery retailers and RDC manufacturers are similar (discussed in Chapter 6.3). Structured surveys were found to be a particularly effective method of collecting data on the determinants of pro-circular behaviours in Chapter 5. Therefore, structured surveys used in this study were re-designed to also evaluate the Behavioural Attitudes, Subjective Norms (Injunctive and Descriptive), Perceived Behavioural Control and Behavioural Intentions, and Past Behaviours of RDC

manufacturers towards the production of remanufactured RDCs (Chapter 6.1.4.1). Product Perceptions towards the remanufactured RDCs (Chapter 6.1.4.2) and Pro-Circular Values (Chapter 6.1.4.3) towards socio-economic and environmental issues were also investigated in the survey. In addition, the influence of the Persuasive Communication on the Behavioural Intentions of RDC manufacturers to *produce remanufactured RDCs* was evaluated in Chapter 6.1.4.4.

This study has been granted ethical approval by the School of Engineering Ethics Committee at London South Bank University. A letter of approval is attached in Appendix G.

6.1.1. Population sample and procedure

The population sample included individuals who produce RDCs for UK grocery stores, defined in this study as Manufacturers. To ensure consistency and accuracy within the sample, the invited individuals had to comply with specific criteria:

- work for a RDC manufacturing company that supplies RDC to UK grocery stores,
- have an influence on business decisions within their company - specifically in relation to the production of RDCs,
- had/have a working relationship with grocery retailers.

Ten individuals who met the criteria were invited to take part in the study by the lead researcher in person at industry meetings. They were all briefed about the study and provided with a paper copy of the Participant Information Sheet (Appendix C) and Survey (Appendix E). Data collection took place between April and September 2017.

As shown in Table 6.1.1, six individuals, from six RDC manufacturing companies agreed to take part in the study. All companies sold brand-new RDCs to grocery retailers in the UK and had factories across Europe. Half of participants held upper management roles, and the other half held mid-level management roles. All participants were male, aged 26 to 65 ($\bar{x}=44$). To ensure confidentiality the participants names, as well as their employers are not disclosed.

Table 6.1.1. Characteristics of population sample (N=6): Participant number, gender, age, position, factory locations.

Participant No.	Gender	Age	Position	Factory location [a]
M1	M	26-35	Middle Management	Poland
M2	M	26-35	Upper Management	Turkey, UK
M3	M	46-55	Upper Management	Italy, UK
M4	M	46-55	Middle Management	UK
M5	M	56-65	Middle Management	Italy
M6	M	36-45	Upper Management	Belgium

[a] This data has been sourced from the RDC manufacturers' websites. To ensure confidentiality, these websites have not been disclosed.

6.1.2. Survey design

The Manufacturers' pro-circular behaviour was investigated using a two-part survey (as illustrated in Figure 6.1.2). The first part evaluated the participant's beliefs towards the production of remanufactured RDCs. It included three questionnaires: *Theory of Planned Behaviour Questionnaire, Product Perceptions Questionnaire* and *Pro-Circular Values Questionnaire.* The second part introduced a Behaviour Change Intervention from which its impact on the participants' Behavioural Intention was measured.

The participants were provided with the same Product Perceptions Questionnaire and Pro-Circular Values Questionnaires as the Retailers in Chapter 5. However, the Theory of Planned Behaviour questionnaires and the Behaviour Change Intervention items were redesigned to specifically target the pro-circular behaviours of Manufacturers. Again, these were developed with the support of three industry experts (one R&D refrigeration engineer and one RDC sales executive) who produce and sell RDCs to Retailers. Their involvement helped to:

- indicate salient beliefs of RDC manufacturers towards producing remanufactured RDCs (i.e. consequences, norms and perceived abilities). This supported the redesign of the *Theory of Planned Behaviour Questionnaire*,

- evaluate the intrinsic and extrinsic motivations that underlie the socio-economic and environmental values held by Manufacturers. This supported the redesign of the Behaviour Change Intervention.

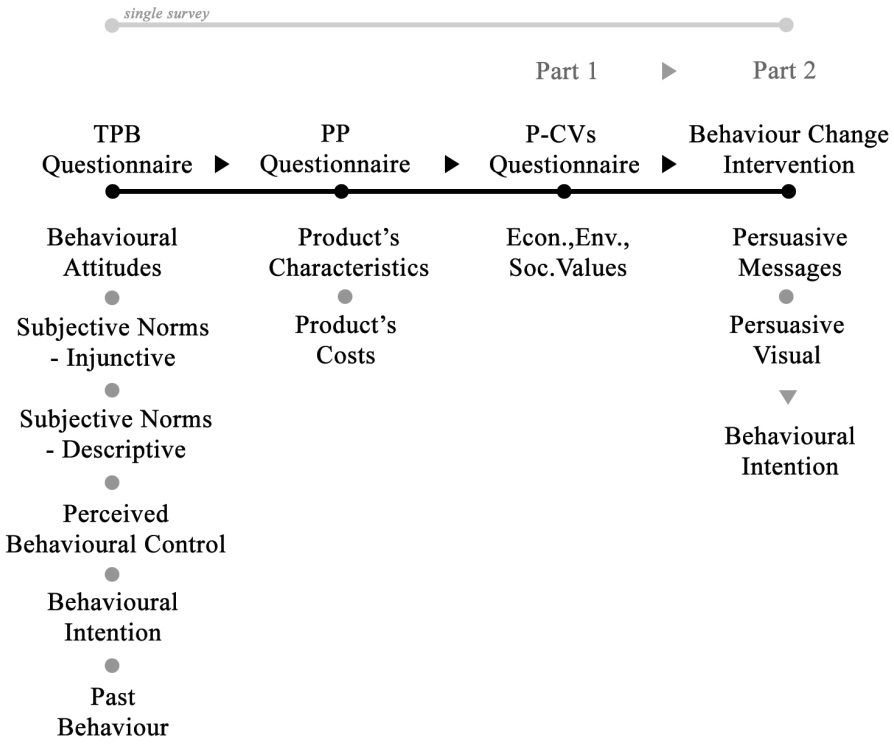


Figure 6.1.2. Manufacturers' survey – outline.

6.1.3. Pilot test

Following the development of the survey, the Theory of Planned Behaviour questionnaire and the behaviour change intervention were piloted on three individuals, including two engineers (one professional and one academic, both working in engineering disciplines) and an industry expert (RDC manufacturer, who met the same criteria as the participants), with all questionnaires being completed on-paper. Their feedback was used to improve the design and layout of the questionnaire and intervention. Following the revisions, the full study was conducted. The revised questionnaire items are presented in Chapter 6.1.4.

6.1.4. Questionnaire items

6.1.4.1. The Theory of Planned Behaviour

In this study, the Theory of Planned Behaviour questionnaire was designed to identify the Behavioural Attitudes, Subjective Norms (Descriptive and Injunctive), Perceived Behavioural Control and Behavioural Intention of Manufacturers' towards *producing remanufactured RDCs*. In addition to evaluating the behavioural constructs proposed by the Theory of Planned Behaviour, Past Behaviour was also assessed to identify the Manufacturers previous involvement in *producing remanufactured RDCs*. The questions were developed in accordance with the TACT elements (as per Ajzen, 2006). To enable participants to express their behavioural beliefs, a seven-point Likert scale was applied alongside each question. The questionnaire items for each of the behavioural determinants are summarised in Table 6.1.4.1 and explained further in sections below.

Table 6.1.4.1. The Theory of Planned Behaviour questionnaire items.

Measures	**Variable**	*Question*	Scale Items [a]
Direct Measures	Behavioural Attitude	*I believe, producing factory-remanufactured refrigerated display cabinets (RDCs) is/would be.*	Good- Bad Convenient - Inconvenient Necessary - Unnecessary Profitable - Expensive
	Subjective Norms - Injunctive	*It is expected of me to produce factory-remanufactured RDCs for my clients.*	Agree - Disagree
	Subjective Norms - Descriptive	*A lot of people like me, produce factory-remanufactured RDCs for their clients.*	Agree - Disagree
	Perceived Behavioural Control	*If I wanted to, I would be able to produce some factory-remanufactured RDCs for my clients this year.*	Agree - Disagree
	Behavioural Intention	*I would like to produce some factory-remanufactured RDCs for my clients this year.*	Agree - Disagree
	Past Behaviour	*I produced some factory-remanufactured RDCs for clients in the past year.*	Yes – No

Indirect Measures	Behavioural Belief	*For my business, producing factory-remanufactured RDCs is/would be.*	Good- Bad
	Outcome Evaluation	*Producing factory-remanufactured RDCs can/could benefit my business.*	Agree - Disagree
	Injunctive Normative Belief	*My clients think that I should produce factory-remanufactured RDCs for them.*	Agree - Disagree
	Motivation to Comply	*When it comes to producing factory-remanufactured RDCs, do you care what your clients think you should do?*	Agree - Disagree
	Descriptive Normative Belief	*I believe that other manufacturers in the UK produce factory-remanufactured RDCs for their clients.*	Agree - Disagree
	Identification with referent	*When it comes to producing factory-remanufactured RDCs, I think it would be good to do as other manufacturers do.*	Agree - Disagree
	Control Belief	*How often are you given an opportunity to produce factory-remanufactured RDCs?*	Often - Never
	Influence of Control Belief	*I would produce factory-remanufactured RDCs, if I was given an opportunity to.*	Agree - Disagree

[a] All scales are 7-point Likert except measure of Past Behaviour

a) Behavioural Attitudes

As in Chapter 4 and 5, the Behavioural Attitudes were assessed using four direct and two indirect measures of behavioural beliefs. The four direct measures assessed the participants' beliefs about how *good – bad, necessary – unnecessary, easy – difficult,* and *profitable – expensive* they perceive it is to produce remanufactured RDCs. The two indirect measures - the Behavioural Belief and Outcome Evaluation, assessed how the participants perceive the impact of producing of remanufactured RDCs on their business. A reliability analysis was conducted using the six measures above. Cronbach's alpha showed all the measures of Behavioural Attitudes had a strong reliability *(α=0.93)*.

b) Injunctive Subjective Norms

The Injunctive Subjective Norms were assessed using one direct and two indirect measures of normative beliefs. The direct measure assessed the extent to which participants believed they were expected to produce remanufactured RDCs. Whereas, the two indirect measures – the Injunctive Normative Belief and Motivation to Comply assessed the extent to which participants perceive that grocery retailers expect them to produce remanufactured RDCs. A reliability analysis was conducted using the three measures above. Cronbach's alpha showed all the measures of Injunctive Subjective Norms had a strong reliability *(α=0.84)*.

c) Descriptive Subjective Norms

The Descriptive Subjective Norms were assessed using one direct and two indirect statements of normative beliefs. The direct measure assessed what the participants perceived to be the norm in relation to the production of remanufactured RDCs. The two indirect measures - the Descriptive Normative Beliefs and Identification with the Referent, assessed what the participants perceived to be the norm in relation to other manufacturers producing remanufactured RDCs. A reliability analysis was conducted using the three measures above. Cronbach's alpha showed all the measures of Descriptive Subjective Norms had an acceptable reliability *(α=0.60)*.

d) Perceived Behavioural Control

The Perceived Behavioural Control was assessed using one direct and two indirect measures of control beliefs. The direct measure assessed the participants' general beliefs about their ability to produce remanufactured RDCs. The two indirect measures - Control Belief and the Influence of Control Belief assessed the participants' beliefs based on an opportunity to produce remanufactured RDCs. A reliability analysis was conducted using the three measures above. Cronbach's alpha showed all the measures of Perceived Behavioural Control had an acceptable reliability *(α=0.76)*.

e) Behavioural Intention

The Behavioural Intention to purchase remanufactured RDCs was measured with a single direct statement indicating the participants' willingness to perform the behaviour. A reliability analysis was

carried using a combination of measures of Behavioural Intention, including before and after the Behaviour Change Intervention (as investigated in Chapter 6.1.4.4). Cronbach's alpha showed all measures of Behavioural Intention had a strong reliability *(α=0.94).*

f) Past Behaviour

A direct measure of Past Behaviour was introduced to identify the participants previous experience of performing the behaviour. As a result, the population sample was categorised into two groups – those that have produced remanufactured RDCs in the recent past (Group A) and those that have not (Group B).

6.1.4.2. Product Perceptions

The Product Perceptions of Manufacturers towards remanufactured RDCs was assessed to understand their impact on uptake of remanufacturing. The Product Perceptions questionnaire was the same as that used in Chapter 5 and contained eight questionnaire items that were designed to measure the participants' perceptions towards the characteristics and costs associated with remanufactured RDCs. All questionnaire items included a 3-point Likert scale to allow the participants to provide their perceptions of remanufactured RDCs by comparing them to new RDCs. A summary of the questionnaire is presented in Table 6.1.4.2.

Table 6.1.4.2. Product Perceptions: questionnaire items.

Variable	*Question*	Scale Items [a]
Quality Performance Appearance Longevity Warranty	*Based on the following characteristics, please compare factory-remanufactured against new RDCs.*	Better than new The same as new Worse than new
Price Maintenance Energy	*Based on the associated costs, please compare factory-remanufactured against new RDCs.*	Cheaper than new The same as new More expensive than new

[a] All scales are 3-point Likert scale

6.1.4.3. Pro-Circular Values

RDC manufacturers commitment to sustainability is an important driver to the adoption of *circular* practices (Monier et al., 2007). In understanding the Pro-Circular Values of Manufactures, this study establishes the extent to which they consider 'bigger-than-self' goals (such as socio-economic and environmental matters) as important. The Pro-Circular Values questionnaire was the same as that used in Chapter 5 and grouped nine questionnaire items into three categories – *economic, environmental* and *social.* To enable participants to express their Pro-Circular Values a five-point Likert scale was applied alongside each questionnaire item. The questionnaire items are summarised in Table 6.1.4.3.

Table 6.1.4.3. Pro-Circular Values: questionnaire items.

Variables	*Question*	Scale Items [a]
Economic Values	*How important are the following to you?*	National economic growth National resource security and resilience Prosperity and growth of local businesses in the UK
Social Values		More education & training opportunities the UK More skilled job opportunities in the UK Nation's health and well-being
Environmental Values		Clean and sustainable living environment Reduction of waste & air, water and soil pollution Reduction of carbon emissions

[a] All scales are 5-point Likert

6.1.4.4. Behaviour Change Intervention

The Behavioural Change Intervention was similar to that in Chapter 5 and also served as the Persuasive Communication delivered in the survey. The intervention included persuasive messages. The persuasive messages were designed to positively influence the participants' Behavioural Intentions towards the production of remanufactured RDCs. Six persuasive messages were developed to comprise of both, extrinsic and intrinsic values associated with the environmental, economic and social benefits of remanufacturing RDCs.

Each item of Persuasive Communication was supplemented with a questionnaire item (question: *Based on this fact, how likely would you produce some factory-remanufactured RDCs for your clients this year?*) that recorded the influence the intervention had on the participants' Behavioural Intentions to produce remanufactured RDCs. The questionnaire items used a 7-point Likert scale. The intervention

items are summarised in Table 6.1.4.4. (the complete messages are attached in the Appendix E, Manufacturers' Survey, p. 16-18).

Table 6.1.4.4. Persuasive Communication items.

Type	Content
Environmental messages	*Message with intrinsic value*; emphasis on the behaviour contributing to reduction of waste form the disposal of refrigerated display cabinets *Message with extrinsic value;* emphasis on the reducing the company's carbon footprint
Economic messages	*Message with intrinsic value;* emphasis on the behaviour helping local manufacturing businesses grow *Message with extrinsic value;* emphasis on profits associated with the purchase of remanufactured refrigerated display cabinets
Social messages	*Message with intrinsic value;* emphasis on preforming of the behaviour contributing to skilled jobs and training opportunities in manufacturing sector *Message with extrinsic value;* emphasis on the behaviour contributing to their clients' Corporate Social Responsibility goals

6.2. Results

6.2.1. Manufacturers' Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Past Behaviour and Behavioural Intentions towards the production of remanufactured RDCs

This section initially presents a descriptive statistical analysis of data derived from the Theory of Planned Behaviour questionnaire (Chapter 6.1.4.1). The analysis includes sample means, standard deviations and standard errors.

This section also presents an inferential statistical analysis of data derived from the Theory of Planned Behaviour, Product Perceptions and Pro-Circular Values questionnaire. The analysis includes an independent sample t-test to identify the differences between the behavioural beliefs of Manufacturers who did and did not produce remanufacture RDCs in the past. In addition, a correlation analysis is conducted to reveal the relationships between the individual determinants and the Manufacturers Behavioural Intention. Lastly, a paired sample t-test is conducted to understand the impact the Behaviour Change Intervention had on the Behavioural Intention of Manufactures.

6.2.1.1. Past Behaviours

Manufacturers who have produced remanufactured RDCs in the past (Group A) accounted for 50% (N=3) of the population sample. The remaining half (N=3) had not produced remanufactured RDCs in the past (Group B). Some differences were observed between the behavioural beliefs of both groups. These are described in the following sections.

6.2.1.2. Behavioural Attitudes

The analysis of results in Table 6.2.1.2 shows that the overall Behavioural Attitudes of Manufacturers towards the production of remanufactured RDCs were negative. The descriptive statistics showed that the overall Behavioural Attitudes of Manufacturers who have produced remanufactured RDCs in the past (in **Group A**) were slightly neutral, whereas those who had not produced remanufactured RDCs in the past (in **Group B**) were negative. The differences in attitudes between both groups however, were statistically non-significant *[t(4)=1.12; p>0.05, p=0.162].*

Looking at the individual items of Behavioural Attitudes, all Manufacturers recorded neutral responses towards the production of remanufactured RDCs being *good, necessary* and *profitable.* All Manufactures also recorded negative responses towards the *convenience* of producing remanufactured RDCs. This was reinforced with all Manufacturers considering the behaviour as *not being beneficial (Outcome Evaluation)*, and generally *bad for their businesses (Behavioural Belief)*.

Two out of the six investigated Behavioural Attitudes provided significantly different responses between Manufacturers in Group A and Group B. The independent sample t-test showed these differences were observed between their Behavioural Attitudes towards the purchase of remanufactured RDCs being *good [t(4)=2.21, p=0.046; Behavioural Belief]* and *beneficial [t(4)=2.77, p=0.025; Outcome Evaluation*] for business, with the means of scores varying from positive for Manufacturers in Group A to strongly negative for those in Group B.

Table 6.2.1.2. Manufacturers' Behavioural Attitudes (BA): mean, standard error, standard deviation and t-test.

Variable	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
	All	6	**4.5**	*.72*	*1.76*			

BA Good - Bad	A	3	**5.0**	*1.00*	*1.73*	**.655**	4	*0.274*
	B	3	**4.0**	*1.15*	*2.00*			
BA Convenient - Inconvenient	All	6	**3.3**	*.71*	*1.75*	**.426**	4	*0.346*
	A	3	**3.7**	*1.20*	*2.08*			
	B	3	**3.0**	*1.00*	*1.73*			
BA Necessary - Unnecessary	All	6	**4.2**	*.94*	*2.32*	**.158**	4	*0.441*
	A	3	**4.3**	*1.20*	*2.08*			
	B	3	**4.0**	*1.73*	*3.00*			
BA Profitable - Expensive	All	6	**4.0**	*.73*	*1.79*	**.894**	4	*0.211*
	A	3	**4.7**	*.88*	*1.53*			
	B	3	**3.3**	*1.20*	*2.08*			
Behavioural Belief	All	6	**3.8**	*.70*	*1.72*	**2.214**	4	*0.046**
	A	3	**5.0**	*.57*	*1.00*			
	B	3	**2.7**	*.88*	*1.53*			
Outcome Evaluation	All	6	**3.7**	*.92*	*2.25*	**2.774**	4	*0.025**
	A	3	**5.3**	*.67*	*1.16*			
	B	3	**2.0**	*1.00*	*1.73*			
BA Mean	All	6	**3.9**	*.68*	*1.68*	**1.122**	4	*0.162*
	A	3	**4.7**	*.88*	*1.53*			
	B	3	**3.2**	*1.01*	*1.74*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
* Significance: p<0.05

6.2.1.3. Injunctive Subjective Norms

The analysis of results in Table 6.2.1.3 suggest that the overall Injunctive Subjective Norms of all Manufacturers towards the production of remanufactured RDCs were neutral. The Injunctive Subjective Norms of Manufacturers who have produced remanufactured RDCs in the past (in Group A) were positive, whereas the Behavioural Attitudes of Manufacturers who had not produced remanufactured RDCs in the past (in Group B) were negative. The differences in responses between both groups marginally missed the statistical significance threshold *[t(4)=2.06; p=0.054]*.

Looking at the individual Injunctive Subjective Norms in turn, all Manufacturers reported the belief that it was *not expected of them to produce remanufactured RDCs (Subjective Norm - Injunctive).* All Manufacturers reported they believe that *the grocery retailers do not think that they should produce remanufactured RDCs (Injunctive Normative Belief).* In addition, the Manufacturers reported that they *care what grocery retailers think they* (the Manufacturers) *should do (Motivation to Comply).* In terms of the differences in normative beliefs between the Manufacturers in Group A and Group B, the descriptive statistics highlighted large differences in all three investigated Injunctive Subjective Norms. However, these differences marginally missed the statistical significance threshold.

Table 6.2.1.3. Manufacturers' Injunctive Subjective Norms (ISN): mean, standard error, standard deviation and t-test.

Variable	Group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Subjective Norms - Injunctive	All	6	**3.7**	*1.02*	*2.50*	**2.132**	4	*0.050*
	A	3	**5.3**	*1.20*	*2.08*			
	B	3	**2.0**	*1.00*	*1.73*			
Injunctive Normative Belief	All	6	**3.7**	*.88*	*2.16*	**1.835**	4	*0.070*
	A	3	**5.0**	*1.16*	*1.73*			
	B	3	**2.3**	*.88*	*1.52*			
Motivation to Comply	All	6	**6.2**	*.83*	*2.04*	NaN [b]		
	A	3	**7.0**	*.0*	*.0*			
	B	3	**5.3**	*1.67*	*2.89*			
ISN Mean	All	6	**4.5**	*.80*	*1.95*	**2.057**	4	*0.054*
	A	3	**5.8**	*.78*	*1.35*			
	B	3	**3.2**	*.97*	*1.68*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

6.2.1.4. Descriptive Subjective Norms

The analysis of results in Table 6.2.1.4 shows that the overall Descriptive Subjective Norms of all Manufacturers towards the production of remanufactured RDCs were neutral. A further inspection of the Descriptive Subjective Norms shows that the majority of Manufacturers who have produced

remanufactured RDCs in the past (in Group A) held positive normative beliefs, whereas the majority of Manufacturers who had not produced remanufactured RDCs in the past (in Group B) held negative normative beliefs. These differences between the two groups were statistically significant *[t(18)=2.59, p<0.05, p=0.030]*.

Looking at the individual Descriptive Subjective Norms in turn, all Manufacturers recorded that they believed *a lot of people like them do not produce remanufactured RDCs (Subjective Norms - Descriptive)*. All Manufacturers gave a neutral response when recording their beliefs about whether *other manufacturers in the UK produce factory-remanufactured RDCs for stores (Descriptive Normative Belief*). However, all Manufacturers agreed that it *would be good to do as other manufacturers do* in relation to producing remanufactured RDCs *(Identification with Referent*).

The responses recorded across all three investigated Descriptive Subjective Norms were higher among the Manufacturers in Group A than Group B. The largest difference was observed in the Descriptive Normative Belief, where Manufacturers in Group A responded that they believe that *other manufacturers in the UK produce factory-remanufactured RDCs for grocery stores*, whereas Manufacturers in Group B responded they do not. The independent sample t-test only showed these differences to be statistically significant *[t(4)=2.50, p<0.05, p=0.033]*. A considerable difference was observed in responses to the Descriptive Subjective Norm, where Manufacturers in Group A responded neutrally to the statement that *other people like them produce factory-remanufactured RDCs*, whereas Manufacturers in Group B responded negatively. These differences however marginally missed the significance threshold *[t(4)=1.60, p>0.05, p=0.092; Descriptive Subjective Norm]*. No significant differences were found for the normative belief regarding the Manufacturers' Identification with Referent.

Table 6.2.1.4. Manufacturers' Descriptive Subjective Norms (DSN): mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Subjective Norms - Descriptive	All	6	**3.7**	*.71*	*1.75*	**1.604**	4	*0.092*
	A	3	**4.7**	*.33*	*.58*			
	B	3	**2.7**	*1.20*	*2.08*			

Descriptive Normative Belief	All	6	**4.7**	*.95*	*2.34*	**2.500**	4	*0.033**
	A	3	**6.3**	*.67*	*1.15*			
	B	3	**3.0**	*1.15*	*2.00*			
Identification with Referent	All	6	**5.5**	*.34*	*.84*	**.447**	4	*0.339*
	A	3	**5.7**	*.33*	*.58*			
	B	3	**5.3**	*.67*	*1.16*			
DSN Mean	All	6	**4.6**	*.53*	*1.31*	**2.592**	4	*0.030**
	A	3	**5.6**	*.44*	*.78*			
	B	3	**3.7**	*.58*	*1.00*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
* Significance: p<0.05

6.2.1.5. Perceived Behavioural Control

The analysis of results in Table 6.2.1.5. shows that the overall Perceived Behavioural Control of all Manufacturers towards the purchase of remanufactured RDCs was negative. Further inspection of the overall Perceived Behavioural Control indicated that the majority of Manufacturers who have produced remanufactured RDCs in the past in (Group A) held positive control beliefs, whereas the majority of Manufacturers who had not produced remanufactured RDCs in the past (in Group B) held negative control beliefs. Nevertheless the difference between the overall control beliefs of both groups marginally missed the statistical significance threshold *[t(4)=1.87, p>0.05; p=0.067]*.

Looking at the Perceived Behavioural Controls in turn individually, the majority of Manufacturers responded positively to the statement, *if they wanted to, they would be able to produce remanufactured RDCs (Perceived Behavioural Control - Direct).* All Manufacturers recorded they *very rarely are given an opportunity to produce remanufactured RDCs (Control Belief)* and responded negatively to the statement that if they *were given an opportunity to, they would produce remanufactured RDCs (Influence of Control Belief).*

The average scores across all three Perceived Behavioural Controls were consistently higher among the Manufacturers in Group A than Group B. The biggest differences in the control beliefs of Manufacturers were found in the Influence of Control Beliefs. The Manufacturers in Group A responded positively to the statement that if they *were given an opportunity to, they would produce remanufactured*

RDCs (Influence of Control Belief), whereas the Manufacturers in Group B responded negatively. Nevertheless the difference between the control beliefs of both groups marginally missed the statistical significance threshold *[t(4)=1.61, p=0.092; Influence of Control Belief]*. No significant differences were found for the remaining beliefs.

Table 6.2.1.5. Manufacturers' Perceived Behavioural Control (PCB): mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
PCB - Direct	All	6	**5.0**	*1.03*	*2.53*	**.603**	4	*0.290*
	A	3	**5.7**	*1.33*	*2.31*			
	B	3	**4.3**	*1.76*	*3.06*			
Control Belief	All	6	**2.7**	*.92*	*2.25*	NaN [b]		
	A	3	**4.3**	*1.20*	*2.08*			
	B	3	**1.0**	*.0*	*.0*			
Influence of Control Belief	All	6	**3.8**	*.83*	*2.04*	**1.606**	4	*0.092*
	A	3	**5.0**	*1.15*	*2.00*			
	B	3	**2.7**	*.88*	*1.53*			
PCB Mean	All	6	**3.8**	*.93*	*2.27*	**1.871**	4	*0.067*
	A	3	**5.0**	*1.23*	*2.13*			
	B	3	**2.7**	*.88*	*1.53*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

6.2.1.6. Behavioural Intention

The analysis of results in Table 6.2.1.6 shows that the overall Behavioural Intentions of Manufacturers towards the purchase of remanufactured RDCs were negative. However, the Behavioural Intentions of Manufacturers who have produced remanufactured RDCs in the past (in Group A) were positive, compared to those who had not produced remanufactured RDCs in the past (in Group B) whose intentions were negative. The difference between the two groups of Manufacturers was statistically significant *[t(4)=2.77, p=0.025]*.

Table 6.2.1.6. Manufacturers' Behavioural Intention (BI): mean, standard error, standard deviation and t-test.

Population	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
					t	df	*p*
All sample population	6	**3.3**	*.92*	*2.25*			
Bought in the past (Group A)	3	**5.0**	*1.00*	*1.73*	**2.774**	4	*0.025**
Did not buy in the past (Group B)	3	**1.7**	*.67*	*1.16*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
* Significance: p<0.05

6.2.1.7. Relationships Between Manufacturers' Behavioural Intentions and the determinants of Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Past Behaviour

The Manufacturers' Behavioural Intentions to produce remanufactured RDCs were analysed with each of the behavioural determinants to identify any positive correlations. These are shown in Table 6.2.1.7. A highly positive and significant correlation was identified between the Behavioural Intention and the Injunctive Subjective Norms *(r=0.913, p=0.062),* Descriptive Subjective Norms *(r=0.869, p=0.012)* and Perceived Behavioural Control *(r=0.823, p=0.022).* A positive correlation was identified between the Behavioural Intentions and Behavioural Attitudes *(r=0.412, p=0.036)*, although it narrowly missed the statistical significance threshold *(r=0.697, p=0.062).* No correlations were found between the Behavioural Intention and Past Behaviours.

Table 6.2.1.7. Pearson's correlation: relationships between the Behavioural Intention (BI) and the determinants of Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.), Perceived Behavioural Control (PCB) and Past Behaviour (PB).

Variable		**BI**	BA	SN inj.	SN desc.	PBC	PB
Behavioural Intention (BI)	r	—					
	p	—					
Behavioural Attitude (BA)	r	**0.697**	—				
	p	***0.062***	—				
Injunctive Subjective Norms (SN inj.)	r	**0.913***	0.695	—			
	p	***0.006***	*0.063*	—			
Descriptive Subjective Norms (SN desc.)	r	**0.869***	0.560	0.967*	—		
	p	***0.012***	*0.124*	*< .001*	—		

Perceived Behavioural Control (PBC)	r	**0.823***	0.865*	0.841*	0.795*	—	
	p	***0.022***	*0.013*	*0.018*	*0.029*	—	
Past Behaviour (PB)	r	**-0.811**	-0.489	-0.703	-0.792	-0.683	—
	p	***0.975***	*0.838*	*0.941*	*0.970*	*0.933*	—

CI 95%
* Significance: $p<0.05$
Note: all tests one-tailed, for positive correlation.

6.2.2. Product Perceptions

This section presents an analysis of data derived from the Product Perception questionnaire (Chapter 6.1.4.2). It presents a descriptive statistical analysis of the Manufacturers' perceptions towards the characteristics and costs of remanufactured RDCs. It includes sample means, standard deviations and standard errors. In addition, a correlation analysis is conducted to investigate the relationship between Product Perceptions and other behavioural determinants, including Behavioural Attitudes, Injunctive and Descriptive Subjective Norms, Perceived Behavioural Control, Behavioural Intention and Past Behaviour.

6.2.2.1. Perceptions about characteristics of remanufactured RDCs

The analysis of results in Table 6.2.2.1. shows that the overall perceptions of Manufacturers about characteristics of remanufactured RDCs were negative and did not differ significantly *[t(4)=0, p=0.500]* between the Manufacturers in Group A and Group B.

Looking at each of the Product Perceptions in turn, all Manufacturers perceived the *quality, performance, appearance, longevity* and *warranty* of remanufactured RDCs to be less than brand-new RDCs. The only positive Product Perception was recorded for *performance*, where the Manufactures in Group A perceived that remanufactured RDCs perform equally as well as brand-new RDCs *($\bar{x}$=2.0, SD=0.0, SE=0.0)*.

Table 6.2.2.1. Manufacturers' Product Perceptions (PP) about characteristics of remanufactured RDCs: mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Quality	All	6	**1.5**	*.22*	*.54*	**0.707**	4	*0.741*
	A	3	**1.3**	*.33*	*.58*			
	B	3	**1.7**	*.33*	*.58*			
Performance	All	6	**1.7**	*.21*	*.52*	NaN[b]		
	A	3	**2.0**	*0*	*0*			
	B	3	**1.3**	*.33*	*.58*			
Appearance	All	6	**1.7**	*.21*	*.52*	**.0**	4	*0.500*
	A	3	**1.7**	*.33*	*.58*			
	B	3	**1.7**	*.33*	*.58*			
Longevity	All	6	**1.5**	*.22*	*.55*	**0.707**	4	*0.741*
	A	3	**1.3**	*.33*	*.58*			
	B	3	**1.7**	*.33*	*.58*			
Warranty	All	6	**1.3**	*.21*	*.52*	**.0**	4	*0.500*
	A	3	**1.3**	*.33*	*.58*			
	B	3	**1.3**	*.33*	*.58*			
PP Mean	All	6	**1.5**	*.12*	*.31*	**.0**	4	*0.500*
	A	3	**1.5**	*.24*	*.42*			
	B	3	**1.5**	*.13*	*.23*			

[a] Hypothesis: Group A > group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

6.2.2.2. Perceptions about costs associated with remanufactured RDCs

The analysis of results presented in Table 6.2.2.2 show that the overall perceptions of Manufacturers about the costs associated with remanufactured RDCs were slightly negative. However, they differed significantly *[t(4)=2.68, p=0.028]* between the Manufacturers in Group A who recorded positive perceptions about the remanufactured RDCs costing less than brand-new RDCs, and Manufacturers in Group B, who did not.

Looking at each of the Product Perceptions in turn, the majority of Manufacturers perceived the *price* of remanufactured RDCs to be better than the price of brand-new RDCs. However, they perceived the costs associated with the *energy* and *maintenance* of remanufactured RDCs to be worse than brand-new RDCs. The Manufacturers in Group A held more positive perceptions towards the *price* and *energy costs*, than the Manufacturers in Group B whose perceptions towards the price and energy costs were negative. An independent sample t-test was conducted on all the Product Perceptions above and showed these differences to have marginally missed the significance levels. The t-test did not show any statistically significant differences among the perceptions towards the *maintenance* costs.

Table 6.2.2.2. Manufacturers' Product Perceptions (PP) about costs of remanufactured RDCs: mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Price	All	6	**2.3**	*.42*	*1.03*	NaN [b]		
	A	3	**3.0**	*.0*	*.0*			
	B	3	**1.7**	*.67*	*1.16*			
Energy Cost	All	6	**1.8**	*.31*	*.75*	**2.121**	4	*0.051*
	A	3	**2.3**	*.33*	*.58*			
	B	3	**1.3**	*.33*	*.58*			
Maintenance Cost	All	6	**1.5**	*.22*	*.55*	**.707**	4	*0.741*
	A	3	**1.3**	*.33*	*.58*			
	B	3	**1.6**	*.33*	*.58*			
PP Mean	All	6	**1.9**	*.19*	*.46*	**2.683**	4	*0.028**
	A	3	**2.2**	*.22*	*.28*			
	B	3	**1.6**	*.11*	*.19*			

[a] Hypothesis: Group A > Group B. *Note: Student t-test*
[b] Variance = 0 after grouping on Past Behaviour

6.2.2.3. Relationship between the overall Product Perceptions and other behavioural constructs

The Manufacturers' overall Product Perceptions of remanufactured RDCs were analysed with each of the behavioural determinants to identify any positive correlations. The results are shown in Table 6.2.2.3. Positive correlations were identified between the Product Perceptions and, both the Behavioural

Intentions *(r=0.651, p=0.081)* and Perceived Behavioural Control *(r=0.683, p=0.067)*. However, both marginally missed the statistical significance threshold.

Table 6.2.2.3. Pearson's correlation: Relationships between the overall Product Perception (PP) and Behavioural Determinants of Behavioural Intention (BI), Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.) and Past Behaviour (PB).

Variables		BI	BA	SN inj.	SN desc.	PBC	PB
Product Perceptions	r	**0.651**	0.381	0.500	0.476	0.683	-0.438
	p	***0.081***	*0.228*	*0.156*	*0.170*	*0.067*	*0.807*

CI 95%
Note: all tests one-tailed, for positive correlation.

6.2.3. Pro-Circular Values

This section presents an analysis of data derived from the Pro-Circular Values questionnaire (Chapter 6.1.4.3). It presents a descriptive statistical analysis of the Manufacturers' values towards socio-economic and environmental goals. It includes sample means, standard deviations and standard errors. In addition, a correlation analysis is conducted to investigate the relationship between Pro-Circular Values and the other behavioural determinants, including Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control, Behavioural Intention and Past Behaviour.

6.2.3.1. Pro-Circular Values of the Manufacturers

The analysis of results in Table 6.2.3.1 shows that the overall Pro-Circular Values were slightly positive and did not differ significantly *[t(3)=1.20, p=0.158]* between Manufacturers who produced remanufactured RDCs in the past (in Group A) and those who had not produced remanufactured RDCs in the past (in Group B).

Looking at each of the Pro-Circular Values in turn, all Manufacturers considered *economic* goals to be most important, in comparison to *environmental* and *social* goals which scored slightly neutral. An independent sample t-test was conducted on the Pro-Circular Values above. A statistically significant difference in Pro-Circular Values among the Manufacturers in Group A and B was found for the *economic* value. Manufacturers in Group B held strongly positive *economic* values, whereas Manufacturers in Group A held slightly neutral *economic* values.

Table 6.2.3.1. Manufacturers' Pro-Circular Values (P-CVs): mean, standard error, standard deviation and t-test.

Variable	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Economic	All	5	**4.3**	*.24*	*.53*	**3.000**	3	*0.029**
	A	2	**3.8**	*.17*	*.24*			
	B	3	**4.7**	*.19*	*.33*			
Environmental	All	5	**3.9**	*.46*	*1.04*	**0.153**	3	*0.444*
	A	2	**3.8**	*.17*	*.24*			
	B	3	**4.0**	*.84*	*1.45*			
Social	All	5	**3.8**	*.27*	*.61*	**.878**	3	*0.222*
	A	2	**3.5**	*.50*	*.71*			
	B	3	**4.0**	*.33*	*.58*			
P-CVs Mean	All	5	**4.0**	*.21*	*.48*	**1.201**	3	*0.158*
	A	2	**3.7**	*.28*	*.39*			
	B	3	**4.2**	*.27*	*.48*			

[a] Hypothesis: Group A ≠ Group B. *Note: Student t-test*
* Significance: p<0.05

6.2.3.2. Relationships between Pro-Circular Values and Pro-Circular Behaviour

The Manufacturers' overall Pro-Circular Values were analysed with each of the behavioural determinants to identify any positive relationships. The results are shown in Table 6.2.3.2. No significant relationships were identified.

Table 6.2.3.2. Pearson's correlation: Relationships between the Manufacturers' overall Pro-Circular Values (P-CV) and Behavioural Determinants of Behavioural Intention (BI), Behavioural Attitude (BA), Injunctive Subjective Norms (SN inj.), Descriptive Subjective Norms (SN desc.) and Past Behaviour (PB).

Variables		**BI**	BA	SN inj.	SN desc.	PBC	PB
Pro-Circular Values	r	**-0.252**	0.207	-0.293	-0.525	-0.437	0.570
	p	***0.658***	*0.369*	*0.684*	*0.818*	*0.769*	*0.158*

CI 95%
Note: all tests one-tailed, for positive correlation.

6.2.4. Behaviour Change Intervention

This section presents an analysis of data derived from the Behaviour Change Intervention questionnaire (Chapter 6.1.4.5). It presents a descriptive statistical analysis of the impact that the intervention had on the Manufacturers' Behavioural Intentions to produce remanufactured RDCs. Like in Chapter 5, it includes sample means, standard deviations and standard errors. The analysis includes a paired sample t-test, which was used to identify whether the Behavioural Intentions of Manufacturers differed significantly before and after the Behaviour Change Intervention.

6.2.4.1. Influence of the Behaviour Change Intervention on Behavioural Intentions

The results presented in Table 6.2.4.1.a show the Manufacturers Behavioural Intentions influenced by the Behaviour Change Intervention. The results of the independent sample t-test show there were no statistically significant differences in the influence of the intervention on the overall Behavioural Intention between Manufacturers who produced remanufactured RDCs in the past (in Group A) and those who had not produced remanufactured RDCs in the past (in Group B).

Looking at the individual items, the biggest shift in Behavioural Intention was recorded against the intervention that included an *economic* message with an *intrinsic* value. The smallest shift in Behavioural Intentions was recorded against the intervention that included an *environmental* message with an *intrinsic* value. The descriptive statistics indicate that the *economic* message with an *extrinsic* value, and the *environmental* message with both an *extrinsic* and *intrinsic* value *(Group A: $\bar{x}$=5.5; Group B= $\bar{x}$=4.3)* had a stronger impact on the Manufacturers in Group A than Group B. Nevertheless, the results of the paired sample t-test show that the differences between the impact of these two interventions on both groups of Manufacturers missed the statistical significance threshold.

Table 6.2.4.1.a. Manufacturers' Behavioural Intentions (BI) influenced by the Behaviour Change Intervention (BCI): mean, standard error, standard deviation and t-test.

Intervention Type	group	N	$\bar{x}$	*SE*	*SD*	t-test [a]		
						t	df	*p*
Economic Message								
Extrinsic value	All	5	**5.2**	*1.11*	*2.50*	**.939**	3	*0.208*
	A	2	**6.5**	*.50*	*.71*			
	B	3	**4.3**	*1.76*	*3.01*			
Intrinsic value	All	5	**5.6**	*.60*	*1.34*	**.118**	3	*0.543*
	A	2	**5.5**	*1.50*	*2.12*			
	B	3	**5.7**	*.67*	*1.15*			
Environmental Message								
Extrinsic value	All	5	**5.2**	*1.11*	*2.50*	**.531**	3	*0.316*
	A	2	**6**	*1.00*	*1.41*			
	B	3	**4.7**	*1.86*	*3.22*			
Intrinsic value	All	5	**4.8**	*.97*	*2.17*	**.534**	3	*0.315*
	A	2	**5.5**	*.50*	*.71*			
	B	3	**4.3**	*1.67*	*2.89*			
Social Message								
Extrinsic value	All	5	**5.0**	*1.05*	*2.35*	**.344**	3	*0.377*
	A	2	**5.5**	*.50*	*.71*			
	B	3	**4.7**	*1.86*	*3.22*			
Intrinsic value	All	5	**5.2**	*.58*	*1.30*	**.372**	3	*0.367*
	A	2	**5.5**	*1.50*	*2.12*			
	B	3	**5.0**	*.58*	*1.00*			

[a] Hypothesis: Group A > Group B. *Note: Student t-test*

The results of paired sample t-test in Table 6.2.4.1.b show the impact the Behaviour Change Intervention had on the Behavioural Intentions of Manufacturers. All forms of Persuasive Communication that included *economic, environmental* and *social* messages with *extrinsic* values, had a positive and statistically significant influence on the Manufacturers' Behavioural Intentions. The *economic, environmental* and *social* messages that included *intrinsic* values had a similarly positive and statistically significant impact on all Manufacturers Behavioural Intentions to produce remanufactured RDCs.

Table 6.2.4.1.b. Paired sample t-test on Manufacturers' Behavioural Intentions (BI) before and after the Behaviour Change Intervention (BCI).

	t	df	*p*
BI before BCI - BI after intrinsic economic PC	**3.873**	4	*0.009**
BI before BCI - BI after intrinsic environmental PC	**2.557**	4	*0.031**
BI before BCI - BI after intrinsic social PC	**3.833**	4	*0.009**
BI before BCI - BI after extrinsic economic PC	**3.474**	4	*0.013**
BI before BCI - BI after extrinsic environmental PC	**2.804**	4	*0.024**
BI before BCI - BI after extrinsic social PC	**2.588**	4	*0.030**

Hypothesis: BI before BCI < BI after BCI. *Note: Student t-test*
* Significance: p<0.05*

6.3. Discussion

The aim of this study was to investigate the willingness of RDC manufacturers to produce remanufactured RDCs. A population sample of six Manufacturers took part in this study, half of them had produced remanufactured RDCs in the past. Despite the population sample being small, several common tendencies were found in their survey responses, which provided an insight into their remanufacturing behaviours. However, the extremely small sample size lessens the confidence of results and did not allow for further statistical analysis to be conducted, particularly regressions to estimate the predicting power of determinants. Further research into the remanufacturing behaviours of RDC manufacturers, specifically where small population samples are involved, could include qualitative methods such as interviews. Interviews would provide the opportunity to gather detailed information on remanufacturing behaviours, and potentially extend the findings beyond those provided in this study. However, due to participants being unable to offer the time required, interviews were not considered as a research method.

6.3.1. Manufacturers' Behavioural Attitudes towards the production of remanufactured RDCs

Overall the Behavioural Attitudes of Manufacturers towards the purchase remanufactured RDCs analysed in Chapter 6.2.1.2 were negative. This was demonstrated by their responses to the questionnaire items falling on the negative side of the scale ($x=3.9$). The majority of these responses fell far from the mean, resulting in a large standard deviation ($SD=1.68$). The large variance in responses

suggests that Manufacturers attitudes towards the production of remanufactured RDCs were inconsistent across the sample. Despite the extremely small number of participants in this study, the standard error of the mean was relatively small *(SE=0.68)*. However, due to small sample size and large variance in responses, it cannot be said with certainty that these results are representative of a larger population of Manufacturers. Therefore, a larger sample size would be required to validate this.

All Manufactures held unfavourable Behavioural Attitudes towards the *convenience* of remanufacturing RDCs *($\bar{x}$=3.3, SD=1.75, SE=0.71)*. This can be due to the process of remanufacturing RDCs relying on the availability of end-of-life RDC cores. This could be improved by the development of an industry-wide library of remanufacture-ready end-of-life RDC cores, such as the online platform Warp It Reuse Network (2018) where businesses can list end-of-life furniture as resources for reuse. The perceived inconvenience of remanufacturing could be attributed to the complexity of the process. The complexity of remanufacturing could be reduced by creating industry recognised RDC-specific remanufacturing standards and processes, that focusing on simplifying remanufacturing practice (Muranko et al., 2017b).

All Manufacturers also considered remanufacturing RDCs as *not being beneficial*, and generally *bad for their businesses*. These beliefs are supported by a lack of favourable attitudes being recorded towards the *profitability* of remanufacturing. The perception of remanufactured RDCs being unprofitable could be due to the assumption that there is a lack of demand within the market for such products (as reinforced by the results in *Chapter 6.2.2.5. Perceived Behavioural Control*). However, this attitude has also prevented Manufactures from exploring whether there is any demand. The results in Chapter 5 suggests that Retailers are interested in purchasing remanufactured RDC's should they be given the opportunity to do so.

However, Manufacturers who had a history of remanufacturing RDCs in the past held significantly more positive beliefs towards the behaviour being *good [t(4)=2.21, p=0.046]* and *beneficial [t(4)=2.77, p=0.025*] for their businesses. Those Manufacturers who have produced remanufactured RDCs may have experienced the advantages of remanufacturing, therefore perceiving it a beneficial addition to their business models. Although researchers argue that conducting a t-test on extremely small sample

populations is acceptable (de Winter, 2013), with having only three participants in each group, a larger sample size would be required to validate the statistical significance of this result.

6.3.2. Manufacturers' beliefs about the norms associated with the production of remanufactured RDCs

Chapter 6.2.1.3 and 6.2.1.4 explored the Injunctive and the Descriptive Subjective Norms of Manufacturers towards the production of remanufactured RDCs. The Injunctive Subjective Norms were investigated to understand the willingness of Manufacturers to comply with the Retailers' expectations - namely whether Manufacturers should or should not produce remanufactured RDCs. The Descriptive Subjective Norms of Manufacturers were also investigated to understand the extent to which they identify themselves with other RDC manufacturers in relation to them remanufacturing RDCs.

Overall the Subjective Norms of Manufacturers towards the production of remanufactured RDCs were neutral for both the Injunctive *($\bar{x}$=4.5)* and Descriptive ($\bar{x}$=*4.6*) Subjective Norms. The responses fell far from the mean, resulting in a large standard deviation, with majority of responses falling on both, the positive and negative side of the scales (for *Injunctive beliefs SD=1.95; Descriptive beliefs, SD=1.31*). This indicated that what the Manufacturers perceived as the norm when considering the production of remanufactured RDCs varied among the investigated sample. Despite the extremely small number of participants in this study, the standard error of the mean was relatively small *(Injunctive beliefs SE=0.80; Descriptive beliefs SE=0.53*) However, due to small sample size and large variance in responses, it cannot be said with certainty that these neutral Subjective Norms are representative of a larger population of Manufacturers. A larger sample size would be required to validate this.

Overall, Manufacturers believed that they are not expected to produce remanufactured RDCs. This was largely due to the belief that grocery retailers did not think that they [Manufacturers] should produce remanufactured RDCs. This implies that Manufacturers believe that grocery retailers prefer purchasing brand-new instead of remanufactured RDCs. This gives further reasoning to Manufacturers' perception that there is a lack of the demand for remanufactured RDCs. However, Manufacturers reported that they care what grocery retailers think they [Manufacturers] should do, which infers that grocery retailers have a strong influence on the business decisions of the RDCs manufacturers. Based on these normative

beliefs, should grocery retailers show a demand for remanufactured RDCs, there is a strong possibility that Manufacturers will be inclined to produce them.

The descriptive statistics highlighted large differences in the three investigated normative beliefs of Manufacturers who did and did not produce remanufactured RDCs. The Manufacturers who did perform the pro-circular behaviour held considerably more positive normative beliefs than those who did not. However the result of the independent-sample t-test showed these differences marginally missed the statistical significance threshold *[t(4)=2.06, p=0.054].* The lack of significant differences could again be attributed to the small sample size in this study and a larger sample size would be required to validate if past behaviour is a core determinant of injunctive normative beliefs.

Manufacturers reported that they believed *a lot of people like them do not produce remanufactured RDCs.* This perceived norm goes some way to explaining the assumption that the Retail Refrigeration Industry lacks pro-circular behaviours. However, when considering whether *other manufacturers in the UK produce factory-remanufactured RDCs for stores,* Manufacturers provided mixed, though overall neutral responses. This perception shows that some Manufacturers are not aware of their competitor's practices. On the other hand, Manufacturers agreed that it *would be good to do as other manufacturers do* in relation to producing remanufactured RDCs, which suggests the they are likely to follow the perceived industry norm, which at present are mixed. With RDC manufacturers showing an inclination to follow industry trends, it gives remanufacturing and other circular processes a promising route to becoming more mainstream.

The results of the t-test revealed that Manufacturers who had produced remanufactured RDCs in the past held significantly *[t(4)=2.59, p<0.05, p=0.030]* more positive overall descriptive normative beliefs towards the production of remanufactured RDCs, whereas those Manufactures who had not, held negative descriptive normative beliefs. Those Manufacturers who produced remanufactured RDCs in the past responded positively *[t(4)=2.50, p<0.05, p=0.033]* to the statement that *other manufacturers in the UK produce factory-remanufactured RDCs for grocery stores.* Whereas those Manufacturers who had not, responded negatively. This suggests that both groups of Manufacturers believe that their current behaviours reflect the perceived industry norms, and highlights that past behaviour can be an important determinant of descriptive normative beliefs. Nevertheless, due to the extremely small sample

population used in this study, a larger sample size would be required to validate the statistical significance of these assumptions.

6.3.3. Manufacturers' perceived ability to produce remanufactured RDCs

Overall the Perceived Behavioural Control of Manufacturers towards the production of remanufactured RDCs analysed in Chapter 6.2.1.5 was negative *($\bar{x}$=3.8)*. The majority of these responses fell far from the mean resulting in a large standard deviation (*SD=2.27*). The large variance in scores suggests that there was no consensus as to whether Manufacturers perceive that they have an opportunity to produce remanufactured RDCs. This large variance in control beliefs could be based on individual Manufacturers having received/not received a request from grocery retailers to produce remanufactured RDCs. Furthermore, the standard error of the mean is slightly high *(SE=0.93*) suggesting that it is possible that these negative Behavioural Controls are not necessarily representative of a larger population of Manufacturers. Therefore, a larger sample would be required to validate these results.

Overall Manufacturers recorded that *if they wanted to, they would be able to produce remanufactured RDCs ($\bar{x}$=5.0, SD=2.53, SE=1.03)*. However, the extent to which they agreed to the statement varied, as shown by a large standard deviation. The large variance suggests that there was no consensus as to whether Manufacturers perceive they are able to produce remanufactured RDCs. This could be attributed to some Manufactures perceiving the process as more or less complex and having or not having the required skills and resources.

Manufacturers also recorded they very rarely are given an opportunity to produce remanufactured RDCs *($\bar{x}$=2.7, SD=2.25, SE=0.92)* and that if given an opportunity to, they would not produce remanufactured RDCs *($\bar{x}$=3.8, SD=2.04, SE=0.83)*. However, the extent to which all Manufactures agreed to these statements varied, as shown by a large standard deviation. This implies that some Manufacturers are more cautious than others about introducing the model into their businesses. Chapter 6.2.1.7 confirmed that there is a positive and statistically significant correlation between Perceived Behavioural Control and Behavioural Attitudes *(r=0.865, p=0.013)*. This is illustrated in the Manufacturers responses, where their perception of a lack of opportunity to produce remanufactured

RDCs (Perceived Behavioural Control) directly correlates with their attitudes of remanufacturing not being beneficial to their businesses (Behavioural Attitudes).

The descriptive statistics show that Manufacturers who had produced remanufactured RDCs held positive Perceived Behavioural Control towards remanufacturing *($\bar{x}$ =5.0, SD=2.13, SE=1.23)*, whereas those Manufacturers who had not held negative Perceived Behavioural Control *($\bar{x}$=2.7, SD=1.53, SE=0.88)*. These results suggest that Manufacturers who remanufactured in the past are confident in their ability to do so in the future. This may be due to these Manufacturers having developed Process-Supporting tools which have reduced the *complexity* of remanufacturing, or having established a working relationship with grocery retailers who *expect to be able to purchase remanufactured* RDCs. However, the results of t-tests for both groups of Manufacturers marginally missed the statistical significance threshold *[t(4)=1.87, p>0.05; p=0.067]*. Once again, the lack of significant differences in the t-test could be attributed to the small sample size in this study and a larger sample size would be required to reveal if past behaviour is a core determinant of control beliefs.

6.3.4. Behavioural Intention: Manufacturers' intentions to produce remanufactured RDCs

Overall the Behavioural Intention of Manufacturers towards the production of remanufactured RDCs analysed in Chapter 6.2.1.6 was negative *(x=3.3)*. However, the Manufacturers responses fell slightly far from the mean resulting in a high standard deviation (*SD=2.25*). This large variance in responses suggests that the Manufacturers were unable to agree on their intentions to produce remanufactured RDCs. Furthermore, the standard error of the mean is slightly high *(SE=0.92*) suggesting that it is possible that these negative Behavioural Intentions may not be representative of a larger population of Manufacturers. Therefore, a larger sample would be required to validate these results.

The Manufacturers who had produced remanufactured RDCs in the past *($\bar{x}$=5.0, SD=1.73, SE=1.00)* held significantly more positive Behavioural Intentions *[t(4)=2.77, p=0.025]*, whereas those Manufacturers who had not, were significantly lacking in intention to purchase remanufactured RDCs *($\bar{x}$=1.7, SD=1.16, SE=0.6)*. This suggests that Manufacturers who produce remanufactured RDCs have realised its benefits, which has lead them to forming a positive Behavioural Intention towards it. Again,

due to the extremely small sample populations used in this study, a larger sample size would be required to validate the statistical significance of this difference.

There are several empirical studies based on the Theory of Planned Behaviour that extend the model to include Past Behaviour that show its significant effect on Behavioural Intentions (Sommer, 2011). For example, a study conducted by Knussen et al., (2004) found Past Behaviour to be a strong influencer of household recycling behaviours. However, this Chapter found no significant correlations between Behavioural Intention and Past Behaviour.

As suggested by the correlation analysis in section 6.2.1.7 factors other than Past Behaviour, could play a more influential role on the Behavioural Intentions of Manufacturers. For example, Injunctive Subjective Norms *(r=0.913, p=0.062),* Descriptive Subjective Norms *(r=0.869, p=0.012)* and Perceived Behavioural Control *(r=0.823, p=0.022)* were found to have positive and statistically significant correlation with Manufacturers' Behavioural Intention. These results indicate that regardless of Manufacturers' having experience of producing (or not producing) remanufactured RDCs in the past, factors such as the perceived industry norms and consumer demand have a key role in driving their future behaviours. Therefore, targeting these specific beliefs would be one of the most effective ways of influencing the uptake of remanufacturing in this industry. The correlation between the Manufacturers Behavioural Attitudes and Behavioural Intentions was slightly positive, however it marginally missed the statistical significance threshold *(r=0.697, p=0.062).* Therefore, this result requires further testing on a larger population sample to validate.

The results in this study align with those found in Chapter 5, which reinforce that the Perceived Behavioural Control is a key determinant of Behavioural Intention of both Manufacturers and Retailers. While the Manufacturers in this study reported that there is no demand for remanufactured RDCs (as discussed in section 6.3.3.), retailers correspondingly reported that remanufactured RDCs are not available to them to purchase. These results suggest that the adoption or remanufacturing by both groups simultaneously relies on: 1) Manufacturers recognising there is a business opportunity for them to adopt remanufacturing in their offerings and 2) Retailers becoming aware of their options to buy RDCs from the remanufacturing market.

Previous studies that used the Theory of Planned Behavioural to investigate sustainable manufacturing practices suggested that poor control beliefs are the main barrier that prevent businesses adopting resource-efficient practices (Corral, 2003; Zhang et al., 2013; Sigh et al., 2018). As in Chapter 5, this Chapter reinforces that the control beliefs of businesses are key indicators of whether they are likely to adopt circular models, such as remanufacturing.

6.3.5. Product Perceptions: Manufacturers perceptions about remanufactured RDCs

a) Characteristics

The Manufacturers overall perceptions about the characteristics of remanufactured RDCs, namely the *quality, performance, appearance, longevity* and *warranty,* were negative (Chapter 6.2.2.1). This was demonstrated by the small mean of responses *($\bar{x}$=1.5 with values below 2 being negative)*, while small standard deviation (*SD=0.31*) confirmed that most Manufacturers shared the same negative perceptions. Moreover, a small standard error *(SE=0.12*) indicated that these results could potentially be representative of a larger population of Manufacturers, although it requires testing on a larger population sample to validate. These results imply that despite remanufactured products being inherently as 'good-as-new', Manufacturers perceive them as sub-standard. This could be result of Manufacturers lacking knowledge about the remanufacturing process, or mistaking it with refurbishment.

Nevertheless, the Manufacturers who produced remanufactured RDCs recorded a positive Product Perception towards the *performance* of remanufactured RDCs. This implies that those with experience of remanufacturing have produced remanufactured RDCs to perform at the same level as brand-new RDCs *($\bar{x}$=2.0, SD=0.0, SE=0.0)*. This result contradicts the assumptions that some Manufactures and Retailers hold regarding remanufactured products being inferior or sub-standard in terms of their performance.

b) Costs

The Manufacturers overall perceptions about the costs associated with remanufactured RDCs, namely its *price, energy* and *maintenance* costs, were marginally negative (Chapter 6.2.2.2). This was demonstrated by the mean of responses falling slightly below the acceptable value *($\bar{x}$=1.9 with values*

above 2 considered positive). The standard deviation (*SD=0.46)* showed that the majority of Manufacturers' responses fell on both, the positive and negative sides of the scale, which was a result of a large range of scores being given towards the individual product perceptions. Specifically, perceptions towards the *energy* and *maintenance* of remanufactured RDCs were slightly negative. This contrasted with their perceptions about the *price,* which were strongly positive. This reflects the industry norm of remanufactured RDCs being priced substantially lower than brand-new RDCs.

Furthermore, Manufacturers who had produced remanufactured RDCs recorded positive *[t(4)=2.68, p=0.028]* overall perceptions towards remanufactured RDCs*,* whereas those Manufacturers who had not recorded negative overall perceptions*.* However, a larger population sample size would be required to validate the statistical significance of this difference. Manufacturers who remanufactured in the past perceived the *price* and *energy costs* of remanufactured RDCs to be similar to brand-new RDCs. This reflects their knowledge about the remanufacturing process and its outcomes, namely that it provides a considerable financial discount compared to the purchase of a brand-new RDC (Muranko et al., 2016). and it involves a technical upgrade for it to be considered energy efficient. Nevertheless, the Manufacturers who had remanufactured perceived the *maintenance costs* to be more than brand-new RDCs. This may be due to the warranty of remanufactured RDCs typically being shorter than a brand-new RDC. This shorter warranty puts the owner of a remanufactured RDC at a higher risk of having to pay for maintenance issues out of their own pocket. Furthermore, Manufacturers may perceive the longevity of remanufactured RDCs to be inferior, which may be due to concerns over the quality of their end-of-life cores. As a result, this could lead to an expectation that they will be subject to increased maintenance. However, these concerns could be effectively addressed through the implementation of industry wide Quality Standards for remanufactured RDCs (as discussed in Chapter 7).

A correlation between the Manufactures Product Perceptions and Behavioural Intentions marginally missed the statistical significance level *(r=0.651, p=0.081)*. Therefore, a larger sample is required to validate this result. Should this correlation be statistically significant, improving the Manufacturers perceptions towards remanufactured RDCs would be an effective way of influencing their behavioural intentions to produce them.

6.3.6. Pro-Circular Values: Manufacturers' 'bigger-than-self' goals

The Manufacturers' overall Pro-Circular Values towards the 'bigger-than-self' *economic, environmental* and *social* goals were slightly positive (Chapter 6.2.3.1). This was demonstrated by the mean of Manufacturers' responses being slightly large ($\bar{x}$*=4.0 on a 5-point scale*). A small standard deviation (*SD=0.48*) confirmed that most Manufacturers shared the same values. A small standard error *(SE=0.24*) indicated that these results could be representative of a larger population of Manufacturers. As the test was conducted on small sample this cannot be said with certainty. Therefore, a larger sample is required to validate.

Interestingly, the descriptive statistics show that Manufacturers who produced remanufactured RDCs in the past held slightly less positive Pro-Circular Values that Manufacturers who did not. A significant difference was recorded for the *economic* value *[t(3)=3.0, p=0.029],* where Manufacturers who did not perform the behaviour in the past held strongly positive *economic* values, whereas Manufacturers who had, held neutral *economic* values. Although due to the extremely small population sample, this results requires further testing to validate its statistical significance. However, the lack of relationship was confirmed in the results of correlation analysis which found no significant relationships between the Pro-Circular Values and Behavioural Intention to produce remanufactured RDCs or other behavioural determinants. Similar results were found in Chapter 5.

6.3.7. Influence of the Behaviour Change Intervention on Manufacturers' intentions to produce remanufactured RDCs

After being exposed to the Behaviour Change Intervention, there was a positive shift (from negative) in the Behavioural Intentions of Manufacturers to produce remanufactured RDCs. This was demonstrated by the mean of the Manufacturers' responses improving after the intervention *(from* $\bar{x}$*=3.3 to* $\bar{x}$*=4.8 and above).* The standard deviation decreased *(Table 6.2.4.1.a)* although remained high, which indicates that the Manufacturers responses to the intervention varied. The standard error also slightly decreased, however it remained slightly large, which means a larger sample size is required to validate these results.

Nevertheless, the results of the paired sample t-test showed that the differences between the means of Behavioural Intentions recorded before and after the intervention were substantial and statistically

significant for all intervention items. This confirms that the Intervention had a positive effect on the Manufacturers' Behavioural Intentions to produce remanufactured RDCs. The results of this study suggest that if developed into a sustained governmental or industrial campaign, the use of tailored Persuasive Communication has the potential to positively influence the Behavioural Intentions of Manufacturers.

Summary

This study used a selection of constructs from the Pro-Circular Change Model to investigate Manufacturers' pro-circular behaviour, namely the production of remanufactured RDCs. The results of this study found that:

1. Half of the Manufacturers in the sample *produced remanufactured RDCs*[50].
2. All Manufacturers held:
    - **negative Behavioural Attitudes** towards *the production of remanufactured RDCs,*
    - **neutral Injunctive Subjective Norms and Descriptive Subjective Norms -** believing that the *production of remanufactured RDCs* is not an industry norm and is not something they are expected to do,
    - **negative Perceived Behavioural Control** - believing they lack the opportunity and resources to *produce remanufactured RDCs,*
    - **negative Behavioural Intentions** – lacking positive intentions *to produce remanufactured RDCs,*
    - **negative Product Perceptions** – believing the characteristics and costs associated with remanufactured RDCs are poor,
    - **positive Pro-Circular Values -** rating 'bigger-than-self' socio-economic and environmental matters as important to them.
3. The Manufacturers who have produced remanufactured RDCs in the past held:

[50] Nevertheless, the population sample was too small to be representative of a larger population of RDC manufacturers.

- significantly **more positive Behavioural Attitudes** than those Manufacturers who had not - believing that *the production of remanufactured RDCs* is *good* and *beneficial for their business.*
- significantly **more positive Descriptive Subjective Norms** than those Manufacturers who had not – believing that other RDC manufacturers *produce remanufactured RDCs.*
- significantly **more positive Behavioural Intentions** than those Manufacturers who had not - showing a greater inclination to *produce remanufactured RDCs* in the future.
- significantly **more positive Product Perceptions towards costs** associated with remanufactured RDCs than those Manufacturers who had not.

4. Positive correlations were found between the Manufactures **Behavioural Intentions and** Subjective Norms (Injunctive and Descriptive) and Perceived Behavioural Control.
5. The Persuasive Communication positively influenced the Manufacturers' Behavioural Intentions to *produce remanufactured RDCs.*

7. Other factors influencing remanufacturing behaviours of stakeholders in the Retail Refrigeration Industry

Introduction

This chapter identifies other factors that have not been investigated in previous chapters but have an influence on the attitudes, beliefs and perceptions of grocery retailers and RDC manufacturers. Negative factors often revolve around presumptions of remanufacturing, including its processes and outputs (European Remanufacturing Network, 2016; Centre for remanufacturing and Reuse, 2009; All Party Parliamentary Sustainable Resource Group, 2014). On the other hand, positive factors can include financial incentives, process-supporting tools and remanufacturing standards (Ellen MacArthur Foundation, 2015; Carbon Trust et al., 2014; Centre for Remanufacturing and Reuse, 2009). There is currently a lack of research into how these factors can influence remanufacturing behaviours within the Retail Refrigeration Industry. Therefore, this chapter will aim to establish:

- the extent to which grocery retailers and RDC manufacturers understand remanufacturing,
- the key drivers and barriers to the purchase and production of remanufactured RDCs,
- the potential influence of industry-specific Behaviour Change Interventions (e.g. tax rebates, tools and standards) on encouraging remanufacturing within the Retail Refrigeration Industry.

There is also a lack of overall research into the perceptions of Circular Economy within the Retail Refrigeration Industry. Therefore, this chapter will also aim to establish:

- the extent to which grocery retailers and RDC manufacturers are familiar with the Circular Economy concept
- the extent to which grocery retailers and RDC manufacturers understand how their practices can develop the concept,
- the intentions of grocery retailers and RDC manufacturers to engage with *circular* businesses.

The chapter will begin by outlining the methodology, which provides a summary of the examined population sample and details the research procedures. It also provides a description of the investigated

factors, a rationale for their inclusion and an explanation of how they were embedded into the survey. Finally, an analysis and discussion of the results are presented.

7.1. Research methodology

The data investigated in this study was collected during Studies 1 and 2 (as outlined in Chapter 1.5). The surveys used in Chapter 5 and Chapter 6 (Appendix D and E) included additional measures that aimed to evaluate the impact of other factors on the adoption of Circular Economy and two remanufacturing behaviours - *buying remanufactured RDCs* and *producing remanufactured RDCs* (as explained further in Chapter 7.1.2.). The data collected using these additional measures formed the basis of a separate analysis in this chapter.

This study has been granted ethical approval by the School of Engineering Ethics Committee at London South Bank University. A letter of approval is attached in Appendix G.

7.1.1. Population sample and research procedure

This study involved the same population samples as Chapters in 5 and 6. The data in this study was collected between April and September 2017. This sample includes two participants' groups - the Retailers and Manufacturers and all but one participant (number R9 in Chapter 5) took part in this study. In total 25 participants including Retailers (N=19) and Manufacturers (N=6) took part in the study. The responses from the two groups were either completed on-line or in person. The majority of participants were in upper management roles (N=13), followed by a number of mid-level (N=10) and junior (N=2) mangers. The participants' ages ranged from 26 to 65 years ($\bar{x}=42$). The majority of them were male (92%). To ensure confidentiality, the participants names and retail or manufacturing brands are not disclosed.

7.1.2. Survey design

The impact of other factors on the adoption of Circular Economy and pro-circular behaviours of stakeholders was examined using the appropriate questionnaire measures. These measures were embedded in the surveys used in Chapter 5 and 6. The development of these measures was also supported by the same three industry experts. As illustrated in Figure 7.1.2., the questionnaire measures

analysed in this chapter were embedded in the survey in a predetermined order, and positioned carefully to limit the effects on other measures, such as those used in Chapter 5 and 6. The measures in the survey were also ordered to ensure that participants' responses were impartial to other content in the survey.

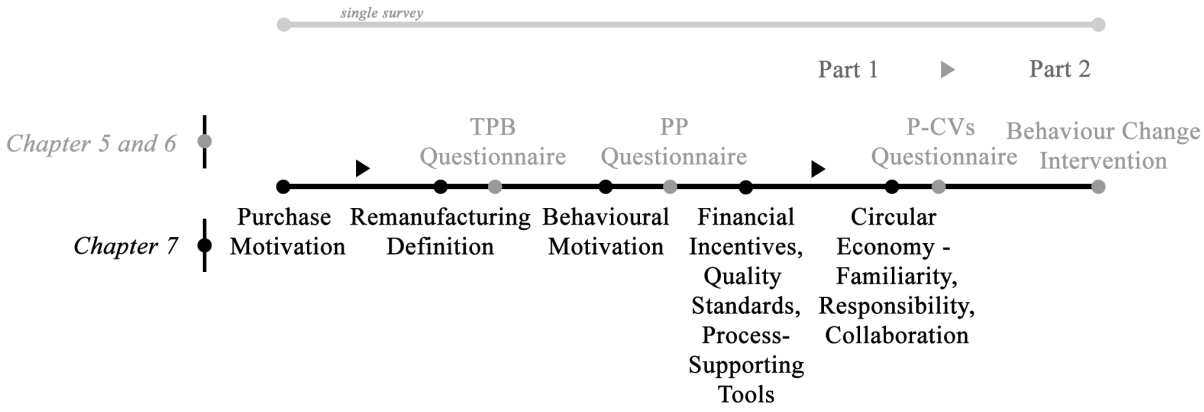


Figure 7.1.2. Retailers' and Manufacturers' survey – outline.

7.1.2.1. Pilot test

All questionnaire measures used in this study, were piloted at the same time as measures used in Chapters 5 and 6. Specifically, the questionnaires used in survey targeted at Retailers were piloted on seven individuals (as described in Chapter 5.1.2.1.). Whereas, the questionnaires targeted at Manufacturers we piloted on three individuals (as described in Chapter 6.1.2.1.). Their feedback was used to refine the instructions, clarify the questions and improve the scales. The revised questionnaire items are presented in Chapter 7.1.2.2.

7.1.2.2. Questionnaire items

The questionnaire items, together with the scales are summarised in Table 7.1.2.2 and explained further in the following sections.

Table 7.1.2.2. Other factors influencing pro-circular behaviours of Retailers (R) and Manufacturers (M) - questionnaire items.

Variable	**Group**	***Question***	**Scale Items**
Purchase Motivation	R	*When choosing RDCs, what factors are the most important to you and have the biggest influence on your decision to purchase?*	*design, price, time of the process (from order to delivery), delivery distance, B2B relationships, quality of cabinets, carbon footprint of cabinets, ability to customise cabinets, running costs, manufacturer's reliability, warranty length, safety of cabinets, sustainability of cabinets, longevity of cabinets, company policies, ability to remanufacture/refurbish cabinets, reliability of cabinets, 'other'*
	M	*In your opinion, what factors are the most important to your clients and have the biggest influence on their decision to purchase RDCs?*	
Remanufacturing Definition	R/M	*How strongly would you agree or disagree that the term remanufactured means the same as refurbished in context of RDCs?*	Agree (7) – Disagree (1) [a]
Financial Incentives	R	*If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to purchase them?*	Likely (7) – Unlikely (1) [a]
	M	*'If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to produce them?*	
Quality Standards	R	*If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to purchase them?*	Likely (7) – Unlikely (1) [a]
	M	*If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to produce them?*	
Process-Supporting Tools	R	*If there was a tool or a system that could make buying factory-remanufactured RDCs easy, how likely would this encourage you to purchase them?*	Likely (7) – Unlikely (1) [a]
	M	*'If there was a tool or a system that could make manufacturing*	

		of factory-remanufactured RDCs easy, how likely would this encourage you to produce them?	
Behavioural Motivation	R	*Why did you decide to purchase any factory-remanufactured RDCs for your stores in the past year?*	Buying / producing factory-remanufactured RDCs saves money / is profitable. I am expected to buy/ produce factory-remanufactured RDCs, Factory-remanufactured RDCs have a lower carbon footprint. It is company policy to buy/produce factory-remanufactured RDCs, Other
	M	*Why did you decide to produce any factory-remanufactured RDCs for your clients in the past year?*	
	R	*Why did you decide not to purchase any factory-remanufactured RDCs for your stores in the past year?*	Purchasing remanufactured RDCs/ Remanufacturing process is too complex. Remanufacturing is not offered by manufacturers/My clients don't want to buy remanufactured RDCs, I prefer to buy/produce new RDCs. I am unconvinced of the benefits of buying factory-remanufactured RDCs/producing factory-remanufactured RDCs, I don't know enough about factory-remanufactured/ factory-remanufacturing RDCs. It's against company policy to buy / produce factory-remanufactured RDCs. Other
	M	*'Why did you decide not to produce any factory-remanufactured RDCs for your clients in the past year?*	
Circular Economy - Familiarity	R/M	*Prior to this survey, how familiar were you with the concept of Circular Economy?*	Familiar (5) – Unfamiliar (1) [b]
Circular Economy – Responsibility	R/M	*How strongly would you agree or disagree, that your business decisions could help to develop a Circular Economy in the retail refrigeration sector?*	Agree (7) – Disagree (1) [a]
Circular Economy – Collaboration	R/M	*'How likely would you choose to work with a company, that incorporates a Circular Economy into their business practice?*	Likely (7) – Unlikely (1) [a]

[a] 7-point Likert scale
[b] 5-point Likert scale

a) Purchase Motivation: exploring influencers of purchasing RDCs

Retailers consider price to be key influencer when deciding to purchase RDCs (Centre for Remanufacturing and Reuse, 2009; Monier et al., 2007; European Commission, 2014a). This study developed a direct measure of 'Purchase Motivation', which allowed Retailers and Manufacturers to indicate the key factors they perceive as having influence over the purchase of RDCs. This measure was assessed using two questions. The first question was directed at Retailers and defined as: '*When choosing RDCs, what factors are the most important to you and have the biggest influence on your decision to purchase?'*. The second question was directed at Manufacturers and defined as: '*In your opinion, what factors are the most important to your clients and have the biggest influence on their decision to purchase RDCs?*'.

Both questions were accompanied by multiple-choice answers, allowing participants to indicate the key factors (a maximum of five) from a list of 18 items. The options included: *design, price, time of the process (from order to delivery), delivery distance, B2B relationships, quality of cabinets, carbon footprint of cabinets, ability to customise cabinets, running costs, manufacturer's reliability, warranty length, safety of cabinets, sustainability of cabinets, longevity of cabinets, company policies, ability to remanufacture/refurbish cabinets, reliability of cabinets* and *'other'* (providing an opportunity for participants to detail any factors that were not included in the questionnaire).

b) Remanufacturing Definition: exploring Retailers' and Manufacturers' understanding of remanufacturing RDCs

Experts agree that a common understanding of terminologies is crucial in supporting the development of Circular Economy (Suff, 2016). In the context of remanufacturing, a lack of understanding about the process and its outcomes has contributed to its low uptake across many industries (European Union, 2017). The absence of common definitions causes misperceptions of remanufactured products being refurbished and of low-quality (European Remanufacturing Network, 2015; Centre for Remanufacturing and Reuse, 2009). This contradicts the industrial definition of remanufactured products being as 'good-as-new' (European Remanufacturing Network, 2015).

The Retail Refrigeration Industry is a prime example where the lack of understanding and absence of common definitions has hindered the popularity of remanufacturing, where the remanufacturing of a

RDC is often mistaken with its refurbishment and/or reuse (Centre for Remanufacturing and Reuse, 2009). This can lead to Retailers incorrectly perceiving the quality of RDCs produced by the above methods as indifferent (Muranko et al., 2016). As explained in Chapter 2, the process of remanufacturing RDCs differs significantly from refurbishment.

A direct measure of 'Remanufacturing Definition' was developed to investigate the extent to which the definition of remanufacturing RDCs is interpreted accurately by Retailers and Manufacturers. This was assessed using a single-response question defined as: *'How strongly would you agree or disagree that the term remanufactured means the same as refurbished in context of RDCs?'*. The question used a 7-point Likert scale, allowing Retailers and Manufacturers to express how strongly they *agreed – disagreed* with the given question. The analysis of results and how both understood the terminology is presented in Chapter 7.2.1.2.

c) Financial Incentives: Measuring the impact of tax rebates on the Behavioural Intentions of Retailers and Manufactures to purchase and produce remanufactured RDCs

Financial incentives are important in driving individuals and businesses to adopt *circular* business models (Ellen MacArthur Foundation, 2015) particularly remanufacturing (Carbon Trust et al., 2014). In many commercial environments price is a key consideration when purchasing products. This is particularly true in the Retail Refrigeration Industry, where Retailers who buy RDCs are very price-sensitive and follow the general principle that the "cheapest is the best" (Centre for Remanufacturing and Reuse, 2009).

As mentioned in Chapter 2, Retailers can potentially benefit from as much as a 30% reduction in the cost of purchasing a remanufactured RDC, when compared with the price of purchasing a new RDC. However, the cost of remanufacture is strongly dependent on the quality of end-of-life cores which can determine the extent of effort, skills and new components required.

The introduction of a regulated financial incentive that provides a fixed discount on remanufactured products (e.g. tax rebate) could positively influence the purchasing behaviour of Retailers and drive demand for remanufactured RDCs. This increase in demand would equally provide Manufacturers with a financial incentive to introduce remanufacturing into their business models.

An example of a successful financial incentive is the Enhanced Capital Allowance (ECA) scheme. The ECA scheme was introduced in the UK in 2001 to encourage businesses to reduce their energy consumption by purchasing energy-efficient products (Department of Energy and Climate Change, 2015). The ECA scheme provides 20% tax relief on the purchase of new energy-efficient products on the Government's Energy Technology List (ETL; Department of Energy and Climate Change, 2015). The ETL currently lists 3,967 products under the 'Refrigeration Equipment' category, including energy-efficient RDCs (Department of Energy and Climate Change, 2015). Despite remanufactured RDCs meeting the eligibility criteria for the ECA scheme, in terms of energy efficiency and technical specifications, they are excluded from the ETL (Muranko et al., 2016). The inclusion of remanufactured products in the ECA scheme would ultimately encourage pro-circular behaviors by providing Retailers with more assured financial incentives to purchase remanufactured RDCs (Centre for Remanufacturing and Reuse, 2009; Muranko et al., 2017b).

A direct measure of 'Financial Incentives' was developed to investigate the influence potential tax rebates can have on the Behavioural Intentions of Retailers and Manufactures to purchase and produce remanufactured RDCs, as well as to practice the Circular Economy. This was assessed using three single-response questions. The first question was directed at Retailers and defined as: *'If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to purchase them?'*. The second question was directed at Manufacturers and defined as: *'If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to produce them?'*. Both questions were also accompanied with a brief explanation of what the ECA scheme entails, namely that it provides a 20% discount on eligible energy-efficient RDCs. This explanation was included to ensure all Retailers and Manufactures were fully aware of the benefits. The third question was defined as: *'If the government provided financial incentives (e.g. tax rebates) supporting a Circular Economy, would that encourage you to practice it?'*. The items were accompanied by a 7-point Likert scale, allowing Retailers and Manufactures to express how *likely* (scored at 7) - *unlikely* (scored at 1) the presence of financial incentives would influence their behavioural intentions to perform pro-circular behaviours.

The analysis of results on the influence financial incentives could have on Retailers and Manufactures Behavioural Intentions are presented in Chapter 7.2.1.3.

d) Quality Standards: Measuring the impact of Quality Standards on the Behavioural Intentions of Retailers and Manufactures to purchase and produce remanufactured RDCs

With the quality of remanufactured products often being perceived as poor (All Party Parliamentary Sustainable Resource Group, 2014), the development of a product-specific remanufacturing quality standard could help to encourage pro-circular behaviours (European Unions, 2017; Carbon Trust et al., 2014).

At present, there is no recognised industry standard for the quality of remanufactured RDCs. This has contributed to the misperception that remanufactured RDCs are inferior to brand-new RDCs, which can reduce the intentions of Retailers to purchase remanufactured RDCs. A recognised quality standard would provide Retailers with an assurance on the quality of remanufactured RDCs and potentially have a positive impact on their attitudes and perceptions towards remanufacturing. The result being an increase in the demand and therefore the supply of remanufactured RDCs in the retail refrigeration market (Muranko et al., 2016).

A direct measure of 'Quality Standards' was developed to investigate the impact a potential standard for quality of remanufactured RDCs can have on the Behavioural Intentions of Retailers and Manufacturers to purchase and produce remanufactured RDCs. This was assessed using two single-response questions. The first question was directed at Retailers and defined as: *'If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to purchase them?'*. The second question was directed at Manufacturers and defined as: *'If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to produce them?'*. Both questions were accompanied by a 7-point Likert scale, allowing Retailers and Manufacturers to express how *likely* (scored at 7) - *unlikely* (scored at 1) the presence of the Quality Standards would influence their Behavioural Intentions to perform pro-circular behaviours.

The analysis of results on the impact quality standards could have on Retailers and Manufacturers Behavioural Intentions are presented in Chapter 7.2.1.4.

e) Process Supporting Tools: encouraging the uptake of pro-circular behaviours

Having Process-Supporting Tools that provide clear guidance on how to successfully implement and practice *circular* business models are important instruments to support businesses shifting to *circular* business practices (Ellen MacArthur Foundation, 2015; Kalmykova et al., 2018; European Union, 2017).The development of industry-specific supporting tools that provide best practice and guidance on the processes of purchasing and producing remanufactured products could be highly influential in encouraging businesses to adopt remanufacturing (Carbon Trust et al, 2014; Ijomah, 2008).

There are currently no widely available Process-Supporting Tools that focus on remanufactured RDCs. Potential tools would include a made-to-order process which would facilitate and streamline dialog between Retailers and Manufacturers when discussing the sale of remanufactured RDCs. There are also currently no process-supporting tools available to produce remanufactured RDCs. Potential tools would include a remanufacturing framework for remanufacturers and an established library of available remanufacturable cores that are specific to RDCs.

A direct measure of 'Process Supporting Tools' was developed to investigate the impact the they could have on Retailers and Manufacturers Behavioural Intentions to purchase and produce remanufactured RDCs. This was assessed using two single-response questions. The first question was directed at Retailers and defined as: *'If there was a tool or a system that could make buying factory-remanufactured RDCs easy, how likely would this encourage you to purchase them?'*. The second question was directed at Manufacturers and defined as: *'If there was a tool or a system that could make manufacturing of factory-remanufactured RDCs easy, how likely would this encourage you to produce them?'*. Both questions were supported by a 7-point Likert scale allowing participants to express how *likely – unlikely* the tools would influence their Behavioural Intentions to perform pro-circular behaviours.

An analysis of results on the impact 'Process Enabling Tools' could have on Retailers and Manufacturers Behavioural Intentions are presented in Chapter 7.2.1.5.

f) Behavioural Motivation: exploring drivers and barriers to performing pro-circular behaviours by Retailers and Manufactures

The results in Chapter 5 and Chapter 6 suggested that Retailers and Manufactures favour the purchase and production of new RDCs[51]. Identifying the underlying reasons for this behaviour will develop an understanding of the common barriers and drivers of remanufacturing in the Retail Refrigeration Industry.

A direct measure of 'Behavioural Motivation' was developed to investigate the drivers and barriers to Retailers and Manufacturers purchasing and producing remanufactured RDCs in the past. This was assessed using four multiple-choice questions. The first two questions were developed to assess factors that caused Retailers and Manufactures to perform pro-circular behaviours in the past. The First question, directed at Retailers (A) was defined as: *'Why did you decide to purchase any factory-remanufactured RDCs for your stores in the past year?'.* The second question, directed at Manufacturers (B) was defined as: *'Why did you decide to produce any factory-remanufactured RDCs for your clients in the past year?'.* Both questions were accompanied by five multiple-choice answers allowing Retailers and Manufactures to indicate the factors that caused their Past Behaviours. The multiple-choice answers included:

- '*Buying (A) / producing (B) factory-remanufactured RDCs saves money (A) / is profitable (B).'*
- *'I am expected to buy (A) / produce (B) factory-remanufactured RDCs.'*
- *'Factory-remanufactured RDCs have a lower carbon footprint.'*
- *'It is company policy to buy (A) / produce (B) factory-remanufactured RDCs.'*
- *'Other'* (providing an opportunity to detail any factors that were not included in the questionnaire).

The next two questions were developed to assess the factors that prevented Retailers and Manufacturers from performing pro-circular behaviours in the past. The first question, directed at Retailers (A) was defined as: *'Why did you decide not to purchase any factory-remanufactured RDCs for your stores in the past year?'.* The second question, directed at Manufacturers (B) was defined as:

[51] Only 5% of Retailers had bought a remanufactured RDC and 20% of Manufacturers in the study had produced a remanufactured RDC

'Why did you decide not to produce any factory-remanufactured RDCs for your clients in the past year?'. The questions were accompanied by seven multiple-choice answers allowing Retailers and Manufactures to indicate the factors that caused their Past Behaviours. The multiple-choice answers included:

- '*Purchasing remanufactured RDCs (A) / Remanufacturing process (B) is too complex.'*
- *'Remanufacturing is not offered by manufacturers (A) / My clients don't want to buy remanufactured RDCs (B).'*
- *'I prefer to buy (A) / produce (B) new RDCs.'*
- *'I am unconvinced of the benefits of buying (A) factory-remanufactured RDCs / producing factory-remanufactured RDCs (B).'*
- *'I don't know enough about factory-remanufactured (A) / factory-remanufacturing (B) RDCs.'*
- *'It's against company policy to buy (A) / produce (B) factory-remanufactured RDCs.'*
- *'Other'* (giving an opportunity to specify any factors that were not included in the questionnaire).

An analysis of results on the 'Behavioural Motivation' of Retailers and Manufacturers Past Behaviour are presented in Chapter 7.2.1.6.

g) Circular Economy – Familiarity: measuring the extent to which Retailers and Manufacturers are familiar with the concept

A most recent study estimated that in 2014 at least 50% of businesses within the technical sector were not aware of the Circular Economy concept (FUSION Project, 2014). This is reflected within the Retail Refrigeration Industry, where only a handful of businesses (e.g. Marks and Spencer, 2018; The Bond Group, 2017) mention or quote the Circular Economy in their marketing communications. The concepts lack of exposure could explain why many Retailers and Manufactures within the Retailer Refrigeration Industry are unfamiliar with the Circular Economy concept.

A direct measure of 'Circular Economy – Familiarity' was developed to investigate the extent to which Retailers and Manufacturers are familiar with the Circular Economy concept. This was assessed using a single-response question, directed at both Retailers and Manufactures and defined as: *'Prior to*

this survey, how familiar were you with the concept of Circular Economy?'. The question was supported by a 5-point Likert scale allowing Retailers and Manufactures to express how *familiar – unfamiliar* (scale items as advised in Vagias, 2006) they are with the Circular Economy concept.

An analysis of their familiarity with the Circular Economy is presented in Chapter 7.2.1.7.

h) Circular Economy – Responsibility: exploring Retailers' and Manufacturers' positioning in the development of Circular Economy

There is some evidence to suggest that resource-efficiency is slowly becoming more prevalent in the Retail Refrigeration Industry. For example, the Corporate Social Responsibility reports of many Retailers publicise their socio-economic and environmental initiatives (e.g. Tesco, 2016; Marks and Spencer, 2017; Sainsbury's, 2018), which centre on waste prevention (e.g. reducing food waste and discouraging carrier bag use) and sustainable operations (e.g. reducing carbon footprint and energy use). This trend is also followed in the marketing publications of RDC manufacturers (e.g. Taylor UK, 2017; Carter Retail Equipment, 2017) who often promote the production of energy-efficient equipment and use of more sustainable refrigerants in the manufacture of new products. However, only few Manufacturers promote refurbishment and remanufacture as a way of achieving environmental and economic efficiency (Epta UK, 2017; Carter Retail Equipment, 2016; The Bond Group, 2017). The lack of specific Circular Economy references in the publications of both Retailers and Manufacturers, suggests that neither position themselves as pioneers or influencers of Circular Economy.

Following an explanation of the Circular Economy in the survey (Appendix D and E), Retailers and Manufacturers were asked 'How strongly would you agree or disagree, that your business decisions could help to develop a Circular Economy in the retail refrigeration sector?'. This was structured as a single-response and supported by a 7-point Likert scale which allowed Retailers and Manufacturers to express how strongly they agreed – disagreed.

An analysis of the extent to which Retailers and Manufacturers perceive they have an influence on the development of the Circular Economy is presented in Chapter 7.2.1.8.

i) Circular Economy – Collaboration: measuring Retailers and Manufactures willingness to work with circular businesses

Cross-sector collaboration between businesses is key when transitioning towards the Circular Economy (Witjes and Lozano, 2016; McKinsey and Company, 2016). This allow businesses to maximise the value of products and materials in an effort to minimise the use of natural resources and bear a positive societal and environmental impact (Kraaijenhagen et al., 2016). A mutually beneficial working partnership between Retailers and Manufacturers is therefore essential in order to develop the Circular Economy in the Retail Refrigeration Industry.

A direct measure of 'Circular Economy - Collaboration' was developed to investigate the extent to which Retailers and Manufacturers are willing to work with companies who apply the principles of Circular Economy in their business practices. This was assessed using a single-response question, defined as: *'How likely would you choose to work with a company, that incorporates a Circular Economy into their business practice?'.* The question was supported by a 7-point Likert scale allowing them to express how *likely – unlikely* they would work with *circular* businesses.

An analysis of results showing both Retailers and Manufacturers willingness to work with *circular* businesses is presented in Chapter 7.2.1.9.

7.2. Results

7.2.1. Descriptive Statistical Analysis

This section presents a descriptive statistical analysis of the Retailers and Manufactures:

- familiarity with remanufacturing and the Circular Economy,
- understanding of the impact their business decision have on the development of the concept,
- willingness to collaborate with other *circular* businesses,
- motivations for past behaviour,
- motivations to purchase RDCs,
- intention to perform pro-circular behaviours based on the introduction of Financial Incentives, Quality Standards and Process Supporting Tools.

First, sample means were calculated to estimate the central tendency of data. Standard deviations were then calculated to indicate the dispersion of data from the sample mean. Lastly, standard errors were calculated to indicate the precision of the study.

7.2.1.1. Purchase Motivation

As illustrated in Figure 7.2.1.1.a, the majority of Retailers reported that the most important factor (scored by >50% of participants) in motivating them to purchase RDCs is *price (N=16; recorded by 80% of Retailers in the sample)*. This was followed by *quality (N=14; 70%), running costs (N=13, 65%)* and *design (N=11, 55%).* The *ability to remanufacture RDCs (N=1, 5%),* their *longevity (N=5, 25%)* and *sustainability* (*N=5; 25%)* were scored considerably lower. No scores were given to the *delivery distance, B2B relationships* and *policies*.

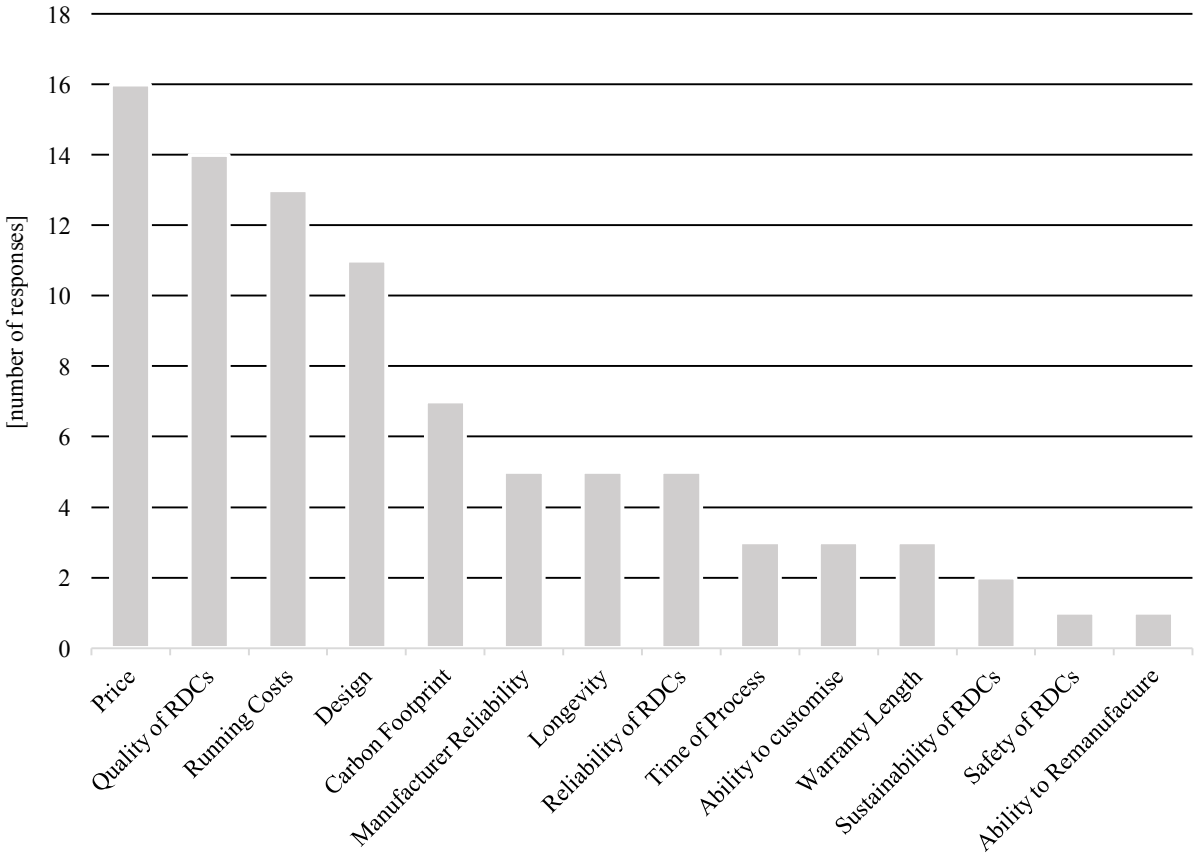


Figure 7.2.1.1.a. Factors that influence Retailers' decisions when purchasing RDCs.

Correspondingly, as illustrated in Figure 7.2.1.1.b, the majority of Manufacturers perceived the most important factor (scored by >50% of participants) in motivating Retailers to purchase RDCs is price *(N=6; recorded by 100% of Manufacturers in the sample;* Figure 7.2.1.1.b). This was followed by *quality (N=4; 67%), running costs (N=4, 67%)* and *design of RDCs (N=4, 67%).* A low number or no scores were given to the *ability to remanufacture RDCs (N=0), longevity (N=1, 17%)* and *sustainability* (*N=1; 17%)*. No scores were given to the *delivery distance*, *warranty length*, *product safety* and *policies*.

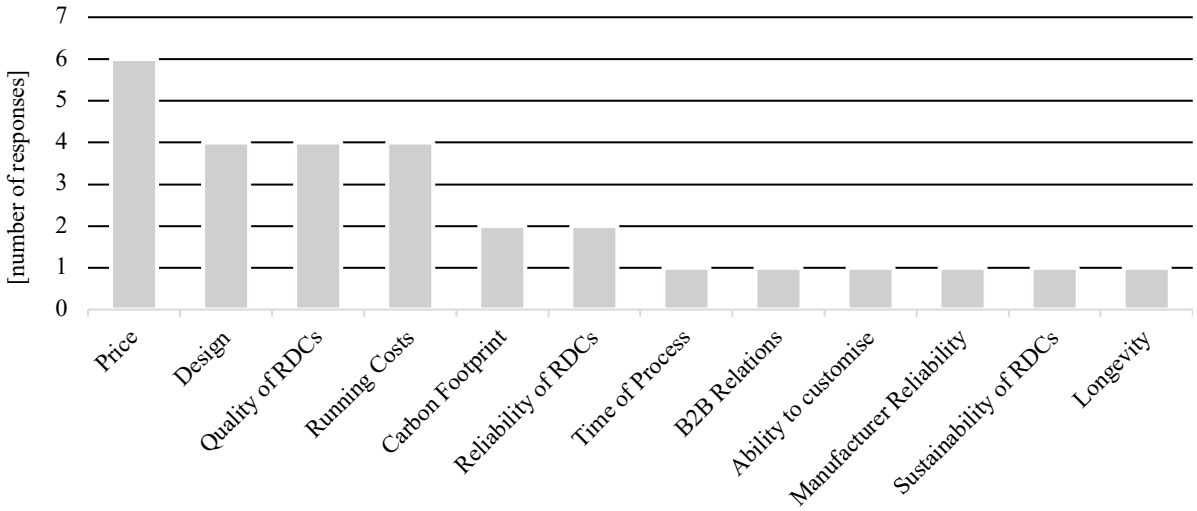


Figure 7.2.1.1.b. Perceived by Manufacturers factors that have an influence on Retailer's decisions when purchasing RDCs.

7.2.1.2. Remanufacturing Definition

The analysis of results presented in Table 7.2.1.2. shows that the majority of Retailers and Manufacturers misunderstand the term 'remanufacturing', in the context of RDC production, and neither Retailers or Manufacturers could differentiate the term 'remanufacture' from 'refurbishment'.

Table 7.2.1.2. Stakeholders' Understanding of remanufacturing definition.

	N	$\bar{x}$	*SE*	*SD*	minimum	maximum
Retailers	20	**4.95**	*0.43*	*1.93*	1	7
Manufacturers	6	**4.18**	*0.79*	*1.94*	1	6

Note: 7-point Likert scale was used

7.2.1.3. Financial Incentives: impact on Behavioural Intentions

The analysis of results presented in Table 7.2.1.3. shows the suggestion of an Enhanced Capital Allowance (ECA) scheme for remanufactured products had a positive impact on the Retailers' and Manufacturers' Behavioural Intentions to purchase and produce remanufactured RDCs. The presence of other potential financial incentives, such as tax rebates for implementing *circular* business models, similarly had a positive impact on Retailers and Manufacturers Behavioural Intentions.

Table 7.2.1.3. Influence of financial incentives (the ECA scheme for Remanufactured RDCs and tax rebates for Circular Economy) on stakeholders Behavioural Intentions.

	N	$\bar{x}$	*SE*	*SD*	minimum	maximum
ECA Incentives						
Retailers	19	**5.74**	*0.21*	*0.93*	4	7
Manufacturers	6	**5.33**	*0.33*	*0.82*	4	6
CE Incentives						
Retailers	19	**6.53**	*0.12*	*0.51*	6	7
Manufacturers	5	**6.20**	*0.58*	*1.30*	4	7

Note: 7-point Likert scale was used

7.2.1.4. Quality Standards: impact on Behavioural Intentions

The analysis of results in Table 7.2.1.4. shows that the suggestion of a Quality Standard for remanufactured RDCs, had a positive impact on the Behavioural Intentions of the Retailers and Manufacturers to purchase and produce remanufactured RDCs.

Table 7.2.1.4. Influence of Quality Standards on Behavioural Intentions

	N	$\bar{x}$	*SE*	SD	minimum	maximum
Retailers	19	**5.26**	*0.24*	1.05	3	7
Manufacturers	6	**5.33**	*0.33*	0.82	4	6

Note: 7-point Likert scale was used

7.2.1.5. Process-Supporting Tools: impact on Behavioural Intentions

The analysis of results in Table 7.2.1.5. shows that the potential presence of Process-Supporting Tools had a positive influence on the Behavioural Intentions of Retailers and Manufacturers to purchase and produce remanufactured RDCs.

Table 7.2.1.5. Influence of Process-Supporting Tools on Behavioural Intentions.

	N	$\bar{x}$	*SE*	SD	minimum	maximum
Retailers	19	**5.53**	*0.19*	0.84	4	7
Manufacturers	6	**5.33**	*0.33*	0.82	4	6

Note: 7-point Likert scale was used

7.2.1.6. Behavioural Motivation: drivers and barriers to performing pro-circular behaviours

a) Drivers

As shown in Table 7.2.1.6.a. most Retailers considered *financial savings (N=3)* as the most important factor when deciding to purchase remanufactured RDCs in the past. Some Retailers considered the *low carbon footprint* of remanufactured RDCs *(N=1)* and their *company policies* (*N=1)* to be influences of their Past Behaviour. None of the Retailers recorded that they were *expected* to purchase remanufactured RDCs.

On the other hand, most Manufacturers acknowledged that it was *expected* of them to produce remanufactured RDCs *(N=3)* and that this was an important factor motivating when deciding to produce remanufactured RDCs in the past. One Manufacturer considered the *profitability* of producing remanufactured RDCs as an influencer of their Past Behaviour. None of the Manufacturers recorded that the *low carbon footprint* of remanufactured RDCs and their *company policies* as being a driver to the production of remanufactured RDCs.

Table 7.2.1.6.a. Drivers to purchasing and producing remanufactured RDCs.

Purchasing Drivers	**N**	Producing Drivers	**N**
Saves money	**3**	It's profitable	**1**
I'm expected to do so	**0**	I'm expected to do so	**3**
Low Carbon	**1**	Low Carbon	**0**
It's company's Policy to do so	**1**	It's company's Policy to do so	**0**
Other*	**-**	Other*	**-**

*No qualitative data was recorded

b) Barriers

As shown in Table 7.2.1.6.b. most Retailers considered a *lack of knowledge* about remanufactured RDCs *(N=6)* as the most important factor preventing them from purchasing remanufactured RDCs in the past. A few Retailers also indicated that the *lack of available* remanufacturing services *(N=4)* was preventing them from purchasing remanufactured RDCs. A similar number of Retailers recorded that the *preference of buying new* RDCs *(N=4)* resulted in them not considering the purchase of remanufactured RDCs. The perceived *complexity (N=1)* and *unconvincing benefits* of purchasing remanufactured RDCs (*N=2)* were given a recorded by the minority of Retailers as having an impact on their Past Behaviour. No Retailers considered *company policy* as a barrier to considering the purchase of remanufactured RDCs.

In comparison, most Manufacturers recorded a *preference to produce new* RDCs *(N=2)* and their *company policy (N=2)* as being key barriers to producing remanufactured RDCs in the past. A *lack of customer demand (N=1), process complexity (N=1)* and *unconvincing benefits of producing remanufactured RDCs* (*N=1)* were also considered as barriers. No Manufacturers considered a *lack of knowledge* about remanufacturing RDCs as being a barrier to production of remanufactured RDCs.

Table 7.2.1.6.b. Barriers to purchasing and producing remanufactured RDCs.

Purchasing Barriers	**N**	Producing Barriers	**N**
Complexity of the process	**1**	Complexity of the process	**1**
Option is Not Offered	**4**	No Demand	**1**
Preference of Buying New	**4**	Preference of Producing New	**2**
Unconvinced about benefits	**2**	Unconvinced about benefits	**1**
Don’t know about it	**6**	Don't know how to do it	**-**
Against company policy	**-**	Against company policy	**2**
Other*	**-**	Other*	**-**

*No qualitative data was recorded

7.2.1.7. Circular Economy: Stakeholders’ Familiarity

The analysis of results presented in Table 7.2.1.7. shows that both Retailers and Manufacturers had little or no familiarity with the concept of Circular Economy.

Table 7.2.1.7. Stakeholders' familiarity with Circular Economy.

	N	$\bar{x}$	*SE*	*SD*	minimum	maximum
Retailers	19	**2.63**	*0.34*	*1.50*	1	5
Manufacturers	6	**2.83**	*0.48*	*1.17*	1	4

Note: 5-point Likert scale was used

7.2.1.8. Circular Economy: Stakeholders' Responsibility

The analysis of results shown in Table 7.2.1.8 shows that both Retailers and Manufactures consider their business decisions as being highly impactful on the development of Circular Economy in the Retail Refrigeration Industry.

Table 7.2.1.8. Stakeholders' perceived responsibility in supporting the development of the Circular Economy.

	N	$\bar{x}$	*SE*	*SD*	minimum	maximum
Retailers	19	**5.84**	*0.29*	*1.26*	2	7
Manufacturers	5	**6.40**	*0.40*	*0.89*	5	7

Note: 7-point Likert scale was used

7.2.1.9. Circular Economy: Collaboration

The analysis of results presented in Table 7.2.1.9 shows that the majority of Retailers and Manufacturers are willing to work with companies who apply Circular Economy to their business practices.

Table 7.2.1.9. Stakeholders' willingness to work with *circular* businesses.

	N	$\bar{x}$	*SE*	*SD*	minimum	maximum
Retailers	19	**6.00**	*0.19*	*0.82*	4	7
Manufacturers	5	**5.80**	*0.49*	*1.09*	4	7

Note: 7-point Likert scale was used

7.2.2. Inferential statistical analysis

A paired sample t-test was used to analyse the impact the Behaviour Change Interventions (i.e. Financial Incentives, Quality Standards and Process-Supporting Tools) had on the Behavioural Intentions of both Retailers and Manufactures. The t-test was used to determine whether the means of

Behavioural Intentions recorded before and after the Behaviour Change Interventions differed significantly.

7.2.2.1. Difference in Behavioural Intentions after the influence of Financial Incentives, Quality Standards and Process Supporting Tools

The result of the paired sample t-test in Table 7.2.2.1. shows that ECA scheme, Quality Standards and Process-Supporting Tools had a positive and statistically significant influence on the Behavioural Intentions of Retailers to purchase remanufactured RDCs. These results were similar for Manufacturers, with the ECA scheme, Quality Standards and Process-Supporting Tools also having a positive statistically significant influence on their Behavioural Intentions to produce remanufactured RDCs.

Table 7.2.2.1. Summary of t-test on Behavioural Intentions (BI) before and after the Behaviour Change Interventions.

	t	df	*p*
Retailers			
Current BI – BI with ECA	**3.67**	18	*< .001**
Current BI – BI with Quality Standard	**1.83**	18	*0.042**
Current BI – BI with Process Supporting Tools	**3.38**	18	*0.002**
Manufacturers			
Current BI – BI with ECA	**2.74**	5	*0.020**
Current BI – BI with Quality Standard	**2.74**	5	*0.020**
Current BI – BI with Process Supporting Tools	**2.74**	5	*0.020**

Hypothesis: Measure 1 < Measure 2. *Note: Student t-test*
* Significance: p<0.05*

7.3. Discussion

7.3.1. Price, quality, running costs and design – the key drivers to the purchase of RDCs

Chapter 7.2.1.1. explored the general factors that influence both Retailers and Manufacturers decisions to purchase RDCs. The responses of Retailers indicated that *price (scored at 80%)* is the most important factor driving their purchasing decisions. This result aligns with similar inferences within current literature (Centre for Remanufacturing and Reuse, 2009; Monier et al., 2007; Muranko et al., 2017b). As suggested by Monier et al. (2007), the majority of Retailers considered the *running costs*

(scored by 65%) as an important factor when deciding to purchase RDCs. In addition, factors such as the *quality (scored by 70%),* and the *design* of RDCs *(scored by 55%)* were also considered to be decisive when deciding to purchase RDCs. Manufacturers perceived the most important factor for Retailers when deciding to purchase RDCs is the *price (scored by 100%)*. This was followed by *quality (scored by 67%), running costs* (*scored by 67%)* and *design* (*scored by 67%)* of RDCs. These results align with the responses of Retailers, which suggests that Manufacturers have a good understanding of their consumers' purchasing drivers. Furthermore, the influence of *price* on the Retailers' Past Behaviours was recorded in Chapter 7.2.1.6. This chapter highlighted that the majority of Retailers previously purchased remanufactured RDCs because *it saves money (N=3)*. The economics of purchasing RDCs was similarly suggested to be a strong influencer of Retailers' behaviour in Chapter 5, where they were exposed to a Behaviour Change Intervention in the form of a Persuasive Communication message. The message emphasised the financial benefits of purchasing remanufactured RDCs and was highly influential. These results suggest that highlighting the financial benefits of purchasing remanufactured RDCs can be a very effective way of instigating pro-circular behaviours among Retailers in the retail grocery sector.

For Retailers to consider the purchase of remanufactured RDCs it is crucial that the remanufactured RDCs are produced to a high quality, with energy efficient components and designed to buyers' specifications. Practically, the development of Quality Standards and Process Supporting Tools would provide Retailers with an assurance regarding the high of remanufactured RDCs (as discussed later 7.3.2). Moreover, the extension of the ECA scheme to apply to remanufactured products would provide Retailers with a level of certification that they are produced to government-led energy efficient criteria. Finally, advertising the ability to modify the design of an end-of-life RDC during its remanufacture (i.e. change of colours, dimensions and materials) would allow Retailers more flexibility when it comes to changing the layout of their stores or conforming to branding guidelines.

Therefore, RDC manufacturers who decide to implement remanufacturing processes into their business models, should highlight the following when communicating to grocery retailers:

- the financial benefits of purchasing remanufactured, in comparison to brand-new RDCs
- the quality of remanufactured RDCs being as 'good-as-new',

- the energy-efficiency components and grades of remanufactured RDCs,
- the ability to modify remanufactured RDCs to tailored design specifications

7.3.2. Changing stakeholders' Behavioural Intentions through Financial Incentives, Quality Standards and Process Supporting Tools

Price uncertainty, a lack of remanufacturing guidance and the absence of a recognised industry quality standard for remanufactured RDCs are common reasons for Retailers and Manufactures holding unfavourable Behavioural Intentions towards performing pro-circular behaviours. The results in Chapter 7.2.2.1 showed that the proposed Behaviour Change Interventions, namely Financial Incentives, Quality Standards and Process-Supporting Tools would positively influence the Behavioural Intentions of Retailers and Manufacturer to purchase and produce remanufactured RDCs. This was demonstrated by all responses to the interventions having positive means (*ranging from 5.33 to 6.53)* and small standard deviations *(ranging from 0.51 to 1.30)* and the latter suggests that most Retailers and Manufactures gave similarly positive responses. A small standard error *(ranging between 0.12 and 0.58*) indicated that the investigated sample could potentially be representative of a larger population of Retailers and Manufacturers. The results of the paired sample t-test, showed there were statistically significant differences between the Retailers' and Manufacturers' Behavioural Intentions to purchase and produce remanufactured RDCs, before and after the proposed Behaviour Change Interventions. These results highlight the positive impact that Financial Incentives, Quality Standards and Process-Supporting Tools could have in developing a more pro-circular Retail Refrigeration Industry. However due to the small sample size, a larger sample is required to validate.

7.3.3. Lack of common language: misconceptions of remanufacturing

The results in Chapter 7.2.1.2 validate the inferences in literature that Retailers and Manufacturers misconceive what remanufacturing is (Walsh, 2009; Muranko et al., 2016). In this study, the majority of Retailers and Manufacturers were unable to distinguish between the processes and outcomes of remanufacturing and refurbishment. This was demonstrated by the majority of responses not disagreeing with the statement that *'...remanufactured means the same as refurbished in context of RDCs' ($\bar{x}$=4.95 for Retailers and $\bar{x}$=4.18 for Manufacturers)*. There was a large variance in these responses *(SD=1.93*

for Retailers and SD=1.94 for Manufacturers) which suggests that there is a lot of ambiguity and uncertainty about the remanufacturing process. The standard error was relatively small *(SE=0.43 for Retailers and SE=0.79 for Manufacturers)* however the large variance still implies that the mean of responses could not be representative of beliefs held by a larger population of Retailers and Manufacturers. These results demonstrate a knowledge gap in the Retail Refrigeration Industry and presents an opportunity to educate its stakeholders as to what the remanufacture of RDCs entails. This knowledge gap could be bridged through the introduction of process-supporting tool and quality standards, and tailored marketing communications. This would help clarify the definition of remanufacturing among the industry, which could in turn positively influence the perceptions of remanufactured RDCs.

7.3.4. Drivers and barriers to purchase and production of remanufactured RDCs

a) Drivers

Based on an analysis of stakeholders' Past Behaviours, this section discusses the key factors that cause and prevent the purchase and production of remanufactured RDCs. As shown in Chapter 7.2.1.6.a, *price* had the biggest influence on Retailers purchasing decisions, when buying both, new and remanufactured RDCs. When asked, *'Why did you purchase remanufactured RDCs in the past?',* Retailers have also indicated that their Past Behaviours were driven by *carbon savings (N=1)* and their *company policies (N=1).* This shows that the likelihood of Retailers engaging in pro-circular behaviours can be dependent on the prioritisation given towards environmental, social and financial themes within their company's agenda. For example, the prioritisation of environmentally friendly or green initiatives within a Retailers' business plan could result in a company policy that focuses on procuring *circular* products.

When asked: *'Why did you produce remanufactured RDCs in the past'*, most Manufacturers indicated that it is because they are *expected to do so (N=3).* This *expectation* could be a result of consumer demand, or the Manufacturers own *company policies*. One Manufacturer attributed the decision to produce remanufactured RDCs in the past to *profitability.* This aligns with the results in Chapter 6, where the delivery of an Economic Persuasive Communication message – which

advocated the financial benefits of producing remanufactured RDCs, was highly successful in influencing Manufacturers to consider remanufacturing.

Only one Manufacturer (out of three) referred to profitability as the main motivation to remanufacture RDCs in the past. This implies that the remaining Manufacturers could have had unprofitable experiences when remanufacturing in the past. Often, the cost of remanufacture is strongly dependent on the quality of end-of-life cores received, which determines the level of effort, skill and number of components required. In cases where RDC cores are of a lower quality, the cost to source and produce new components may jeopardise the profitability of remanufacturing. Profitability could also be impacted by Manufactures under-costing remanufacturing job, which is potentially a consequence of them lacking knowledge and experience of remanufacturing processes. This shows there a need to develop remanufacturing tools and standards, as discussed in Section 7.3.2.

b) Barriers

The responses of Retailers showed that their *lack of knowledge* about remanufactured RDCs in the past *(N=6)* was a key factor preventing them from purchasing remanufactured RDCs. This can stem from misconceptions surrounding the definitions of remanufactured RDCs (as described in Chapter 7.2.1.2) and a lack of opportunities to learn about remanufactured RDCs within the industry. These results provide further evidence of a knowledge gap and presents an opportunity for the industry to educate its stakeholders as to what the remanufacture of RDCs entails. Several Retailers indicated that the option to buy remanufactured RDCs is *not being offered by manufacturers (N=4)*. This reasoning supports the perceived *lack of opportunity* Retailers recorded in Chapter 5, which was a key influencer of purchasing remanufactured RDCs. Four Retailers indicated that they favoured the purchase of new RDCs. This could be due to their unfavourable attitudes, beliefs and perceptions towards purchasing remanufactured RDCs (as investigated in Chapter 5.). Two Retailers were *unconvinced about the benefits* of purchasing remanufactured RDCs. One Retailer indicated that they had not purchased remanufactured RDCS is the past due it its *complexity*. Implementing Behaviour Change Interventions, such as a tailored Persuasive Communication that evidence the benefits of remanufactured RDCs (as investigated in Chapter 5) or Process Supporting Tools that simplify their purchase (as investigated in

Chapter 7.2.1.5) could play an important role in diminishing these barriers and convincing Retailers to consider remanufacturing.

Two Manufacturers recorded that they prefer to produce brand-new instead of remanufactured RDCs. This intention was a result of Manufacturers perceiving a lack of demand for remanufactured RDCs within the market (N=1), and remanufacturing process as *complex* (N=1). Other reasons included remanufacturing not being part of *company policy* (N=2) and being unconvinced about the benefits of producing remanufactured RDCs (N=1). These barriers go some way in explaining the current lack of *circular* business models within the Retail Refrigeration Industry, and provide an indication of the key areas of influence that any future Behaviour Change Intervention should target.

7.3.5. Stakeholders' positioning in the Circular Economy

The results in Chapter 7.2.1.7. suggest that both Retailers *($\bar{x}$=2.63, SE=0.34, SD=1.50)* and Manufacturers *($\bar{x}$=2.83, SE=0.48, SD=1.17)* are not familiar with the Circular Economy. This was demonstrated by their responses having small means *($\bar{x}$=2.63 for Retailers and $\bar{x}$=2.83 for Manufacturers)*. However, there were large standard deviations that showed a high and low level of familiarity among a few selected stakeholders. This is demonstrated by responses falling broadly on the positive and negative sides of the five-point scale *(SD=1.93 for Retailers and SD=1.94 for Manufacturers)*. A small standard error *(SE=0.34 for Retailers and SE=0.48 for Manufacturers)* suggests that this general unfamiliarity with the Circular Economy could potentially be representative of a larger population of both Retailers and Manufacturers within the Retail Refrigeration Industry. These results show there is scope to educate the industry on what Circular Economy is and how it can be practiced. This could improve their familiarity with Circular Economy and drive the adoption of pro-circular behaviours.

The results in Chapter 7.2.1.8. show that Retailers and Manufacturers perceive their business decisions as highly influential on the development of the Circular Economy. This was demonstrated by their responses having large means *($\bar{x}$=5.84 for Retailers and $\bar{x}$=6.40 for Manufacturers)* and relatively small standard deviations with responses falling on the positive side of the scale *(SD=1.26 for Retailers and SD=0.89 for Manufacturers)*. A small standard error *(SE=0.29 for Retailers and SE=0.40 for Manufacturers)* suggests that this belief could be representative of a larger population of both Retailers

and Manufacturers within the Retail Refrigeration Industry. These results imply that the stakeholders are highly aware that involvement is essential for the development of Circular Economy. To also suggests that both stakeholders feel a level of accountability for the progression of the concept within their industry.

The results in Chapter 7.2.1.9. show that Retailers and Manufacturers are willing to collaborate with businesses that practice the Circular Economy. This is demonstrated by their responses having large means *($\bar{x}$=6.00 for Retailers and $\bar{x}$=5.80 for Manufacturers)* and relatively small standard deviations with responses falling on the positive side of the scale *(SD=0.82 for Retailers and SD=1.09 for Manufacturers)*. A small standard error *(SE=0.19 for Retailers and SE=0.49 for Manufacturers)* suggests that the positive intention to collaborate with *circular* businesses could be representative of a larger population of stakeholders. This is important because the development of the Circular Economy is highly reliant of stakeholders working together to build mutually beneficial relationships. This collaboration could be instigated through major industry meetings and events, particularly through dedicated Circular Economy workshops. These events are becoming commonplace in the Waste and Architecture sectors[52], however are currently uncommon in the Retail Refrigeration Industry.

Summary

This study identifies what *factors* have an influence on the attitudes, beliefs and perceptions of Retailers and Manufacturers towards the *purchase* and *production of remanufactured RDCs*. The results of this study are summarised below:

1. The most important factors that influence Retailers' decisions to buy RDCs are:

- the initial purchase **price** of the RDC
- the running costs of the RDC
- the **quality** of the RDC
- the **design** of the RDC
- the **company policies** of the Retailer

2. The key factors that prevent Retailers from *purchasing remanufactured RDCs* are:

[52] E.g. the annual Resource Waste Management Exhibition (2018) and Ecobuild conference (Futurebuild, 2018) hold Circular Economy workshops to promote collaboration within the waste and architecture industry.

- a general **lack of knowledge** about remanufactured RDCs
- **not being offered** to purchase remanufactured RDCs from manufacturers
- a **preference to buy brand-new** RDCs

3. The **demand** for remanufactured RDCs was the key influencer for Manufacturers' when deciding to *produce remanufactured RDCs* in the past
4. The key factors that prevent Manufacturers from *producing remanufactured RDCs* are:

- the **lack of demand**
- the **complexity** of the remanufacturing process
- the **company policies** of the Manufacturers
- an uncertainty about the benefits of remanufacturing

5. **Financial Incentives, Quality Standards and Process-Supporting Tools can positively influence** the intentions of Retailers and Manufacturer to *purchase* and *produce remanufactured RDCs*. Development and implementation of the interventions above could encourage the uptake of remanufacturing within the Retail Refrigeration Industry.
6. Retailers and Manufacturers are unable to distinguish between the processes and outcomes of remanufacturing and refurbishment, which suggests that they are unaware of the **definition of remanufacturing of RDCs**.
7. Retailers and Manufacturers are not familiar with the Circular Economy.
8. Retailers and Manufacturers are aware that their involvement is essential for the development of Circular Economy within the Retail Refrigeration Industry
9. Retailers and Manufacturers are willing to collaborate with businesses that practice Circular Economy.

8. Using the Pro-Circular Change Model to encourage the purchase of remanufactured Refrigerated Display Cabinets

Introduction

This chapter presents an industrial case study in which the Behaviour Change Intervention methods from the Pro-Circular Change Model were used by a RDC manufacturer to encourage a grocery retailer to *purchase remanufactured RDCs.* To ensure confidentiality the RDC manufacturer and grocery retailer are not disclosed. The RDC manufacturer embedded the intervention in their B2B communication to a grocery retailer, who were renovating their stores (~300 across the UK). The renovation involved the redesign and rebranding of the grocery retailer's stores, which required a set of new brand-matching RDCs (~18 chillers and ~12 freezers per store). The grocery retailer had the option to either purchase brand-new RDCs designed to match their new branding specifications (e.g. colour scheme) or to remanufacture their existing RDCs.

If the grocery retailer decided to purchase remanufactured RDCs as part their renovation, they would have prevented the disposal of over 9000 RDCs and an estimated 1710 tonnes of materials. This is based on the grocery retailer's chillers weighing ~500kg and freezers weighing ~200kg per unit, and the reuse of 50%[53] of materials from the end-of-life cores in their existing RDC fleet.

This chapter first describes the Behaviour Change Intervention used and its impact on the pro-circular behaviour the grocery retailer.

8.1. Behaviour Change Intervention

This Behaviour Change Intervention was delivered by an individual working in an upper management role in a manufacturing company who produces both brand-new and remanufactured RDCs within the UK. The recipient of the intervention was a team of individuals who held upper management roles in a grocery retail company who buys RDCs that are typically brand-new.

The Behaviour Change Intervention was introduced after an inquiry from the grocery retailer about sourcing brand-matching RDCs. The grocery retailer expressed an interest in exploring the possibility

[53] Typically, the remanufacture of an RDC involves the reuse of at least 50% of materials from its end-of-life core (Muranko et al., 2017).

of purchasing remanufactured RDCs. The Behaviour Change Intervention aimed to strengthen the Behavioural Intentions of the grocery retailer to purchase remanufactured RDCs.

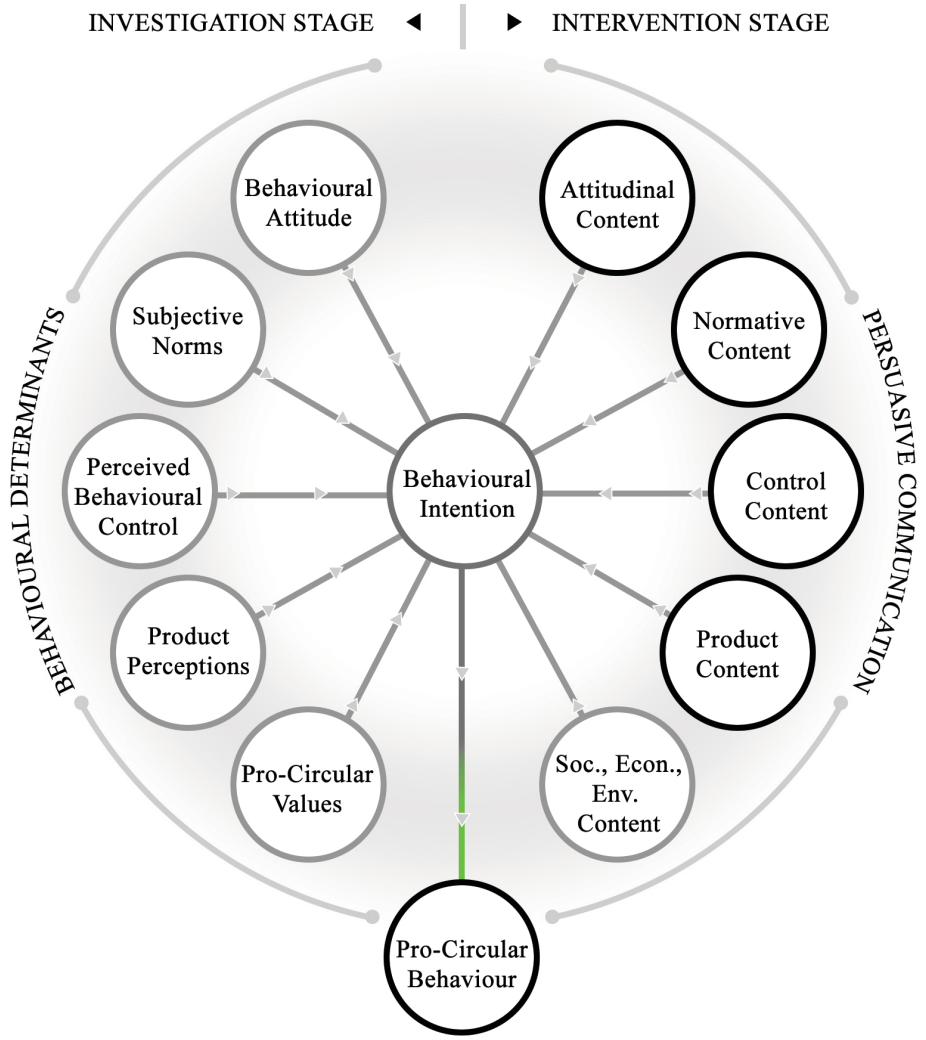


Figure 8.1. The Pro-Circular Change Model – selected constructs.

The intervention was delivered in the form of a Persuasive Communication. The Persuasive Communication was developed using the Pro-Circular Change Model with the aim of influencing the Behavioural Intentions of the Retailers by positively shifting their Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Product Perceptions (Figure 8.1). In comparison to the study in Chapter 5, this study extends the content of intervention to include normative and control messages. This inclusion was influenced by the results of the study in Chapter 5, which suggested that the

correlations between the Behavioural Intentions, and both Subjective Norms and Perceived Behavioural Control are highly positive.

The intervention used in this study included both, persuasive messages and graphics, which were developed and delivered by the Manufacturer in a digital marketing presentation that was sent to the grocery retailer via email. The intervention took place in 2018.

The intervention items contained within the marketing presentation are summarised in Table 8.1.

Table 8.1. Items of the Behaviour Change Intervention.

Target	Type	Content	Channel[1]
Behavioural Attitude	Message	Attitudinal message with extrinsic value; emphasis on financial benefits of purchasing remanufactured RDCs	E-mail correspondence
Subjective Norms	Message	Normative message; emphasis on other grocery retailers purchasing remanufactured RDCs	E-mail correspondence
Perceived Behavioural Control	Message and Visual Persuasion	Control message and visual: Emphasis on manufacturers ability to remanufacture RDCs	E-mail correspondence
Product Perceptions	Visual Persuasion	Photographs; emphasis on the positive effects of remanufacture on an example of a RDC before and after the process	E-mail correspondence

[1]The intervention was channelled through a Manufacturer (a company's executive).

8.1.1. Behavioural Attitudes

The Persuasive Communication messages were developed to influence the grocery retailer's Behavioural Attitudes towards the purchase of remanufactured RDCs being *economically attractive,* and therefore *good for their business*. These Attitudes were targeted due to them being a key influencer of Behavioural Intention (as shown in survey results in Chapter 5 and 7). Therefore, the Persuasive Communicate presented the '*estimated cost of remanufacturing their RDCs'*. The financial savings as in comparison to purchasing brand-new RDCs was assumed to be known by the Retailer (due them purchasing brand-new RDCs in the past).

8.1.2. Subjective Norms

The intervention included a normative message developed to target the Retailers' Subjective Norms. The message aimed to positively influence their beliefs about the purchase of remanufactured

RDCs being an industry norm. In the message, the Manufacturer highlighted that they had previously remanufactured RDCs for other leading grocery retailers[54].

8.1.3. Perceived Behavioural Control

The intervention included a control message developed to target the Retailers' Perceived Behavioural Control by emphasising the ability to have their RDCs remanufactured. The intervention used both, keywords and photographs (Appendix F) to illustrate the core steps involved in the remanufacturing process to convince the Retailer that remanufacturing is a viable option.

8.1.4. Product Perceptions

Retailers are typically unfamiliar with remanufacturing and hold negative Product Perceptions towards RDCs (as shown in Chapters 5 and 7), The intervention included persuasive images to positively influence the Retailer's Product Perceptions, which would result in a likewise shift in their Behavioural Attitudes[55]. The persuasive images included two photographs. The first was of an end-of-life RDC, the second showed the same RDC after the remanufacturing process (similar as those that were used in Chapter 4). The images aimed to promote the perception that the *appearance* and *quality* of a remanufactured RDC is equal to that of a brand-new RDC.

8.2. Influence of the Behaviour Change Intervention

The Persuasive Communication had a positive influence on the Behavioural Intention of the Retailer to purchase remanufactured RDCs. After its delivery, the Retailer engaged in further communication with the Manufacturer and eventually purchased several hundred remanufactured RDCs. The decision to purchase resulted in many positive socio-economic and environmental benefits. Firstly, the large contract provided a long-term revenue source for the Manufacturer, which not only helped secure the employment of their existing workers, but enabled them to offer employment to more workers and generated 10 permanent positions. It also provided workers with the opportunity to upskill and learn about remanufacturing. The reuse of the Retailers existing end-of-life RDC cores, meant that

[54] Four well-known UK Retail Grocery supermarkets and convenience stores were listed in the message.
[55] The results in Chapter 5 showed that there is a positive correlation between Product Perceptions and Behavioural Attitudes.

the costs of remanufactured RDCs were lower than brand-new RDCs (this can reach up to 30% discount, and varies depending on the quality of cores), which has led to the retailer making significant financial savings. It also meant that several tonnes of long-life materials, including metals, polymers, glass and wood were prevented from being disposed and entering the waste stream. In comparison, the purchasing of new RDCs would have resulted in the Manufacturer sourcing raw materials and consuming more energy, meaning the remanufacturing option is more sustainable.

Furthermore, this also resulted in the RDC manufacturer developing an Asset Management Tool (Process-Supporting Tool), which was used to monitor the grocery retailer's stock end-of-life RDCs. This included logging the quantity, type, location and condition of end-of-life RDCs to identify remanufacturable cores.

8.3. Discussion

This industrial case study validates that the application of the Pro-Circular Change Model, which illustrates that tailored Persuasive Communication can be effective in encouraging the purchase of remanufactured RDCs. However, the case study highlights that its effectiveness is strongly dependent on several practicalities. Firstly, getting an opportunity to deliver the intervention can be challenging, if the remanufacturer does not have a trusting B2B relationship with their customer. This relies on individuals within both businesses, forming collaborative associations with each other, that ensures the interventions are not ignored (as in the case study, the intervention was delivered by email and prone to being ignored). Furthermore, to ensure that any positive change in the customer's behaviour is sustained, process supporting tools must be tested and most importantly be readily-available soon after the intervention is delivered. This streamlines the process and instils confidence in the customer that their behaviour will be realised (by the delivery of remanufactured RDCs). This increases the likelihood of the behaviour being embedded by the consumer for the longer term.

This study contributes to the literature on Circular Economy and behaviour change, by highlighting the impacts of Persuasive Communication on pro-circular behaviours, such as purchasing remanufactured products (Michaud and Llerena, 2010). The Persuasive Communication employed in this case study targeted a combination of the Retailers behavioural determinants, namely Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Product Perceptions. It cannot be

distinguished which Persuasive Communication item had the strongest influence on the Retailer's decision to purchase remanufactured RDCs, however a combination of Persuasive Communication items was ultimately effective in positively influencing their Behavioural Intention. Therefore, RDC manufacturers wanting to sell their remanufacturing services should follow the Pro-Circular Change Model when developing their marketing strategy and develop Process-Supporting Tools to ensure their transition to remanufacturing is successful.

Summary

This study used a selection of constructs from the Pro-Circular Change Model, to develop Persuasive Communication, which was used as an intervention to encourage the grocery retailer's intention to *purchase remanufactured RDCs*. The intervention strengthened the grocery retailers' Behavioural Intentions and contributed to the grocery retailer performing the pro-circular behaviour.

9. Conclusions and Recommendations

Introduction

This thesis began with an Introduction in Chapter 1, outlining the research background, aims and questions. Chapter 2 provided a review of literature on the Circular Economy and the Retail Refrigeration Industry. The review found that the industry largely operates in a linear manner and that there are several behavioural constraints that prevent the adoption of *circular* business models. The review also found a lack of research on methods to investigate and influence pro-circular behaviours within the technical sector. Chapter 3 presented a Pro-Circular Change Model (PCCM) - a theoretical framework for investigating and influencing pro-circular behaviours, specifically in the context of *purchasing* and *producing remanufactured RDCs* within the Retail Refrigeration Industry. The PCCM was initially used in Chapter 4 to evaluate how effective the use of Persuasive Communication could be in influencing positive Behavioural Attitudes, Product Perceptions and Behavioural Intentions among individuals from the Food and Retail Refrigeration Industry towards the purchase of remanufactured RDCs. Selected constructs of the PCCM are then used in Chapters 5 and 6 to investigate the pro-circular behaviours of grocery retailers and RDC manufacturers and encourage them to *purchase* and *produce remanufactured RDCs*. Other factors that influence remanufacturing behaviours for both, grocery retailers and RDC manufacturers were investigated in Chapter 7. Finally, Chapter 8 presented an industrial case study demonstrating the effectiveness of Persuasive Communication on a UK grocery retailer to encourage the *purchase of remanufactured RDCs.*

The following sections explain how the research aims were met and research questions were answered, limitations of the research, recommendations for industry and future research, and original contribution to knowledge.

9.1. Overview of Research Aims and Research Questions

Development of Pro-Circular Change Model

This research developed a Pro-Circular Change Model (PCCM) to provide a method for investigating and influencing pro-circular behaviours. The model combines a set of behavioural

determinants[56], that can be influential in driving pro-circular behaviours among consumers and producers. The model suggests investigating the behavioural determinants of the subject, which is a prerequisite to enabling the design of an effective Behaviour Change Intervention. The investigation stage of the PCCM identified which of the behavioural determinants are key drivers to both, the *purchase of remanufactured RDCs* (in Chapter 5) and the *production of remanufactured RDCs* (in Chapter 6). The intervention stage of the PCCM enabled the development of tailored Persuasive Communication content, which was used to influence the pro-circular behaviours of the Food and Retailer Refrigeration Industry stakeholders (in Chapters 4), grocery retailers (in Chapter 5 and 8) and RDC manufacturers (in Chapter 6).

Research question 1:
What are the key behavioural determinants that influence whether grocery retailers purchase remanufactured RDCs?

Chapter 5 used a selection of constructs from the Pro-Circular Change Model to investigate the *key* ***behavioural determinants of the purchase of remanufactured RDCs by the grocery retailers***. The findings showed that currently the adoption of remanufacturing by the grocery retailers is **unlikely.** This was demonstrated by their lack of Behavioural Intentions to purchase remanufactured RDCs. This lack of Behavioural Intention was directly associated with their current Injunctive and Descriptive Subjective Norms and Past Behaviours, and indirectly with their Pro-Circular Values. However, the lack of Behavioural Intention was mostly influenced by their perceived lack of opportunity and resources to enable the purchase of remanufactured RDCs - the Perceived Behavioural Control. Changing the Perceived Behavioural Control of grocery retailers would be key in attempting to positively influence their Behavioural Intentions. The findings also show that the grocery retailers who have purchased remanufactured RDCs are keen to repeat this behaviour.

In addition, **Chapter 7** identified what other *factors* influenced the grocery retailers' intention to *purchase remanufactured RDCs*. The results of this study showed that the price, running costs, quality and the design of RDCs are all important influencing factors. The grocery retailers' company policies

[56] These determinants include the Behavioural Attitudes, Subjective Norms, Perceived Behavioural Controls, Behavioural Intentions, Product Perceptions and Pro-Circular Values.

are also a contributing factor. Conversely, a lack of knowledge about remanufactured RDCs and manufacturers not offering the opportunity to purchase remanufactured RDCs was shown to prevent the uptake of *purchasing remanufactured RDCs.* The latter reinforces the importance the Perceived Behavioural Control plays in driving the Behavioural Intentions of grocery retailers (as highlighted in Chapter 5).

Research question 2:
What are the key behavioural determinants that influence whether RDC manufacturers produce remanufactured RDCs?

Chapter 6 used a selection of constructs from the Pro-Circular Change Model to investigate the *key behavioural determinants of the production of remanufactured RDCs by the RDC manufacturers.* The findings suggest that currently the adoption of remanufacturing by the RDC manufacturers is unlikely. This was demonstrated by their lack of Behavioural Intentions to produce remanufactured RDCs. This is attributed to the RDC manufacturers' perception that there is a lack of opportunity and resources to *produce remanufactured RDCs* – the Perceived Behavioural Control. Their lack of Behavioural Intention can also be due to them not perceiving the *production of remanufactured RDCs* as an industry norm and therefore not something they are expected to do - the Injunctive and Descriptive Subjective Norms. This suggests that the demand for remanufactured RDCs is a key driver of the RDC manufacturers' Behavioural Intentions to *produce remanufactured RDCs*. The findings also show that RDC manufacturers who had *produced remanufactured RDCs* in the past had significantly more positive opinions about remanufacturing RDCs and a stronger intention to *produce remanufactured RDCs* again, than those manufacturers who did not.

In addition, **Chapter 7** identified what other *factors* influence the RDC manufacturers' intention to *produce remanufactured RDCs*. The results of this study reinforced that the demand for remanufactured RDCs is an important factor driving manufacturers to *produce remanufactured RDCs*. Conversely, the lack of demand is a key barrier. Other factors that prevent manufacturers from *producing remanufactured RDCs* are their perception of the remanufacturing process as complex, their company policies and scepticism about its benefits.

Research question 3:

Can Persuasive Communication be an effective Behaviour Change Intervention in encouraging the purchase and production of remanufactured RDCs within the Retail Refrigeration Industry?

This research used tailored Persuasive Communication to influence the behavioural determinants of Behavioural Intentions to perform a pro-circular behaviour. **Chapter 4** applied the methods of tailored Persuasive Communication in form of messages and graphics targeting the Behavioural Attitudes and Product Perceptions of individuals from the Food and Retail Refrigeration Sector towards the *purchase of remanufactured RDCs*. The findings suggested that the Persuasive Communication used was effective in positively changing their Behavioural Attitudes, Product Perceptions and ultimately positively influenced their Behavioural Intentions towards the *purchase of remanufactured RDCs.*

Chapter 5 investigated the influence that tailored Persuasive Communication had on Behavioural Intentions of the grocery retailers to *purchase remanufactured RDCs.* The findings showed that messages and graphics used in this study were effective in positively changing the Behavioural Intentions of grocery retailers. In addition, the industrial case study in **Chapter 8** used *tailored* Persuasive Communication messages and graphics to target Behavioural Attitudes, Subjective Norms, Perceived Behavioural Control and Product Perceptions of a grocery retailer to successfully encourage them to *purchase remanufactured RDCs*. Findings in both, Chapter 5 and 8 suggest that if developed into a sustained marketing programme, the use of tailored Persuasive Communication has the potential to positively influence the grocery retailers' pro-circular behaviours. Furthermore, findings in **Chapter 5** suggest that Persuasive Communication targeting the key determinants of their Behavioural Intentions, namely their Perceived Behavioural Control, could be most effective in encouraging them to *produce remanufactured RDCs.*

In addition, **Chapter 6** investigated the influence tailored Persuasive Communication had on Behavioural Intentions of the RDC manufacturers to *produce remanufactured RDCs.* The findings showed that messages and graphics used in this study were effective in positively changing the Behavioural Intentions of RDC manufacturers. This suggests that if embedded into a governmental or industrial campaign, the use of tailored Persuasive Communication has the potential to positively influence the RDC manufacturers to *produce remanufactured RDCs*. Furthermore, findings in **Chapter**

6 suggest that Persuasive Communication tailored to influence the key determinants of their Behavioural Intentions, namely their Perceived Behavioural Control and both, Injunctive and Subjective Norms, could be most effective in encouraging them to *produce remanufactured RDCs.*

Research question 4:
What other types of Behaviour Change Interventions would be effective in encouraging the purchase and production of remanufactured RDCs within the Retail Refrigeration Industry?

This thesis revealed that *other intervention types could be effective in encouraging remanufacturing behaviours* of grocery retailers and RDC manufacturers. The findings in **Chapter 7** suggested the inclusion of remanufactured products on the Enhanced Capital Allowance would encourage the grocery retailers and RDC manufacturers to adopt remanufacturing. This can be due to price being the key influencer of the grocery retailers' purchasing decisions. The findings also suggest that a recognised Industry Standard for the quality of remanufactured RDCs could have a similarly positive effect on the adoption of remanufacturing by both groups. This can provide an assurance on the quality of remanufactured RDCs, which is an important factor driving the grocery retailers' purchasing decisions. In addition, the findings suggested that Process-Supporting Tools for the purchase and production of remanufactured RDCs would also positively influence the decisions of grocery retailers and RDC manufacturers to adopt the model in practice. This could reduce the perceived complexity of performing both pro-circular behaviours, which was identified as barrier. It could also provide clarity to the misunderstood definition of remanufacturing.

Research question 5.
How willing are grocery retailers and RDC manufacturers to support the development of the Circular Economy in the Retail Refrigeration Industry?

Findings in **Chapter 7** suggested that grocery retailers and RDC manufacturers are not familiar with the Circular Economy. This unfamiliarity could be explained by the concept's lack of exposure within the Retail Refrigeration Industry. The findings also suggested that after being educated on the principles of Circular Economy, both groups of stakeholders acknowledged that their involvement is essential for its development in this sector. Accordingly, they are also willing to collaborate with

businesses that practice Circular Economy with a view to support its adoption in this sector. This shows a strong potential for the concept being practiced by grocery retailers and RDC manufacturers.

9.2. Limitations of the research

Population sample

To fulfil the aims of this research, selection criteria were set out when considering the sample population. The selection criteria (as described in Chapter 5) ensured the sample population only included specific individuals from the Retail Refrigeration Industry; for example, the selection criteria aimed to recruit individuals who were directly responsible for the purchase or production of RDCs for retail grocery stores. With these individuals often working at senior management level, as expected they were difficult to access and recruit for this study. As a result, this research had a relatively small population sample, which ranged from 6 to 26 individuals per study. This limitation meant that some findings cannot be confidently interpreted as being representative of the target population. The small population sample also limited the number of data analysis methods that could be used, and increased the likelihood of finding non-significant results. Despite the population sample being small, several results suggested the findings to be representative of the target population and statistically significant. However, as highlighted across the Discussions sections, further testing on a larger sample would be required to increase the confidence of findings.

Control group

Research studies that involve testing the impacts of persuasive communication on small sample populations use control groups to validate the impacts of interventions (Warren et al., 2016). Using control groups in addition to having a larger sample population would have helped further validate the impact of the interventions in studies throughout Chapters 4, 5 and 6. This is however dependent on participants in the control group being representative of target population. As mentioned in above section on Sample Population, extending the study population to include a control group of the same demographics would pose recruitment challenges.

Survey measures

Structured surveys were developed and used to collect the data in **Chapter 4, 5, 6** and **7.** Literature on survey research often centres on the effects of social desirability bias when collating data on attitudes, beliefs and behaviours in particular (Kaminska and Foulsham, 2013). The most common cause of social desirability bias is due to the respondent not feeling comfortable enough to provide honest responses which can result in the collection of inaccurate data. It is possible that the population sample may have consciously provided responses that they perceived to be more socially desirable and not representative of their own opinions. To reduce the impact of social desirability bias all participants were assured that their responses would be anonymous.

It is conceivable that participants in the study may have responded to survey questions in a personal capacity, from the perspective of their own ambitions and beliefs. These could be at odds with the realities of their businesses and not necessarily reflective of industry trends. To mitigate this, participants were informed via the Participant Information Sheet (Appendix C) that they were targeted due to their roles as purchasers and producers of RDCs. Therefore, it was assumed that the participants responded in their professional capacity, as current stakeholders in the Retail Refrigeration Industry.

An individual's perception about *circular* products and their intrinsic values to 'bigger-than-self' goals can influence them performing pro-circular behaviours. In recent literature, there has been a lack of novel methods for investigating Product Perceptions and pro-circular behaviours. Therefore, **Chapter 5** and **6** developed new survey measures to investigate grocery retailers' and RDC manufacturers' Product Perceptions and Pro-Circular Values. As with all new research methods, there is an inherent risk to the accuracy of collected data. This is due to the methods not yet having the advantage of being applied and subsequently refined in other research studies.

On review, the questionnaire scales used in **Chapters 4, 5** and **6** were not consistent. The Product Perceptions questionnaire used a three-point Likert scale whereas the Pro-Circular Values questionnaire used a five-point Likert scale. Both questionnaire measures were shown to be reliable. This is illustrated by the consistency of measurement (acceptable Cronbach's alphas) and clearly distributed data sets. However, introducing a seven-point Likert scale (as used in the Theory of Planned Behaviour questionnaire) in both Product Perceptions and Pro-Circular Values questionnaires would have offered

a larger variance of data. This would have provided a better understanding of the relationships between Product Perceptions and Pro-Circular Values, and other behavioural determinants by enabling a more accurate correlation and regression analysis. Therefore, further development and testing of the appropriate scales in two questioners is required to improve these methods.

Current research

Research on the Circular Economy in the technical sector is inherently multidisciplinary, fusing skills from several fields such as design, engineering marketing and psychology. The design of *circular* products requires not only a technical perspective from a product development standpoint, but also an understanding of the human behaviours that underpin product selection, ownership and end-of-life treatment. Currently research on the Circular Economy focuses more on the technicalities within the fields of material sciences, product design, environmental engineering, business models or economy. However, research on social dimensions of Circular Economy, particularly in regards to methodologies for investigating and influencing pro-circular behaviours of consumers and producers is limited. This knowledge gap, particularly the lack of previous studies or proven investigative methods, means that any future research on these social dimensions must include the development of new research methods, such as the PCCM.

9.3. Research and industry recommendations

Application of the Pro-Circular Change Model to investigate and influence other types of pro-circular behaviours

The Pro-Circular Change Model – as a research method has been applied within most of the studies in this thesis. The model has the potential to support future research on pro-circular behaviours in other industries. It is recommended that the model is tested in different contexts to test, refine and improve the underlying methodology. This could involve research on pro-circular behaviours that can drive the adoption of other *circular* business models (e.g. product-as-service systems, sharing, repair) and *circular* products (e.g. personal electronics, packaging, fast-moving consumer goods).

Development of Process-Supporting tools for the purchase and production of remanufactured RDCs

The findings in this thesis show that grocery retailers perceived lack of ability to *purchase remanufactured RDCs* is a key reason why they don't perform this pro-circular behaviour. Chapter 5 concluded that this perceived lack of ability is a result of RDC manufacturers not offering remanufacturing services to grocery retailers. Chapter 7 suggested that RDC manufacturers instead choose to focus on promoting the sales of brand-new RDCs, as they perceive the remanufacturing process as complex, and therefore not in demand by grocery retailers. Having Process-Supporting Tools that provide best practice and clear guidance on the process of producing remanufactured RDCs would be an effective way of reducing the perceived complexity of the remanufacturing process. As a result, future research should look at developing such tool which could include an accredited remanufacturing framework, or an established industry-wide library of available remanufacturable RDC cores.

The findings in this thesis also show a supporting tool that simplifies the purchase of remanufactured RDCs would positively influence grocery retailers' intentions to perform the pro-circular behaviour. Future research should therefore look at developing such tools that provide a more streamlined purchase process. This could include creating an online platform for the purchase of made-to-order remanufactured RDCs, which could enable communication between grocery retailers and RDC manufacturers.

Development of Quality Standards for remanufactured RDCs

Chapter 5 concludes that most grocery retailers perceive the quality of remanufactured RDCs to be lower than brand-new RDCs. The findings in this thesis indicate that having an industry-recognised standard for the quality of remanufactured RDCs, could positively influence grocery retailers to *purchase remanufactured RDCs.* An industry-recognised standard could provide grocery retailers with assurances on the performance, longevity and warranty of remanufactured RDCs. It is therefore recommended as an area for future research, with the view to its development creating more demand for remanufactured RDCs.

Promotion of remanufacturing in the Retail Refrigeration Industry to encourage RDC manufacturers to adopt remanufacturing in their business models

Encouraging RDC manufacturers to adopt remanufacturing in their business models is crucial to develop the Circular Economy of RDCs. Chapter 6 concludes that the tailored Persuasive Communication was successful in positively influencing the Behavioural Intentions of RDC manufacturers to *produce remanufactured RDCs.* In an attempt to promote this pro-circular behaviour across the industry on a larger scale, it is recommended that Persuasive Communication is used as a Behaviour Change Intervention in future industrial campaigns.

Development of Persuasive Communication for RDC manufacturers to encourage grocery retailers to purchase of remanufactured RDCs

Chapter 5 and 8 concluded that tailored Persuasive Communication was successful in positively influencing the Behavioural Intentions of grocery retailers to *purchase remanufactured RDCs.* To encourage this pro-circular behaviour among grocery retailers on a larger scale, it is recommended that tailored Persuasive Communication is used as a Behaviour Change Intervention in the future marketing campaigns of RDC manufacturers who want to embed remanufacturing in their businesses. As a result, future research should look at providing guidance on how to develop tailored Persuasive Communication and implement it into marketing content to effectively target the key determinants of grocery retailers' purchasing behaviours.

Development of ECA scheme for remanufactured RDCs

Chapter 7 concluded that the introduction of remanufactured products in the Enhanced Capital Allowance (ECA) scheme would positively influence the grocery retailers' decisions to purchase remanufactured RDCs. The proposed inclusion of remanufactured products on the ECA scheme would involve the governmental bodies[57] developing eligibility criteria in terms of their resource efficiency (both energy and material) requirements. The inclusion of remanufactured products on the ECA is

[57] The ECA scheme is currently managed by the HM Government's Department for Business, Energy and Industrial Strategy

therefore recommended as the findings in this thesis suggest it would incentivise the purchase of remanufactured RDCs and consequently increase their demand among grocery retailers.

9.4. Original Contribution to Knowledge

As detailed in the Introduction Chapter, this thesis contributes to literature on the Circular Economy and Behaviour Change within the Retail Refrigeration Industry by:

- Developing a novel methodology for investigating and influencing pro-circular behaviours (Pro-Circular Change Model)
- Undertaking a quantitative data analysis on the behavioural determinants that currently influence grocery retailers and RDC manufacturers to *purchase* and *produce remanufactured RDCs*
- Developing and measuring the effectiveness of several Behaviour Change Interventions aimed at influencing grocery retailers and RDC manufacturers intentions to *purchase* and *produce remanufactured RDCs*
- Identifying current industry enablers that are likely to facilitate the remanufacturing of RDCs

Conclusion

Finally, while the research undertaken has highlighted behavioural barriers to the implementation of remanufacturing in the Retail Refrigeration Industry, it has also demonstrated that these barriers can be overcome in this sector. What has been learnt can be transferred to and implemented in other industrial sectors to accelerate development of a Circular Economy.

References

Aaker, D. A. (1991). Managing brand equity: Capitalizing on the value of a brand name. New York: Free Press.

Abraham, C. and Michie, S. (2008). A taxonomy of behavior change techniques used in interventions, Health Psychology, 27 (3), pp. 379-387.

Aguilar-Luzón, M., García-Martínez, J., Calvo-Salguero, A. and Salinas, J. (2012). Comparative Study Between the Theory of Planned Behavior and the Value-Belief-Norm Model Regarding the Environment, on Spanish Housewives' Recycling Behavior, Journal Of Applied Social Psychology, 42 (11), pp. 2797-2833.

Ajzen, I. (1991). The theory of planned behavior, Organizational Behavior And Human Decision Processes, 50 (2), pp. 179-211.

Ajzen, I. (1992). Persuasive Communication Theory in Social Psychology: A Historical Perspective. In book: Influencing human behavior: Theory and applications in recreation, tourism, and natural resource management, Publisher: Champaign, IL: Sagamore Publishing, Editors: M. J. Manfredo, pp.1–27

Ajzen, I. (2006). Constructing a Theory of Planned Behavior Questionnaire. Available from: https://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Ajzen, I. (2006b). Behavioural Interventions Based on the Theory of Planned Behaviour. Available from: https://people.umass.edu/aizen/pdf/tpb.intervention.pdf

Ajzen, I. (2012). Values, attitudes, and behaviour. In Methods, Theories, and Empirical Applications in the Social Sciences. Springer Nature, pp. 33–38.

Ajzen, I., and Fishbein, M. (1977). Attitude–behavior relations: A theoretical analysis and review of empirical research. Psychological Bulletin, 84, 888–918.

All Party Parliamentary Sustainable Resource Group (2014). Remanufacturing: Towards a Resource Efficient Economy. Available at: https://www.policyconnect.org.uk/apsrg/sites/site_apsrg/files/apsrg_-_remanufacturing_report.pdf

Andrews, D., Muranko, Z., and Chaer, I. (2015). An Assessment of Differing Environmental and Economic Factors and Their Impact on the Development of a Circular Economy for Refrigerated Display Cabinets in the UK. Proceedings of the Sustainable Innovation Conference 2015, University for the Creative Arts Epsom, UK

Antikainen, M., Lammi , M. , Paloheimo, H., Rüppel , T & Valokari, K. (2015). Towards Circular Economy Business Models: Consumer Acceptance of Novel Services. In the Proceedings of the ISPIM Innovation Summit: Changing the Innovation Landscape. International Society for Professional Innovation Management`s Innovation Conference. Brisbane, Australia

Apple (2017). Discover the Apple Certified Refurbished promise. Available at: https://www.apple.com/uk/shop/refurbished/about [Accessed on: 3 May 2016]

APPSRG and APPMG (All Party Parliamentary Sustainable Resource Group and All Party Parliamentary Manufacturing Group). (2014). Triple Win: The Social, Economic and Environmental Case for Remanufacturing. Available at:

https://www.policyconnect.org.uk/research/triple-win-social-economic-and-environmental-case-remanufacturing [Accessed 21 Mar. 2015].

APSRG (All Party Parliamentary Sustainable Resource Group), (2014) Remanufacturing: Towards a Resource Efficient Economy.

Ardente, F. and Mathieux, F. (2014). Environmental assessment of the durability of energy-using products: method and application, Journal of Cleaner Production, 74, pp. 62-73.

Ardente, F., Calero Pastor, M., Mathieux, F. and Talens Peiró, L. (2015). Analysis of end-of-life treatments of commercial refrigerating appliances: Bridging product and waste policies, Resources, Conservation And Recycling, 101, pp. 42-52.

Atherton, M. (2015). Behaviour change towards a circular economy - part 1 – RSA. Available at: https://www.thersa.org/discover/publications-and-articles/rsa-blogs/2015/10/blog-behaviour-change-for-ce-part-1/ [Accessed: 20 September 2015].

Bardi, A. and Schwartz, S. (2003). Values and Behavior: Strength and Structure of Relations, Personality and Social Psychology Bulletin, 29 (10), pp. 1207-1220.

Barlow, D. (2013). SPICe Briefing: A Circular Economy. Scottish Parliament. Available from: http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_13-72.pdf

Bastein, T., E. Roelofs, E. Rietveld and A. Hoogendoorn (2013). Opportunities for a Circular Economy in the Netherlands. TNO, Report commissioned by the Netherlands Ministry of Infrastructure and Environment.

Bastein, T., W. Koers, K. Dittrich, J. Becker, F. Lopez (2014). Business barriers to the uptake of resource efficiency measures. POLFREE Deliverable 1.5. Policy Options for a Resource Efficient Economy (POLFREE)

Behrens, A. (2016). Time to Connect the Dots: What is the Link between Climate Change Policy and the Circular Economy? CEPS Policy Brief, 2016.

Bibalou, D., Chaer, I., Andrews, D., Maidment, G. and Longhurst, M. (2011). A carbon footprint study of a remanufactured and/or refurbished retail refrigerated display cabinet. LeventLecocq, N. LCA in Business Conference, Lille, France.

BlaBlaCar (2016). How it works. Available at: https://www.blablacar.co.uk/how-does-car-sharing-work [Accessed on: 9 October 2016]

Boks, C., Lilley, D. And Pettersen, I. (2015). The future of design for sustainable behaviour revisited. In Proceedings of 2015 9th EcoDesign international symposium on environmentally conscious design and inverse manufacturing, Tokyo, Japan, 2-4 December 2015.

Braungart, M., McDonough, W. and Bollinger, A. (2007). Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design, Journal Of Cleaner Production, 15 (13-14), pp. 1337-1348. DOI:10.1016/j.jclepro.2006.08.003.

British Standards Institution (2005). BS EN ISO 23953-2:2005+A1:2012: Refrigerated display cabinets. Classification, requirements and test conditions.. Available from: https://shop.bsigroup.com/ProductDetail/?pid=000000000030209883.

British Standards Institution (2009). BS 8887-2:2009: Design for manufacture, assembly, disassembly and end-of-life processing (MADE). Terms and definitions. . Retrieved from https://shop.bsigroup.com/ProductDetail/?pid=000000000030182997.

British Standards Institution (2017). BS 8001:2017 Framework for implementing the principles of the circular economy in organisations. Available at: https://www.bsigroup.com/en-GB/standards/benefits-of-using-standards/becoming-more-sustainable-with-standards/BS8001-Circular-Economy/.

Bulmus, S.C.; Zhu, S.X.; Teunter, R. (2014) Competition for cores in remanufacturing. Eur. Journal of Operational Research, 233, 105–113.

Burucuoglu, M., & Erdogan, E. (2019). Evaluation of Young Consumers' Remanufactured Products Purchase Intention Within Context of Extended Planned Behavior Theory. In U. Akkucuk (Ed.), The Circular Economy and Its Implications on Sustainability and the Green Supply Chain (pp. 246-264). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-8109-3.ch014

Cambridge Econometrics and BIO Intelligence Service (2014). Study on modelling of the economic and environmental impacts of raw material consumption. Publications Office of the European Union. Luxembourg

Canon (2018) Sustainability Factsheets. Available at: https://canon.ssl.cdn.sdlmedia.com/636729480774289830OE.pdf Accessed on: 22nd June 2018

Carbon Trust (2012). Refrigeration Road Map. Available from: https://www.carbontrust.com/media/147175/j7924_ctg021_refrigeration_road_map_aw.pdf

Carbon Trust (2018). About Us. Available from: https://www.carbontrust.com/about-us/ [Accessed on: 12 February 2018]

Carbon Trust, Knowledge Transfer Network, Centre for Remanufacturing and Reuse and High Speed Sustainable Manufacturing Institute (2014). Supporting Excellence in UK Remanufacturing. Stakeholder dialogue on opportunities and challenges". Available at: https://www.carbontrust.com/media/627773/supporting-excellence-in-uk-remanufacturing.pdf [Accessed on: 10 Feb. 2016]

Carter (2017). Your first steps to sustainability. Available at: https://www.cre-ltd.co.uk/ [Accessed on: 21 January 2017]

Carter Retail Equipment (2016). Refurbishment/Energy Initiative Schemes and Ex-Stock Sales. Available at: http://www.cre-ltd.co.uk/news.php?id=897 [Accessed on: 7 April 2016]

Caterpillar (2015). Cat Reman. Available at: https://www.caterpillar.com/en/company/brands/cat-reman.html [Accessed on 10 April 2015]

Centre for Remanufacturing and Reuse (2009). Report on the remanufacturing of refrigerated display cabinets. Available at: http://www.remanufacturing.org.uk/pdf/story/1p346.pdf

Chamberlin, L.; Boks, C. Marketing Approaches for a Circular Economy: Using Design Frameworks to Interpret Online Communications. Sustainability 2018, 10, 2070.

Chapman A.C. Chapman, Bartlett, C., McGill, I., Parker, D., Ben Walsh (2009) Remanufacturing in the UK: A snapshot of the UK remanufacturing industry. Oakdene Hollins and Centre for Remanufacturing & Reuse

Chartered Institution of Waste Management (2014). The circular economy: What does it mean for the waste and resource management sector? Available at: http://www.ciwm-journal.co.uk/downloads/CIWM_Circular_Economy_Report-FULL_FINAL_Oct_2014.pdf (Accessed: 23 January 2017).

Chen, Y. S., and Chang, C. H. (2012). Enhance green purchase intentions: The roles of green perceived value, green perceived risk, and green trust. Management Decision, 50(3), 502-520.

Chilton et al (2012), 'Communicating Bigger Than Self Problems to Extrinsically Oriented People', Common Cause Foundation. Available from: https://valuesandframes.org/downloads

Choi, B. C., & Pak, A. W. (2005). A catalog of biases in questionnaires. Preventing chronic disease, 2(1), A13.

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behaviour: A review and avenues for further research. Journal of Applied Social Psychology, 28, 1429-1464.

Corral, C.M. (2003). Sustainable production and consumption systems—cooperation for change: assessing and simulating the willingness of the firm to adopt/develop cleaner technologies. The case of the In-Bond industry in northern Mexico. Journal of Cleaner Production. 11:14, 411-426. https://doi.org/10.1016/S0959-6526(02)00063-X

Crompton, T. and McMahon, S. (2011). Balancing intrinsic and extrinsic values. Available at: https://www.theguardian.com/sustainable-business/social-psychologists-environmental-values (Accessed: 22 January 2017).

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika. 16, 297-334.

Daae J., Chamberlin L. and Boks C. (2017). Dimensions of Sustainable Behaviour in a Circular Economy Context. Product Lifetimes and The Environment 2017 - Conference Proceedings. Delft University of Technology and IOS Press.

Dainton, M. and Zelley, D. (2005). Applying communication theory for professional life: a practical introduction. Thousand Oaks, Calif, ISBN-10 0761929142.

De Jesus, A. and Mendonna, S. (2017) Lost in Transition? Drivers and Barriers in the Eco-Innovation Road to the Circular Economy, SSRN Electronic Journal. DOI:10.2139/ssrn.3038887.

De Winter J.C.F. (2013) "Using the Student's t-test with extremely small sample sizes". Practical Assessment, Research, & Evaluation. 2013;18:1–12.

Deng, J., Wen, X., Zhao, Y. (2008). Evaluating the treatment of E-waste – a case study of discarded refrigerators. J. China Univ. Mining Technol. 18, 454–458.

Department for Business, Energy & Industrial Strategy (2016) Energy Technology Criteria List: Refrigerated Display Cabinets. Crown copyright. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/788796/2019_ETL_Criteria_Refrigerated_Display_Cabinets.pdf [Accessed on: 17 November 2017]

Department for Environment, Food and Rural Affairs (2015). European Commission Circular Economy Package UK response to European Commission consultation of member states on the circular economy. HM Government.

Department of Energy and Climate Change (2015). The Energy Technology List: Call for evidence. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/484663/ETL_Call_for_Evidence.pdf

Desso (2016). Cradle to Cradle. Available at: http://www.desso-businesscarpets.com/corporate-responsibility/cradle-to-cradler/ [Acessed on: 7 May 2016]

Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002L0095

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Available from: http://data.europa.eu/eli/dir/2008/98/oj

Draper, S. (2013). Creating the big shift: system innovation for sustainability. Forum for the Future. Availeble from: https://www.forumforthefuture.org/Pages/Category/publication-library?Take=24

Duflou, J., Seliger, G., Kara, S., Umeda, Y., Ometto, A. and Willems, B. (2008). Efficiency and feasibility of product disassembly: A case-based study, CIRP Annals, 57 (2), pp. 583-600.

Eagly, A. H. and Chaiken, S. (1993). The psychology of attitudes. Orlando, FL, US: Harcourt Brace Jovanovich College Publishers.

Ebay (2017). 2020 Goals. Available at: https://www.ebayinc.com/impact/responsible-business/goals-progress/ [Accessed on: 18 December 2017]

Ellen MacArthur Foundation (2013a). Towards the Circular Economy Vol 2: Opportunities for the consumer goods sector. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Report-2013.pdf [Accessed: 21 January 2017].

Ellen MacArthur Foundation (2013b). Towards the Circular Economy Vol. 1: Economic and Business Rationale for an Accelerated Transition. Available at: https://www.ellenmacarthurfoundation.org/publications/towards-the-circular-economy-vol-1-an-economic-and-business-rationale-for-an-accelerated-transition [Accessed: 20 March 2015].

Ellen MacArthur Foundation (2015). Towards A Circular Economy: Business Rationale for An Accelerated Transition. Available from: https://www.ellenmacarthurfoundation.org/assets/downloads/TCE_Ellen-MacArthur-Foundation_9-Dec-2015.pdf

Ellen MacArthur Foundation (2017). Circular Economy Schools of Thought. Available from: https://www.ellenmacarthurfoundation.org/circular-economy/concept/schools-of-thought [Accessed 9 April 2017].

Ellen MacArthur Foundation, Stiftungsfonds für Umweltökonomie und Nachhaltigkeit (SUN) and McKinsey Center for Business and Environment (2015). Growth Within: A Circular Economy Vision for a Competitive Europe. Available from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf

Environment Agency (2012). Flammability of fridge insulation foam produced with a hydrocarbon blowing agent. Available from: http://www.weeeconsulting.co.uk/LIT_7627_0492fa%20-%20HC%20flamability%20tests.pdf

Epta UK (2017). Identity. Available at: https://www.epta-uk.co.uk/identity [Accessed on: 15 May 2017]

Eunomia (2016). A Resourceful Future – Expanding the UK Economy. Available from: https://www.eunomia.co.uk/reports-tools/a-resourceful-future-expanding-the-uk-economy/

European Comission (2014b). The Circular Economy - Connecting, creating and conserving value. [online] Available at: https://publications.europa.eu/en/publication-detail/-/publication/c8cfd1ae-6285-40ba-879f-f2e78e4c2b6e [Accessed 9 Sep. 2015].

European Commission (2011). Supporting Environmentally Sound Decisions for Waste Management - A technical guide to Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) for waste

experts and LCA practitioners. JRC Scientific and Technical Reports. Publications Office of the European Union. Luxembourg. doi:10.2788/52632

European Commission (2014a). Ecodesign for Commercial Refrigeration. JRC Science and Policy Reports. [online] Luxembourg: European Commission. Available at: http://susproc.jrc.ec.europa.eu/comrefrig/docs/COMM_REFRIG_PUBLISHED_BKG_DOC%20-%202014%20August%2026.pdf [Accessed 20 Feb. 2015].

European Commission (2015a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of The Regions. Closing the loop - An EU action plan for the Circular Economy. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614 [Accessed: 19 December 2016].

European Commission (2015b). From Niche to Norm. Suggestions by the Group of Experts on a Systemic Approach to Eco-Innovation to achieve a low-carbon, Circular Economy. Luxembourg. Available from: http://www.gppq.fct.pt/h2020/_docs/brochuras/env/from_niche_to_norm_sei.pdf

European Commission (2016). Directive 2008/98/EC on waste (Waste Framework Directive). Available from: http://ec.europa.eu/environment/waste/framework/ [Accessed 17 February 2017].

European Commission (2016). Directive 2008/98/EC on waste (Waste Framework Directive). Available from: http://ec.europa.eu/environment/waste/framework/ [Accessed 17 February 2017].

European Environmental Agency (2017). Circular by design: Products in the circular economy. EEA Report No. 6, 2017, DOI: 10.2800/860754

European Environmental Bureau (2014). Advancing Resource Efficiency in Europe: Indicators and waste policy scenarios to deliver a resource efficient and sustainable Europe. Available from: https://makeresourcescount.eu/wp-content/uploads/2014/11/FINAL_Advancing-Resource-Efficiency-in-Europe_PUBL.pdf

European Rare Earths Competency Network (2015). Strengthening the European rare earths supply chain: Challenges and policy options.

European Remanufacturing Network (2015). Remanufacturing Market Study For Horizon 2020. Available at: https://www.remanufacturing.eu/assets/pdfs/remanufacturing-market-study.pdf

European Remanufacturing Network (2016). Map of Remanufacturing Business Model Landscape For Horizon 2020. Available from: http://www.remanufacturing.eu/assets/pdfs/EC--09_404_D3.1_Business_model_landscape_wi.pdf

European Remanufacturing Network (2017). European need for a shared vision Available at: https://www.remanufacturing.eu/ern.php [Accessed on: 2 November 2017]

European Union (2017). Promoting Remanufacturing, Refurbishment, Repair, and Direct Reuse. Available at: http://ec.europa.eu/environment/international_issues/pdf/7_8_february_2017/workshop_report_Brussels_7_8_02_2017.pdf

Feng, Z. (2004). An introduction to the circular economy. People's Press, Beijing

Field, A. (2009). Discovering Statistics Using SPSS. 3rd Edition, Sage Publications Ltd., London.

Fife-Schaw, C., Sheeran, P. and Norman, P. (2007). Simulating behaviour change interventions based on the theory of planned behaviour: Impacts on intention and action, British Journal of Social Psychology, 46 (1), pp. 43-68.

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley.

FUSION Project (2014). The Fusion Observatory: The Circular Economy. Embedding low carbon thinking through the life of a business. Available from: https://www.kent.gov.uk/__data/assets/pdf_file/0020/49520/Fusion-project-report.pdf

Futurebuild (2018). Ecobuild Conference. Time for Action. Available at: https://www.futurebuild.co.uk/ecobuild-conference#/ [Accessed: 10 July 2018]

Gaur, J., Amini, M., Banerjee, P. and Gupta, R. (2015). Drivers of consumer purchase intentions for remanufactured products, Qualitative Market Research: An International Journal, 18 (1), pp. 30-47. DOI:10.1108/qmr-01-2014-0001.

Giutini, R. and Gaudette, K. (2003). Remanufacturing: The next great opportunity for boosting US productivity. Business Horizons, 46(6), pp.41-48.

Google and Ellen MacArthur Foundation (2017). Circular Economy at Work in Google Data Centres. Available from: https://static.googleusercontent.com/media/www.google.com/en//green/pdf/data-center-case-study.pdf

Gould, H. (2016). Can the advertising industry sell us waste-free living? Available at: https://www.theguardian.com/sustainable-business/2016/jun/28/advertising-industry-waste-free-living-circular-economy [Accessed: 11 September 2016].

Grand View Research (2016). Commercial Refrigeration Equipment Market Analysis By Type (Transportation Refrigeration Equipment, Refrigerators & Freezers, Display Showcases, Beverage Refrigeration, Parts), By Retail Channel (Hypermarkets, Supermarkets, Convenience Stores, Restaurants), By Application (Food Service, Food & Beverage Production, Food & Beverage Distribution, Food & Beverage Retail) And Segment Forecasts To 2024. Avlaible from: https://www.grandviewresearch.com/industry-analysis/commercial-refrigeration-equipment-market [Accessed on: 8 November 2016]

Gray, C. and Charter, M. (2007). Remanufacturing and Product Design. Designing for the 7th Generation. The Centre for Sustainable Design University College for the Creative Arts, Farnham, UK.

Greaves, M., Zibarras, L. and Stride, C. (2013). Using the theory of planned behavior to explore environmental behavioral intentions in the workplace. Journal of Environmental Psychology. 34. 109-120.

Guo, B., Geng, Y., Sterr, T., Zhu, Q. and Liu, Y. (2017). Investigating public awareness on circular economy in western China: A case of Urumqi Midong, Journal of Cleaner Production, 142, pp. 2177-2186.

Hagger, M., Chatzisarantis, N. and Biddle, S. (2002). A Meta-Analytic Review of the Theories of Reasoned Action and Planned Behaviour in Physical Activity: Predictive Validity and the Contribution of Additional Variables. Journal of Sport and Exercise Psychology. 24. 3-32. 10.1123/jsep.24.1.3.

Hauser, W., Lund, R.T.(2003). The Remanufacturing Industry: Anatomy of a Giant. Department of Manufacturing Engineering, Boston University

Hawken, P., Lovins, L. H. and d Lovins, A. (1999). Natural capitalism: Creating the Next Industrial Revolution. New York: Little, Brown & Company.

Hewlett Packard (2017). HP and the Circular Economy. HP Development Company, L.P. Available from: http://www8.hp.com/h20195/v2/getpdf.aspx/c05364027.pdf

HM Government (2018). Industrial Strategy: Building Britain fir for the future. Available at:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf [Accessed 8 Jul. 2018].

HM Revenue and Customs (2017). Overseas Trade Statistics. Data by commodity code. Filtered on "84185011 - Refrigerated show-cases and counters, with a refrigerating unit or evaporator, for frozen food storage" and "84185019 - Refrigerated show-cases and counters, with a refrigerating unit or evaporator, for non-frozen food storage" only. Available at: https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Table.aspx [Accessed on: 14 February 2017]

Houston, J., Casazza, E., Briguglio, M., Spiteri, J. (2018). Stakeholder Views Report Enablers and Barriers to a Circular Economy, The R2π Project. Available from: http://www.r2piproject.eu/wp-content/uploads/2018/08/R2pi-stakeholders-report-sept-2018.pdf

Huber, J. (2000). Towards Industrial Ecology: Sustainable Development as a Concept of Ecological Modernization, Journal of Environmental Policy and Planning, October–December 2000, Vol. 2, No. 4, pp. 269–85.

Husband, P. A. and Hellier, E. J. (2011). Persuasive Methods of Communication. Available at: http://www.devon.gov.uk/persuasive_methods_of_communication.pdf [Accessed on: 7 Nov. 2016].

Ijomah, W.L. (2008). A tool to improve training and operational effectiveness in remanufacturing. International Journal of Computer Integrated Manufacturing, 21(6), 676-701.

Institute of Refrigeration (2018). About the Institute of Refrigeration. Available at: https://ior.org.uk/about [Accessed on: 12 February 2018]

Intergovernmental Panel on Climate Change (2014). Climate Change. Synthesis Report. Summary for Policymakers. IPCC, Geneva, Switzerland

Jiménez-Parra, B., Rubio, S. and Vicente-Molina, M. (2014). Key drivers in the behaviour of potential consumers of remanufactured products: a study on laptops in Spain, Journal of Cleaner Production, 85, pp. 488-496.

Joshi, Y. and Rahman, Z. (2015). Factors Affecting Green Purchase Behaviour and Future Research Directions, International Strategic Management Review, 3 (1-2), pp. 128-143.

Jouhara, H., Nannou, T., Ghazal, H., Kayyali, R., Tassou, S. and Lester, S. (2017). Temperature and energy performance of open refrigerated display cabinets using heat pipe shelves, Energy Procedia, 123, pp. 273-280.

Kaiser, F. G., Hübner, G. and Bogner, F. X. (2005). Contrasting the Theory of Planned Behavior With the Value-Belief-Norm Model in Explaining Conservation Behavior. Journal of Applied Social Psychology, 35: 2150–2170.

Kalmykova, Y., Sadagopan, M. and Rosado, L. (2018). Circular economy – From review of theories and practices to development of implementation tools. Resources, Conservation and Recycling, 135, pp.190-201.

Kaminska, O. and Foulsham, T. (2013). Understanding sources of social desirability bias in different modes: Evidence from eye-tracking, ISER Working Paper Series, No. 2013-04, University of Essex, Institute for Social and Economic Research (ISER), Colchester

Kampa, M. and Castanas, E. (2008). Human Health Effects of Air Pollution. Environmental Pollution, 151, 362-367.

Kerr, W. and Ryan, C. (2001) Eco-efficiency gains from remanufacturing: a case study of photocopier remanufacturing at Fuji Xerox Australia. Journal of Cleaner Production no.9, pp 75-81, 2001.

Kingfisher (2017) Sustainability Report 2016/17. Kingfisher PLC. Available at: https://www.kingfisher.com/sustainability/files/reports/cr_report_2017/2017_Sustainability_Report.pdf [Accessed: 2 July 2017].

Knussen, C., Yule, F., MacKenzie, J., Wells, M. (2004): An analysis of intentions to recycle household waste: The roles of past behaviour, perceived habit, and perceived lack of facilities; in: Journal of Environmental Psychology, Vol. 24, pp. 237-246

Kong, Y., & Zhang, L. (2014). When does green advertising work? The moderating role of product type. Journal of Marketing Communications, 20(3), 197-213.

Korhonen, J., Honkasalo, A. and Seppälä, J. (2018). Circular Economy: The Concept and its Limitations. Ecological Economics, 143, pp.37-46.

Korhonen, J., Honkasalo, A. and Seppälä, J. (2018). Circular Economy: The Concept and its Limitations, Ecological Economics, 143, pp. 37-46.

Kraaijenhagen, C., van Oppen, C., and Bocken, N. M. B. (2016). Circular Business: Collaborate & Circulate. Amersfoort, The Netherlands: Circular Collaboration.

Khor, K. S. & Hazen, B. T. (2017) Remanufactured products purchase intentions and behaviour: Evidence from Malaysia, International Journal of Production Research, 55:8, 2149-2162, DOI: 10.1080/00207543.2016.1194534

Kumar, A. (2019). Exploring young adults' e-waste recycling behaviour using an extended theory of planned behaviour model: A cross-cultural study, Resources, Conservation and Recycling, 141, pp. 378-389.

Lagerstedt, J., and Luttrop, C., (2006). Guidelines in ecodesign: a case study from railway industry. In: Brissaud, D., Tichkiewitch, S., Zwolinski, P. (Eds.), Innovation in Life cycle Engineering and Sustainable development. Springer, Dordrecht (The Netherlands), pp. 245–254.

Lavery, G., Pennell, N., Brown, S., Evans, S. (2013). The Next Manufacturing Revolution: Non-Labour Resource Productivity and its Potential for UK Manufacturing. Available at http://www.nextmanufacturingrevolution.org/nmr-report-download/

Lee, K. (2010). The green purchase behaviour of Hong Kong young consumers: the role of peer influence, local environmental involvement, and concrete environmental knowledge. Journal of international consumer marketing, 23(1), 21-44.

Leonidou, L., Leonidou, C., Kvasova, O. (2010). Antecedents and outcomes of consumer environmentally friendly attitudes and behaviour. Journal of Marketing Management 26, 1319e1344.

Likert, R. (1932). A Technique for the Measurement of Attitudes. Archives of Psychology, 140, 1–55.

Linder, M., and Williander, M. (2015). Circular Business Model Innovation: Inherent Uncertainties. Bus. Strat. Env., 26: 182– 196. doi: 10.1002/bse.1906.

Liu, X., Wang, C., Shishime, T., & Fujitsuka, T. (2012). Sustainable consumption: Green purchasing behaviours of urban residents in China. Sustainable Development, 20(4), 293-308.

Lizin, S., Van Dael, M. and Van Passel, S. (2017). Battery pack recycling: Behaviour change interventions derived from an integrative theory of planned behaviour study. Resources, Conservation and Recycling, 122, pp. 66-82.

Matsumoto, M., and Umeda, Y. (2001) An analysis of remanufacturing practices in Japan. Journal of Remanufacturing, 1 (1), pp. 1-11

Madden, T., Ellen, P. and Ajzen, I. (1992). A Comparison of the Theory of Planned Behavior and the Theory of Reasoned Action. Personality and Social Psychology Bulletin, 18(1), pp.3-9.

Maichum, K., Parichatnon, S. and Peng, K. (2016). Application of the Extended Theory of Planned Behavior Model to Investigate Purchase Intention of Green Products among Thai Consumers, Sustainability, 8, issue 10, p. 1-20.

Marks & Spencer (2018). Waste & Circular Economy. Available at: https://corporate.marksandspencer.com/sustainability/business-wide/waste-and-circular-economy#cc29d6cfd4d64f6d8c9592483192da03 [Accessed: 24 January 2018].

Marks and Spencer (2017). Plan A 2025 Commitments. Marks and Spencer Group PLC. Available from: https://corporate.marksandspencer.com/documents/plan-a/plan-a-2025-commitments.pdf

McDonough, W. and M. Braungart (2002), Cradle to cradle: Remaking the way we make things, New York, NY: North Point Press.

McKenzie-Mohr, D. (2000). New Ways to Promote Pro-Environmental Behaviour: Promoting Sustainable Behaviour: An Introduction to Community-Based Social Marketing, Journal of Social Issues, 56 (3), pp. 543-554.

McKinsey & Company (2016). The circular economy: Moving from theory to practice. McKinsey Center for Business and Environment Special edition. Available from: https://www.mckinsey.com/business-functions/sustainability/our-insights/the-circular-economy-moving-from-theory-to-practice

McKinsey Global Institute (2011). Resource Revolution: Meeting the World's Energy, Materials, Food, and Water needs. McKinsey & Company

McKinsey Global Institute (2013). Resource Revolution: Tracking global commodity markets. Available at: https://www.mckinsey.com/~/media/McKinsey/Not%20Mapped/TEST%20Copy%20of%20Resource%20revolution%20Tracking%20global%20commodity%20markets/MGI_Resources_survey_Full_report_Sep2013.ashx [Accessed: 12 September 2015].

Meadows, D.L., Meadows, D.H., Randers, J., Behrens III, W. (1972). The Limits to Growth, Club of Rome Reports. Universe Books, New York.

Michaud, C. and Llerena, D. (2010). Green consumer behaviour: an experimental analysis of willingness to pay for remanufactured products, Business Strategy And The Environment, pp. n/a-n/a.

Miller, G. R. (1980). On being persuaded: Some basic distinctions. In M. Roloff, & G. R. Miller (Eds.), Persuasion: New directions in theory and research, 11–28. Beverly Hills, CA: Sage.

Monier, V., Mudgal, S., Iyama, S. and Tinetti, B. (2007). Preparatory Studies for Eco-design Requirements of EuPs. Lot 12: Commercial Refrigerators and Freezers. BIO Intelligence Service

Mont, O. (2002). Clarifying the concept of Product Service System. Journal of Cleaner Production, 10, 237-245.

Mont, O., Plepys, A., Whalen, K., & Nußholz, J. L. K. (2017). Business model innovation for a Circular Economy: Drivers and barriers for the Swedish industry – the voice of REES companies. Mistra REES. Available from: http://lup.lub.lu.se/search/ws/files/33914256/MISTRA_REES_Drivers_and_Barriers_Lund.pdf

Muranko, Z., Andrews, D., Chaer I, I., Newton, E., Proudman, P., Longhurst, M. (2016). Developing a Circular Economy through the remanufacture of Refrigerated Display Cabinets (RDCs) and implications of the Enhanced Capital Allowance scheme in the UK, Proceedings of the 21st International Sustainable Innovation Conference, 07-08 November 2016, Epsom, UK

Muranko, Z., Andrews, D., Chaer, I. and Newton, E. (2019). Circular economy and behaviour change: Using persuasive communication to encourage pro-circular behaviours towards the purchase of remanufactured refrigeration equipment. Journal of Cleaner Production, 222, pp.499-510.

Muranko, Z., Andrews, D., Chaer, I., Newton, E. J., Proudman, P. and Longhurst, M. (2017a). Pro-circular behaviours and refrigerated display cabinets: supporting resource efficiency in the retail refrigeration sector. Elsevier Energy Procedia, Volume 123, Pages 70-75, ISSN 1876-6102.

Muranko, Z., Andrews, D., Chaer, I., Newton, E. J., Proudman, P. and Longhurst, M. (2016b). Developing Circular Economy for the Retail Refrigeration Industry: How Financial Incentives Could Influence Remanufacturing of Refrigerated Display Cabinets in the UK. In Proceedings of the Avnir LCA Conference 2016, Lille, France

Muranko, Z., Andrews, D., Chaer, I., Newton, E. J., Proudman, P. and Longhurst, M. (2017b). Incentivising pro-circular behaviours: proposing a new enhanced capital allowance scheme for remanufactured products - the case of refrigerated display cabinets in the United Kingdom, Energy Procedia, Volume 123, Pages 369-374.

Muranko, Z., Andrews, D., Newton, E., Chaer, I. and Proudman, P. (2018). The Pro-Circular Change Model (PCCM): Proposing a framework facilitating behavioural change towards a Circular Economy, Resources, Conservation and Recycling, 135, pp. 132-140.

O'Shaughnessy, J. and O'Shaughnessy, N.J. (2003). Persuasion in advertising. London: Taylor & Francis.

Oakdene Hollins (2004). Remanufacturing in the UK: A Significant Contributor to Sustainable Development? Skipton: The Resource Recovery Forum.

Oakdene Hollins (2011). The further benefits of business resource efficiency. A research report completed for the Department of Environment, Food and Rural Affairs.

Oakdene Hollins (2018). Hebei, China? It's time to look closer. Available at: https://www.oakdenehollins.com/news-insights/2018/5/15/a-visit-to-chinas-new-remanufacturing-zone Accessed on: 10th March 2019

Organisation for Economic Cooperation and Development (2012). Sustainable Materials Management: Making Better Use of Resources, OECD Publishing.

Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R. and Jaca, C. (2018). Circular Economy in Spanish SMEs: Challenges and opportunities, Journal Of Cleaner Production, 185, pp. 157-167.

Örsdemir, A., Kemahlıoğlu-Ziya, E. and Parlaktürk, A. (2013). Competitive Quality Choice and Remanufacturing, Production And Operations Management, 23 (1), pp. 48-64.

Pajunen, N., Watkins, G., Wierink, M. and Heiskanen, K. (2012). Drivers and barriers of effective industrial material use, Minerals Engineering, 29, pp. 39-46.

Parker, D., Butler P. (2007) An Introduction to Remanufacturing. Oakdene Hollins

Pauli, G. (2010). The Blue Economy-10 Years, 100 Innovations, 100 Million Jobs. New Mexico (USA): Paradigm Publications.

Peaslee, K., Naumovich Lekakh, S. and Randall, B. (2004). Thermal Efficiency of Steel Melting, Proceedings of the SFSA Technical and Operating Conference, Steel Founders' Society of America (SFSA)

Pelletier, L. G., & Sharp, E. (2008). Persuasive communication and pro-environmental behaviours: How message tailoring and message framing can improve the integration of behaviours through self-determined motivation. Canadian Psychology. 49(3), 210-217.

Pheifer, A. G. (2017). Barriers and Enablers to Circular Business Models. Value C. Available at: https://www.circulairondernemen.nl/uploads/4f4995c266e00bee8fdb8fb34fbc5c15.pdf

Philips (2014). Case study National Union of Students. Available from: http://www.lighting.philips.co.uk/cases/cases/education/national-union-of-students

Philips (2016). Rethinking the future Our transition towards a circular economy. Available from: https://www.philips.com/a-w/about/sustainability/sustainable-planet/circular-economy.html [Accessed 4 February 2016].

Philips (2017). Rethinking the future. Our transition towards a Circular Economy. [online] Philips. Available at: https://www.philips.com/a-w/about/sustainability/sustainable-planet/circular-economy.html [Accessed 2 Feb. 2016].

Pieroni, M., McAloone, T. and Pigosso, D. (2019). Business model innovation for circular economy and sustainability: A review of approaches, Journal of Cleaner Production, 215, pp. 198-216. DOI:10.1016/j.jclepro.2019.01.036.

Rana, S. and Brandt, K. (2016). Circular Economy at Work in Google Data Centers. [online] Google and Ellen MacArthur Foundation. Available at: https://static.googleusercontent.com/media/www.google.com/en//green/pdf/data-center-case-study.pdf [Accessed 21 Feb. 2017].

Reday-Mulvey, G. and Stahel, W. (1977). The potential for substituting manpower for energy. Geneva, Switzerland: Battelle, Geneva Research Centre.

Renault (2017). Circular Economy. [online] Available at: https://group.renault.com/en/our-commitments/respect-for-the-environment/circular-economy/ [Accessed 14 Sep. 2017].

Renault (2018). Groupe Renault's circular economy. Available from: https://group.renault.com/en/our-commitments/respect-for-the-environment/circular-economy/ [Accessed 3 January 2018].

Resource Waste Management Exhibition (2018). About RWM. Available at: https://www.rwmexhibition.com/about/ [Accessed: 10 July 2018]

Ritzén, S. and Sandström, G. (2017). Barriers to the Circular Economy – Integration of Perspectives and Domains, Procedia CIRP, 64, pp. 7-12.

Rizos, V., Behrens, A., Kafyeke, T., Hirschnitz-Garbers, M. and Ioannou, A. (2015). The circular economy: Barriers and opportunities for SMEs. Available at: http://www.greengrowthknowledge.org/sites/default/files/downloads/resource/GreenEconet_CEPS_SMEs_Circular_Economy.pdf

Rizos, V., Tuokko, K. and Behrens, A. (2017). The Circular Economy A review of definitions, processes and impacts. CEPS Research Report No. 2017/09. Available from: https://www.ceps.eu/publications/circular-economy-review-definitions-processes-and-impacts

Rolls-Royce (2015). Power by the Hour. Available at: https://www.rolls-royce.com/media/our-stories/discover/2017/totalcare.aspx [Accessed on: 10 June 2015]

Ruddick, G. (2015). Five facts that illustrate the dramatic changes in the supermarket industry. [online] Telegraph. Available at: https://www.telegraph.co.uk/finance/newsbysector/retailandconsumer/11522968/Five-facts-that-show-the-dramatic-changes-in-the-supermarket-industry.html [Accessed 9 Jul. 2016].

RWM and CIWM (Resource Waste Management and Chartered Institution for Waste Management) (2014). Ever-Decreasing Circles. Closing in on The Circular Economy. Available at: http://www.rwmexhibition.com/files/rwm14_ambassadors_doc.pdf (Accessed: 10 December 2016).

Sainsbury's (2018). Sustainability Update. Our values Sustainability Make Us Different. J Sainsbury PLC. Available from: https://www.about.sainsburys.co.uk/~/media/Files/S/Sainsburys/documents/making-a-difference/Sustainability_Update_2018.pdf

Salazar, H. A., Oerlemans, L., and van StroeBiezen, S. (2013). Social influence on sustainable consumption: evidence from a behavioural experiment. International Journal of Consumer Studies, 37(2), 172-180

Saunders, A. C. (1994). Graphics and How They Communicate. In Visual Literacy: A Spectrum of Visual Learning, Englewood Cliffs, NJ: Educational Technology Publications, Inc., 1994, pp. 183-192.

Schulte, U. (2013). New business models for a radical change in resource efficiency, Environmental Innovation and Societal Transitions, 9, pp. 43-47.

Schwartz, S. (2012). An Overview of the Schwartz Theory of Basic Values, Online Readings In Psychology And Culture, 2 (1). DOI:10.9707/2307-0919.1116.

Seyranian, V., Sinatra, G. and Polikoff, M. (2015). Comparing communication strategies for reducing residential water consumption, Journal of Environmental Psychology, 41, pp. 81-90.

Simons, H. W. (1976). Persuasion: Understanding, practice, and analysis. Reading, Mass: Addison-Wesley Pub. Co.

Singh, M., Chakraborty, A. and Roy, M. (2018). Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India, Resources, Conservation And Recycling, 135, pp. 313-322.

Singh, M.P., Chakraborty, A., Roy, M., (2017). Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India. Resources, Conservation and Recycling, Volume 135, 2018, Pages 313-322, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2017.07.015.

Smol, M., Avdiushchenko, A., Kulczycka, J. and Nowaczek, A. (2018). Public awareness of circular economy in southern Poland: Case of the Malopolska region, Journal of Cleaner Production, 197, pp. 1035-1045.

Solomon, M., Bamossy, G., Askegaard, S., and Hogg, M. K. (2006). Consumer Behaviour: A European Perspective. Third Edition. Pearson Education Limited. ISBN:978-0-273-71472-9

Sommer, L. (2011). The Theory Of Planned Behaviour And The Impact Of Past Behaviour. International Business & Economics Research Journal (IBER), 10(1). https://doi.org/10.19030/iber.v10i1.930

Sreen, N., Purbey, S. and Sadarangani, P. (2018). Impact of culture, behavior and gender on green purchase intention, Journal Of Retailing And Consumer Services, 41, pp. 177-189.

Stahel, W. (2010). The Performance Economy. Second Edition. Palgrave Macmillan London.

Stahel, W. and Reday, G. (1981). Jobs for Tomorrow, the Potential for Substituting Manpower for Energy, Vantage Press, N.Y.

Stec, T. and Zwolinski, P. (2018). Using Values Management for Shifting Companies to Circular Economy, Procedia CIRP, 69, pp. 805-809.

Stern, P. C., Dietz, T., Abel, T. D., Guagnano, G. A., and Kalof, L. (1999). A Value-Belief-Norm Theory of Support for Social Movements: The Case of Environmentalism. Huxley College on the Peninsulas Publications. 1. https://cedar.wwu.edu/hcop_facpubs/1

Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G. and Soto-Oñate, D. (2019). Operational principles of circular economy for sustainable development: Linking theory and practice, Journal Of Cleaner Production, 214, pp. 952-961.

Subramoniam, R., Huisingh, D. and Chinnam, R. (2010). Aftermarket remanufacturing strategic planning decision-making framework: theory & practice, Journal of Cleaner Production, 18 (16-17), pp. 1575-1586.

Suff, P. (2016). Coming full circle. In The Environmentalist, December 2016, p. 30–33.

Suh, T. (1999). Visual Persuasion. Communication Research Trends. Volume 19. No. 3. Centre for the Study of Communication and Culture. Saint Luis University. ISSN 0144-4646

Taber, K. (2017). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education, Research In Science Education, 48 (6), pp. 1273-1296. DOI:10.1007/s11165-016-9602-2.

Taylor UK (2017). Environment – Sustainability Aria project: growing respect for the environment. Available from: https://www.taylor-company.co.uk/isa-refrigerated-display/ [Accessed on: 21 January 2017]

Tesco (2016). An update on our Corporate Responsibility commitments. Tesco PLC. Available from: https://sustainability.tescoplc.com/media/475739/corporate-responsibility-update_nov-2016-final.pdf

Thackara, J. (2015). How to Thrive in the Next Economy: Designing Tomorrow's World Today. Thames & Hudson Limited

The Bond Group (2017). About The Bond Group | Commercial Refrigeration Cabinets. [online] Available at: https://www.bond-group.com/company/company-profile [Accessed 9 May 2018].

The Bond Group (2017). Remanufacture. Don't throw away your old RDCs and extend their life! Available at: https://www.bond-group.com/remanufacture [Accessed on: 15 May 2017]

The Restart Project (2018). Repair a laptop, fix the system. Available at: https://therestartproject.org/ [Accessed on: 10 January 2018]

The Scottish Government (2016). Making Things Last a Circular Economy Strategy for Scotland. Available from: https://circulareconomy.europa.eu/platform/sites/default/files/making_things_last.pdf

The World Bank (2010). Persuasion. Communication for Governance and Accountability Program (CommGAP). Washington, DC. Available from:

http://documents.worldbank.org/curated/en/771061468156572295/Persuasion [Accessed on: 20 March 2017]

The World Bank (2014). World Development Report 2015 - Mind, society, and behaviour. World Bank Publications, Washington

TNS Political & Social (2013). Flash Eurobarometer 381. SMEs, resource efficiency and green markets. The European Commission, Directorate-General for Enterprise and Industry. Available from: file:///Users/wayneullah/Downloads/fl_381_sum_en.pdf

Tonglet, M., Phillips, P. and Read, A. (2004). Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK, Resources, Conservation and Recycling, 41 (3), pp. 191-214.

Tukker, A. (2004). Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet. Business Strategy and Environment. 13: 246-260. doi:10.1002/bse.414

Unilever (2018). Rethinking plastic packaging – towards a circular economy. [online] Unilever. Available at: https://www.unilever.com/sustainable-living/reducing-environmental-impact/waste-and-packaging/rethinking-plastic-packaging/ [Accessed 16 Dec. 2018].

Unilever (2018). Rethinking plastic packaging – towards a circular economy. Available at: https://www.unilever.com/sustainable-living/reducing-environmental-impact/waste-and-packaging/rethinking-plastic-packaging/ [Accessed: 25 October 2018].

United Nations (2017). Population. Available at: https://www.un.org/en/sections/issues-depth/population/ [Accessed on: 20 December 2017]

United Nations Environment Programme (2017). With resource use expected to double by 2050, better natural resource use essential for a pollution-free planet. Available at: https://www.unenvironment.org/news-and-stories/press-release/resource-use-expected-double-2050-better-natural-resource-use [Accessed: 17 January 2018].

Vagias, W. M. (2006). Likert-type scale response anchors. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Van Weelden, E., Mugge, R. and Bakker, C. (2016). Paving the way towards circular consumption: exploring consumer acceptance of refurbished mobile phones in the Dutch market, Journal Of Cleaner Production, 113, pp. 743-754. DOI: 10.1016/j.jclepro.2015.11.065.

Voulvoulis, N. (2015). The circular revolution. An Imperial College London report commissioned by Veolia. Available from: https://www.veolia.co.uk/sites/g/files/dvc1681/files/document/2015/07/LIVING_CIRCULAR_BROCHURE.pdf

Wan, C., Shen, G. and Choi, S. (2017). Experiential and instrumental attitudes: Interaction effect of attitude and subjective norm on recycling intention, Journal Of Environmental Psychology, 50, pp. 69-79.

Wang, S, Wang, J, Yang, F, Wang, Y, Li, J. (2018) Consumer familiarity, ambiguity tolerance, and purchase behavior toward remanufactured products: The implications for remanufacturers. Bus Strat Env. 2018; 27: 1741– 1750. https://doi.org/10.1002/bse.2240

Wang, Y., Wiegerinck, V., Krikke, H. and Zhang, H.(2013), "Understanding the purchase intention towards remanufactured product in closed-loop supply chains", International Journal of Physical Distribution & Logistics Management, Vol. 43 No. 10, pp. 866-888.

Warp It Reuse Network (2014). Find, give away, or loan office furniture, equipment and other resources. Waste Action Resource Efficiency. Available at: https://www.warp-it.co.uk/ [Accessed on: 2 June 2015]

Warren, C., Becken, S. and Coghlan, A. (2016). Using persuasive communication to co-create behavioural change – engaging with guests to save resources at tourist accommodation facilities, Journal of Sustainable Tourism, 25 (7), pp. 935-954.

Warren, C., Becken, S. and Coghlan, A. (2016). Using persuasive communication to co-create behavioural change – engaging with guests to save resources at tourist accommodation facilities, Journal of Sustainable Tourism.

Warren, C., Becken, S., and Coghlan, A. (2016): Using persuasive communication to co-create behavioural change – engaging with guests to save resources at tourist accommodation facilities, Journal of Sustainable Tourism, DOI: 10.1080/09669582.2016.1247849

Waste and Resources Action Programme (2008). Reclaimed building products guide. A guide to procuring reclaimed building products and materials for use in construction projects. Available at: http://www.wrap.org.uk/sites/files/wrap/Reclaimed%20building%20products%20guide.pdf [Accessed 14 Aug. 2016].

Waste and Resources Action Programme (2015). Economic growth potential of more circular economies. Available form: http://www.wrap.org.uk/content/economic-growth-potential-more-circular-economies

Waste and Resources Action Programme and Green Alliance (2015). Opportunities to tackle Britain's labour market challenges through growth in the circular economy. Available from: https://www.green-alliance.org.uk/opportunities-to-tackle-britains-labour-market-challenges.php

Wastling, T., Charnley, F. and Moreno, M. (2018) Design for Circular Behaviour: Considering Users in a Circular Economy, Sustainability, 10 (6), pp. 1743. DOI:10.3390/su10061743.

Watkins, R. (2015). Lifecycle Analysis, Carbon Footprint, Sustainability in Evans, J. and Foster, A. M., Sustainable Retail Refrigeration. John Wiley and Sons Ltd.

Watkins, R. and Tassou, S. (2006). Life cycle analysis of the environmental impact of different cabinet designs. in: IUFoST 2006 13th World Congress of Food Sciences Technology. Available at: http://dx.doi.org/10.1051/IUFoST:20060701

Watson, M. (2008). A Review of literature and research on public attitudes, perceptions and behaviour relating to remanufactured, repaired and reused products. Centre for Remanufacturing and Reuse and the University of Sheffield.

Wiard, M.L. and Sopko, B.G. (1991). Recycling basics: a positive waste management alternative for Ohio, Ohio Department of Natural Resources, Division of Litter Prevention and Recycling.

Witjes, S. and Lozano, R. (2016). Towards a more Circular Economy: Proposing a framework linking sustainable public procurement and sustainable business models, Resources, Conservation and Recycling, 112, pp. 37-44.

World Health Organization (2018). World health statistics 2018: monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization

Xerox (2010) Nurturing a Greener World through Sustainable Innovation and Development. Our 2010 Environment, Health and Safety Report.

Xue, B., Chen, X., Geng, Y., Guo, X., Lu, C. and Zhang, Z. et al. (2010). Survey of officials' awareness on circular economy development in China: Based on municipal and county level, Resources, Conservation and Recycling, 54 (12), pp. 1296-1302.

Yan, W.; Chai, J.; Qian, Z.; Tsai, S.B.; Chen, H.; Xiong, Y. (2018) Operational Decisions on Remanufacturing Outsourcing Involved with Corporate Environmental and Social Responsibility—A Sustainable Perspective. Sustainability 2018, 10, 1132

Yang, S.; Su, Y.; Wang, W.; Hua, K. (2019) Research on Developers' Green Procurement Behavior Based on the Theory of Planned Behavior. Sustainability, 11, 2949.

Ylä-Mella, J., Keiski, R. and Pongrácz, E. (2015). Electronic waste recovery in Finland: Consumers' perceptions towards recycling and re-use of mobile phones, Waste Management, 45, pp. 374-384.

Yong, R. (2007). The circular economy in China. J. Mater. Cycles Waste Manag., 9, pp. 121-129, 10.1007/s10163-007-0183-z

Zeithaml, V.A. (1998). Consumer Perceptions of Price, Quality, and Value: A Means-End Model and Synthesis of Evidence. Journal of Marketing, 52, 2-22.

Zhang, B., Yang, S., & Bi, J. (2013). Enterprises' willingness to adopt/develop cleaner production technologies: an empirical study in Changshu, China. Journal of Cleaner Production, Volume 40, Pages 62-7, https://doi.org/10.1016/j.jclepro.2010.12.009

Zhu, J., Fan, C., Shi, H., and Shi, L. (2018). Efforts for a Circular Economy in China: A Comprehensive Review of Policies. Journal of Industrial Ecology. https://doi.org/10.1111/jiec.12754.

Zip Car (2016). Green Benefits. Available at: https://www.zipcar.co.uk/universities/how/greenbenefits [Accessed on: 9 October 2016]

Appendix A. Chapter 4: Survey

Part 1 Questionnaire

PART 1

If you wish to take part in this survey, please answer questions in **PART 1** prior to Zaneta's presentation.
Please answer questions in **PART 2** after the presentation.

This short survey consist of questions related to **supermarket fridges** (RDCs) and the collated data will be used to establish opinion of the UK food, retail and refrigeration industry about **remanufactured RDCs**. All participants who take part in this survey are treated with a **strict confidentiality** and **answers to all of the questions are anonymous**.

Q.1. Which of the following best describes you?

- ☐ I buy supermarket fridges (RDCs)
- ☐ I buy other refrigeration equipment
- ☐ I produce/sell supermarket fridges (RDCs)
- ☐ I produce/sell other refrigeration equipment
- ☐ I work with supermarket fridges (RDCs)
- ☐ I work with other refrigeration equipment
- ☐ I work in research (*please, specify subject*):.....
- ☐ I work in food industry (*please, specify*):.....
- ☐ I work on product development (*please, specify*):.....
- ☐ Other (*please, specify*):.....

Q.2. In your opinion, **if a retailer needed 50 fridges to furnish their new supermarket, which type of RDCs would be better to buy?**

- ☐ 50 new fridges (RDCs)
- ☐ 50 factory-remanufactured (RDCs)
- ☐ I don't know

Q.3. In your opinion and based on the following characteristics, **please compare factory-remanufactured RDCs with new RDCs.**

	better than new	same as new	worse than new
Quality	☐	☐	☐
Performance	☐	☐	☐
Appearance	☐	☐	☐
Longevity	☐	☐	☐
Warranty	☐	☐	☐

Q.4. In your opinion, **buying factory-remanufactured RDCs could be:**

	EXTREMELY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	EXTREMELY	
Good	☐	☐	☐	☐	☐	☐	☐	Bad
Convenient	☐	☐	☐	☐	☐	☐	☐	Inconvenient
Necessary	☐	☐	☐	☐	☐	☐	☐	Unnecessary
Profitable	☐	☐	☐	☐	☐	☐	☐	Expensive

Part 2 Questionnaire

PART 2

Please, do not look at your answers in **PART 1.**
Please, answer questions in **PART 2** after the presentation.

Q.5. Prior to this presentation**, were you aware that RDCs could be factory-remanufactured?**

- ☐ Yes
- ☐ No

Q.6. If a retailer needed a number fridges to furnish their new supermarket, which type of RDCs would be better to buy?

- ☐ New fridges (RDCs)
- ☐ Factory-remanufactured (RDCs)
- ☐ I don't know

Q.7. Based on the following characteristics, **please compare factory-remanufactured RDCs with new RDCs.**

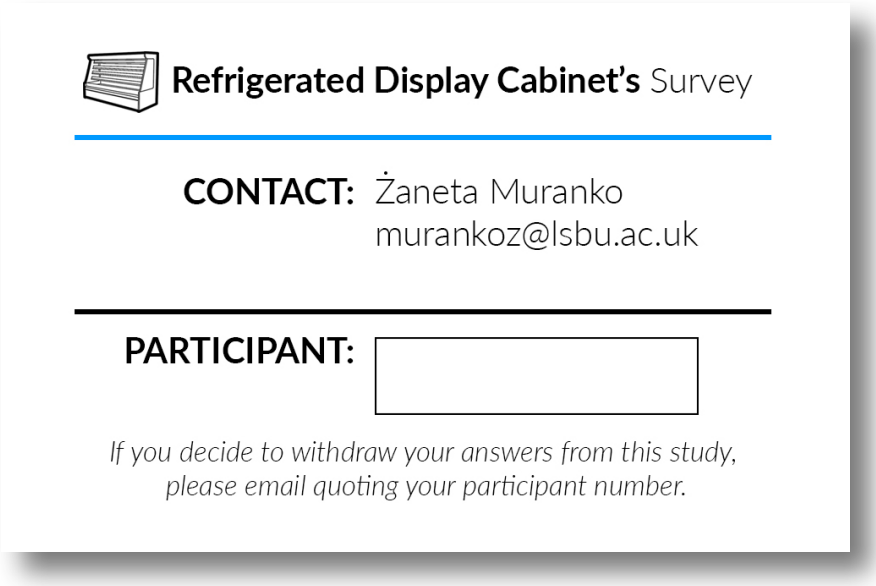
	better than new	same as new	worse than new
Quality	☐	☐	☐
Performance	☐	☐	☐
Appearance	☐	☐	☐
Longevity	☐	☐	☐
Warranty	☐	☐	☐

Q.8. Buying factory-remanufactured RDCs is:

	EXTREMELY	MODERATELY	SLIGHTLY	NEITHER	SLIGHTLY	MODERATELY	EXTREMELY	
Good	☐	☐	☐	☐	☐	☐	☐	Bad
Convenient	☐	☐	☐	☐	☐	☐	☐	Inconvenient
Necessary	☐	☐	☐	☐	☐	☐	☐	Unnecessary
Profitable	☐	☐	☐	☐	☐	☐	☐	Expensive

Thank you for taking part in this survey.
If you wish to leave a comment, please use the space below.

Contact Card



Appendix B. Chapter 4: Behaviour Change Intervention

Survey

What do you think about remanufactured RDCs?

PART 1

Please, complete it now

PART 2

Please, complete it after

Outline

What this presentation is about.

Circular Economy
Remanufacture
Remanufacturing examples
Benefits of remanufacturing

Refrigerated Display Cabinets

Background.

Long-life materials
70% steel
500kg

MATERIAL	NEW RDC CONTENT
Galvanised steel	277.5 kg
Stainless steel	77.68 kg
Polyurethane	27.6 kg
MDF	44.8 kg
Glass	44 kg
Copper	11.5 kg
Aluminium	18.2 kg

Circular Economy

Why is it important?

Waste reduction
Embodied Carbon

Remanufacture

How is it different from refurbishment?

On-site refurbishment:

Cosmetic update
Technical upgrade
75% parts remain
Often practiced

Remanufacture

How is it different from refurbishment?

Factory-remanufacture:

Manufacture
Technical upgrade
Increased efficiency by 40%
68% parts remain
Very rarely practiced

Examples

of remanufactured cabients.

11 year old

recoated, new ligting, fans, coil

Examples

Which RDC is new and which one was remanufactured?

Did you know that purchasing remanufactured RDCs could help create jobs in the UK?

FACT#1 In 2016 there were **1.6 million** people unemployed in the UK. **3,050 new jobs** could be created to annually remanufacture 58,000 RDCs.
(source: Office of National Statistics; Centre for Remanufacture and Reuse).

A greater demand for remanufactured RDC's could help provide jobs in the UK manufacturing sector. This would provide the opportunity for manufacturers to train (e.g. apprentices) and hire more staff (temporary and permanent).

Did you know that purchasing remanufactured RDCs could help revitalise the UK manufacturing sector?

FACT#2 In 2015, UK retailers spent £55 million on RDCs imported from outside the UK (EU and non-EU).
This represents the purchase of 200,000 units.
(Source: HM Revenue & Customs)

A greater demand for RDC's remanufactured in the UK could **help local businesses to grow.**

Did you know that if a grocery retailer purchased 50 remanufactured RDCs, they could save 12.5 tonnes of reusable parts and material from entering the waste-stream?

FACT#3 In 2015 there were 69,000 RDCs in the UK at their end-of-life available to be remanufactured.
Due to a low demand for remanufactured RDCs, they were disposed of and generated 34,000 tonnes of waste.
(source: Centre for Remanufacture and Reuse).

A greater demand for remanufactured RDC's could help to reduce waste.

Did you know, that by buying remanufactured RDCs a grocery retailer could champion the Corporate Social Responsibility initiative of your company?

FACT#4 In 2016, top 12 retailers in the UK have achieved remarkable efforts to deliver their economic, social and environmental goals.
These goals ranged from investing in local businesses **(e.g. farmers),**
preventing waste **(e.g. food, carrier bags)**
to efficient operations **(e.g. water efficiency).**
(Source: Corporate Social Responsibility and Sustainability Reports of Asda, Tesco, Sainsbury's, M&S, Waitrose, Co-op)

By choosing to buy remanufactured RDCs a retailer could lead their company's Cooperate Social Responsibility initiative and help them achieve their goals.

Did you know that remanufactured RDCs can cost up to 30% less than new ones?

FACT#5. Remanufactured RDCs are indistinguishable from new ones.
Remanufacturing of RDCs is a **manufacturing process** that takes place in an **industrial set up,** as a result the end-of-life cabinet is reproduced to a **"good-as-new"** state.
Up to 50% of components in remanufactured RDCs are new.
(Source: Centre for Remanufacture and Reuse)

By choosing to buy remanufactured RDCs a grocery retailer can save money.

Did you know that buying remanufactured RDCs can help reduce the carbon footprint?

FACT#6. The production of 50 new RDCs can generate 21,100 kg of CO_{2e}.
While carbon emissions associated with remanufacture of the same type RDCs are 10,250 kg CO_{2e}. Remanufactured RDCs have 51% less carbon footprint than new ones.
(Source: D.Bibalou, Carbon Calculator)

By choosing to buy remanufactured RDCs a retailer could reduce the environmental impact of their company.

Survey

What do you think about remanufactured RDCs now?

PART 2

Please, complete it now

Appendix C. Participant's Information Sheet

PARTICIPANT'S INFORMATION SHEET

Study Title:

Developing a Circular Economy in the Retail Refrigeration Industry

Please type your given participant's number in the text box below (e.g. P10, P11...).

P...

You are being invited to take part in a research study.
Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Please, ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Introduction to Survey

This survey is a part of a PhD research the aim of which is to build a platform of knowledge necessary for the development of a Circular Economy in the retail refrigeration industry. This questionnaire is given to the individuals in the UK, who purchase or produce Refrigerated Display Cabinets (RDCs) for retail stores.

This survey consist of questions related to **Refrigerated Display Cabinets (RDCs)** and the collated data will be used to establish opinion of the UK retail refrigeration industry about remanufactured Refrigerated Display Cabinets (RDCs) and Circular Economy. Results of this survey will help to create a framework, which will aim to enable remanufacturing to support the development of Circular Economy of retail refrigeration sector, that has a potential to positively impact the economy, environment and society.

All participants who take part in this survey are treated with a strict confidentiality and answers to all of the questions are anonymous. To maintain the confidentiality, each participant is given a code (e.g. P10, P11, P12). Each participant is free to withdraw from the study at any time and their given answers will be deleted. The recorded data will be stored on the password protected account of the Lead Researcher - Żaneta Muranko, to which only she has the access to. All recored answers will be safely stored until 30th September 2017. On the 1st of October 2017 all the collated identifiable data will be deleted.

You are invited to participate in this study as you are involved in the purchase or production of Refrigerated Display Cabinets (RDCs). If you are willing to participate, you are invited to answer this **survey lasting approximately 13 minutes**. In total, 60 people will be invited to participate in this survey.

Participant Information

It is up to you to decide whether or not to take part. If you do, you will be given this information sheet to keep and be asked to sign a consent form. You are still free to withdraw anytime up to the submission of the dissertation and without giving a reason.

It is not anticipated that you will be at any disadvantage or suffer any risk form this study.

It is unlikely that you will gain any immediate personal benefit from participating in this research. However, the information you share with the researcher will have a later impact on creating a framework supporting the development and adaptation of Circular Economy in retail refrigeration industry, that could bring a number of economic, social and environmental benefits. Some individuals may gain some benefit from having the opportunity to discuss this topic with the Lead Researcher, Żaneta Muranko.

You are free to withdraw from the study and not have your information included, at any time up to the time of completion of the dissertation. However, after that time, it would be impossible for the researcher to comply.

All information received from you will be handled in a confidential manner and stored in a locked filing cabinet and on a password protected computer in an environment locked when not occupied. Only the Lead Researcher, Żaneta Muranko, will have direct access to the information. Any reference to you will be coded. This information will be held until 30th September 2017.

This study is being completed as part of a PhD Research at London South Bank University, School of Engineering. It has been reviewed and ethically approved by the London Southbank University Research Ethics Committee.

Contact Details

If you have a concern about any aspect of this study, you should ask to speak with the researcher who will do their best to answer your questions.

Żaneta Muranko, Lead Researcher
02078157172
07747337492
murankoz@lsbu.ac.uk

As the Lead Researcher responsible for this study, I confirm that I have explained to the participant the nature and purpose of the research to be undertaken. I confirm that all collected data will be kept strictly confidential and each participant in the study is treated anonymously.

Researcher's Name: Żaneta Muranko **Researcher's Signature:** 

If you wish to receive any further information regarding this study or have any complaints about the way you have been dealt with during the study or other concerns you can contact:
Dr Deborah Andrews, Academic Supervisor
02078157682
deborah.andrews@lsbu.ac.uk

Finally, if you remain unhappy and wish to complain formally, you can contact the Chair of the University Research Ethics Committee. Details can be obtained from the university website:
https://my.lsbu.ac.uk/page/research-degrees-ethics

Appendix D: Chapter 5 and 7: Grocery Retailers' Survey

PhD Research Questionnaire

Developing a Circular Economy in the Retail Refrigeration Industry

Refrigerated Display Cabinets (RDCs)
Remanufacture
Circular Economy

By **Żaneta Muranko**
London South Bank University

Study Title:

Developing a Circular Economy in the Retail Refrigeration Industry

Please type your given participant's number in the text box below:

P... (e.g. P10, P11, P12...)

PARTICIPANT'S CONSENT

- I have read the attached information sheet on the research in which I have been asked and agree to participate and have been given a copy to keep. I have had the opportunity to discuss the details and ask questions about this information.
- The Researcher has explained the nature and purpose of the research and I believe that I understand what is being proposed.
- I understand that my personal involvement and my particular data from this study will remain strictly confidential. Only the Lead Researcher - Żaneta Muranko, involved in the study will have access.
- I have been informed about what the data collected will be used for, to whom it may be disclosed, and how long it will be retained.
- I have received satisfactory answers to all of my questions.
- I hereby fully and freely consent to participate in the study which has been fully explained to me.
- I understand that I am free to withdraw from the study at any time, without giving a reason.

Please tick the box below to consent and begin the questionnaire.

☐ **I have read the above information and I consent to take part in the study.**

Demographic Information

Q.I **What is your gender?**

- ○ Female
- ○ Male
- ○ I prefer not to say

Q.II **What is your age?**

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56-65
- ○ 66-75
- ○ 75+
- ○ I prefer not to say

Q.III **Which of the following best describes your role in the industry?**

- ○ Upper management
- ○ Middle management
- ○ Junior Management
- ○ Administrative staff
- ○ Support staff
- ○ Consultant
- ○ Contractor
- ○ Other (please specify):_____
- ○ I prefer not to say

Q.IV **What sector do you work within?**

You can select more than one answer to this question.

- ○ Hypermarkets
- ○ Supermarkets
- ○ Convenience stores
- ○ Discount stores
- ○ Small retail stores
- ○ Independent store/s
- ○ Other (please specify): _____
- ○ I prefer not to say

Questionnaire

Q.1 **When choosing refrigerated display cabinets (RDCs), what factors are the most important to you and have the biggest influence on your decision to purchase?**

*Please select **minimum 1 and maximum 5 answers** to this question.*

- ○ Design of cabinets
- ○ Price of cabinets
- ○ Time of the whole process (from order to delivery)
- ○ Delivery distance
- ○ B2B relationships
- ○ Quality of cabinets
- ○ Carbon footprint of cabinets
- ○ Ability to customise cabinets
- ○ Running costs of cabinets
- ○ Manufacturer's reliability
- ○ Warranty length of cabinets
- ○ Safety of cabinets
- ○ Sustainability of cabinets
- ○ Longevity of cabinets
- ○ Company policies
- ○ Ability to remanufacture/refurbish cabinets
- ○ Reliability of cabinets
- ○ Other (please specify):_____

The next part of the survey relates to the remanufacture of refrigerated display cabinets (RDCs).

Please read the following statements and select your answers on the scales.

All scales have 7 points and opposite answers on each side.

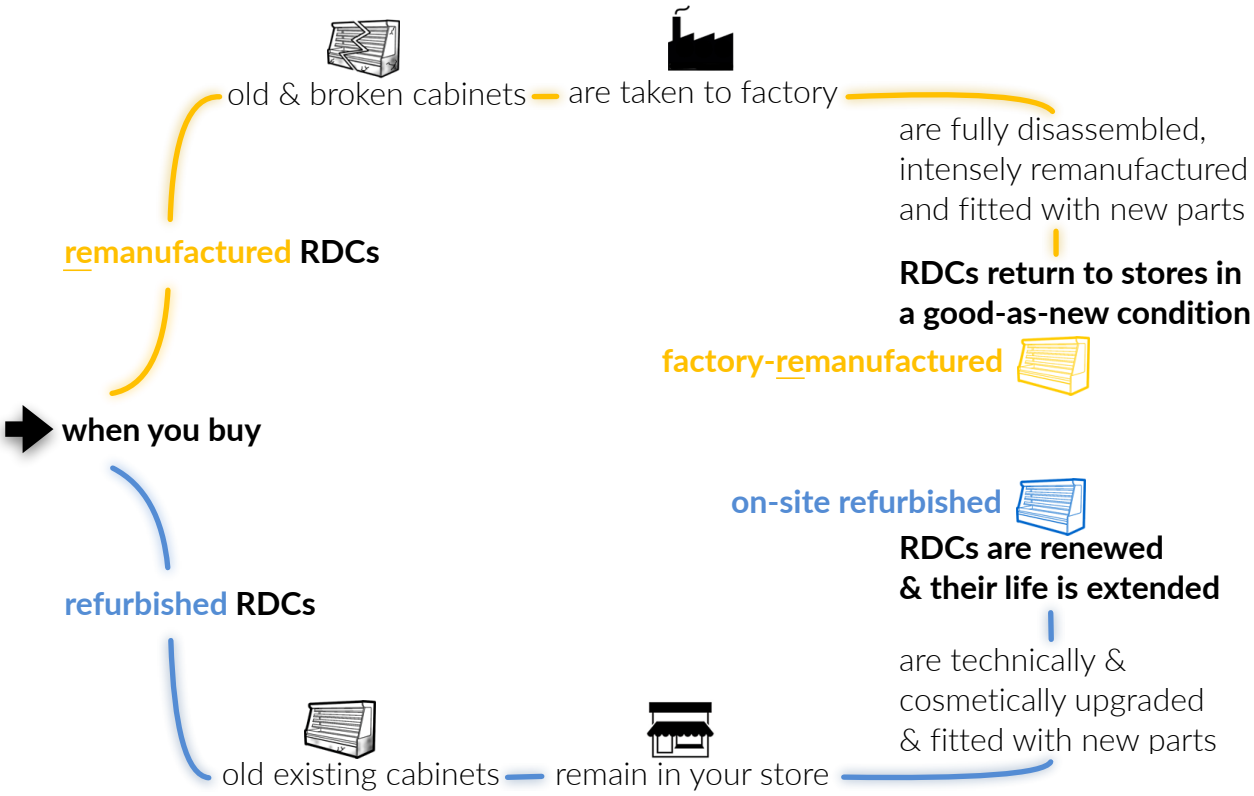
Q.2 **How strongly would you agree or disagree** that the term remanufactured means the same as refurbished in context **of refrigerated display cabinets (RDCs)?**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

WHAT IS DIFFERENT BETWEEN remanufacture and refurbishment ?

Remanufacture and refurbishment
are commonly mistaken to be the same process.

The infographic below clarifies the differences between both processes.
This information is particularly **important**,
because the next questions will ask about the both processes **independently.**



Q.3 **Prior to this survey, were you aware that you could factory-remanufacture your old refrigerated display cabinets (RDCs)?**

- ○ Yes
- ○ No

Q.4 **Prior to this survey, were you aware that you could on-site refurbish your existing refrigerated display cabinets (RDCs)?**

- ○ Yes
- ○ No

Based on the definition on the previous page, please rate the following statements related to factory-remanufacture only (not on-site refurbishment).

Q.5 I believe that **buying factory-remanufactured** refrigerated display cabinets (RDCs) for my stores **is/would be**:

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
good	○	○	○	○	○	○	○	bad
convenient	○	○	○	○	○	○	○	inconvenient
necessary	○	○	○	○	○	○	○	unnecessary
profitable	○	○	○	○	○	○	○	expensive

Q.6 **For my business, buying factory-remanufactured RDCs is/would be:**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
good	○	○	○	○	○	○	○	bad

Q.7 **Buying factory-remanufactured RDCs can/could benefit my business.**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.8 **It is expected of me to buy factory-remanufactured RDCs** for my stores.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.9 **Manufacturers think that I should buy factory-remanufactured RDCs** for my stores.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.10 **When it comes to buying factory-remanufactured RDCs, do you care what manufacturers think you should do?**

	definitely	moderately	slightly	neither	slightly	moderately	definitely	
yes	○	○	○	○	○	○	○	no

Q.11 **A lot of people like me, buy factory-remanufactured RDCs** for their stores.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.12 **I believe that other retailers in the UK buy factory-remanufactured RDCs** for their stores.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.13 **When it comes to buying factory-remanufactured RDCs, I think it would be good to do as other retailers do.**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.14 **If I wanted to, I would be able to buy some factory-remanufactured RDCs** for my stores this year.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.15 **How often are you given an opportunity to buy factory-remanufactured RDCs?**

	extremely often	often	quite often	undecided	quite rarely	rarely	almost never	
often	○	○	○	○	○	○	○	never

Q.16 **I would buy factory-remanufactured RDCs, if I was given an opportunity to.**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.17 **I would like to buy some factory-remanufactured RDCs** for my stores this year.

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.18 **I bought some factory-remanufactured RDCs for stores in the past year.**

- ○ Yes (please go to Q.19)
- ○ No (please go to Q.21)

---

*Answer this question, only if you selected **YES in Q.18***

Q.19 **What percentage of all RDCs that you purchased in the last year were factory-remanufactured?**

- ○ none
- ○ 0-10%
- ○ 10-20%
- ○ 20-30%
- ○ 30-40%
- ○ 40-50%
- ○ 50-60%
- ○ 60-70%
- ○ 70-80%
- ○ 80-90%
- ○ 90-100%
- ○ I prefer not to say

---

*Answer this question, only if you selected **YES in Q.18***

Q.20 **Why did you choose to buy factory-remanufactured RDCs** for your stores in the past year?

You can give more than one answer to this question.

- ○ Buying factory-remanufactured RDCs saves money.
- ○ I am expected to buy factory-remanufactured RDCs.
- ○ Factory-remanufactured RDCs have a lower Carbon Footprint.
- ○ It is company's policy to buy factory-remanufactured RDCs.
- ○ Other (please specify): _____
- ○ I prefer not to say.

Answer this question, only if you selected ***NO in Q.18***

Q.21 **Why did you decide not to buy any factory-remanufactured RDCs** for your stores in the past year?

You can give more than one answer to this question.

- ○ Remanufacturing process is too complex.
- ○ Remanufacturing is not offered by manufacturers.
- ○ I prefer to buy new RDCs.
- ○ I'm unconvinced of the benefits of factory-remanufactured RDCs.
- ○ I don't know enough about factory-remanufactured RDCs.
- ○ It's against company's policy to buy remanufactured RDCs.
- ○ Other (please specify): _____
- ○ I prefer not to say.

Q.22 **Based on the following characteristics, please compare factory-remanufactured (not on-site refurbished) against new RDCs.**

Factory-remanufactured RDCs in my opinion are:
Please, select your answers on the table below.

	better than new	the same as new	worse than new
Quality	○	○	○
Performance	○	○	○
Appearance	○	○	○
Longevity	○	○	○
Warranty	○	○	○

Q.23 **Based on the associated costs, please compare factory-remanufactured (not on-site refurbished) against new RDCs.**

Factory-remanufactured RDCs in my opinion are:
Please, select your answers on the table below.

	cheaper than new	the same as new	more expensive than new
Price of cabinets	○	○	○
Operational energy cost	○	○	○
Maintenance cost	○	○	○

Q.24 **In your opinion, how much less than new should factory-remanufactured RDCs cost?**

- ○ the same price
- ○ 0-10% less
- ○ 10-20% less
- ○ 20-30% less
- ○ 30-40% less
- ○ 40-50% less
- ○ 50-60% less
- ○ 60-70% less
- ○ 70-80% less
- ○ 80-90% less
- ○ 90-100% less
- ○ I don't know.

Q.25 **If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to purchase them?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.26 **If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to purchase them?**

*note: **The ECA scheme** currently provides eligible products with **20% tax relief, that can be fully claimed** on purchase of equipment included in the scheme (Source: Department of Energy & Climate Change (2015), The Energy Technology List: Call for Evidence)*

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.27 If there was **a tool or a system that could make buying factory-remanufactured RDCs easy, how likely would this encourage you to purchase them?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

The next part of this survey will be related to Circular Economy.

Please read the following statements and give your answers on the scales

Q.28 **Prior to this survey, how familiar were you with the concept of Circular Economy?**

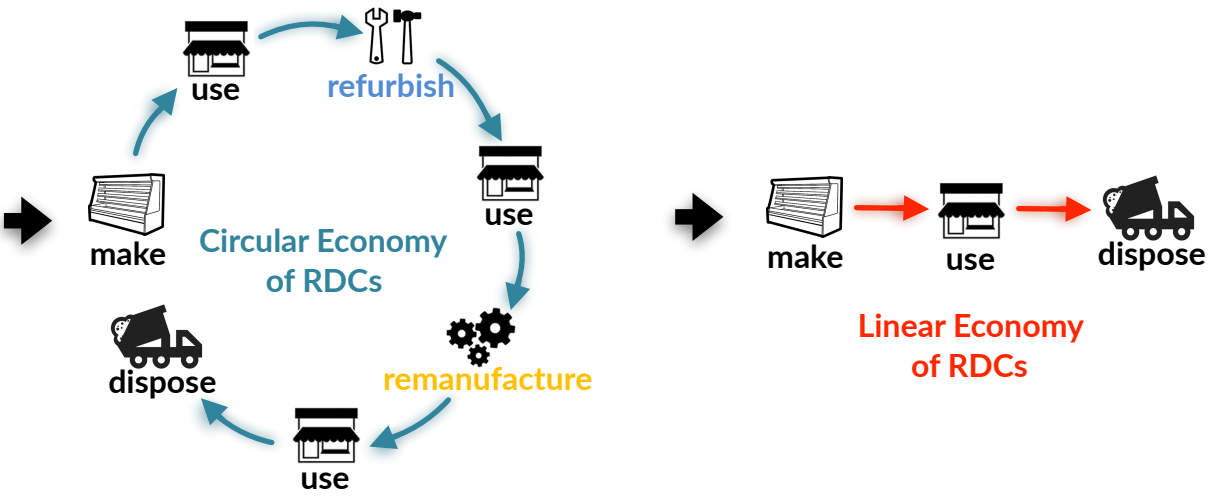
	extremely familiar	moderately familiar	slightly familiar	somewhat familiar	not familiar at all	
familiar	○	○	○	○	○	unfamiliar

WHAT IS a Circular Economy?

Circular Economy is a system which focuses on keeping products and resources in use for as long as possible before they are completely disposed of.

Circular Economy can be practiced though processes such as:
factory-remanufacture and refurbishment.

Please see the infographic below explaining the concept and move on to next question.



Based on the definition of Circular Economy, please rate the following statements.

Q.29 How strongly would you agree or disagree, **that your purchasing decisions could help to develop a Circular Economy in the retail refrigeration sector?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
agree	○	○	○	○	○	○	○	disagree

Q.30 How likely would you choose to **work with a company, that incorporates a Circular Economy into their business practice?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.31 If the government provided **financial incentives** (e.g. tax rebates) **supporting a Circular Economy, would that encourage you to practice it?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.32 **How important are the following to you?**
Please, select your answers on the table below.

	Extremely important	**Very** important	**Moderately** important	**Slightly** important	**Not at all** important
National economic growth	○	○	○	○	○
National resource security and resilience	○	○	○	○	○
Prosperity and growth of local businesses in the UK	○	○	○	○	○
More education & training opportunities the UK	○	○	○	○	○
More skilled job opportunities in the UK	○	○	○	○	○
Nation's health and well-being	○	○	○	○	○
Clean and sustainable living environment	○	○	○	○	○
Reduction of waste & air, water and soil pollution	○	○	○	○	○
Reduction of carbon emissions	○	○	○	○	○

Finally, in the last part of this survey you will be shown 7 pieces of short information.

Please read them carefully and answer questions A to G.

Did you know that your purchase of remanufactured RDCs could help create jobs in the UK?

FACT#1 In 2016 there were **1.6 million** people unemployed in the UK. **3,050 new jobs** could be created to annually remanufacture 58,000 RDCs.
(source: Office of National Statistics; Centre for Remanufacture and Reuse).

A greater demand for remanufactured RDC's could help provide jobs in the UK manufacturing sector. This would provide the opportunity for manufacturers to train (e.g. apprentices) and hire more staff (temporary and permanent).

Q.A **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that your purchase of remanufactured RDCs could help revitalise the UK manufacturing sector?

FACT#2 In 2015, UK retailers spent £55 million on RDCs imported from outside the UK (EU and non-EU).
This represents the purchase of 200,000 units.
(Source: HM Revenue & Customs)

A greater demand for RDC's remanufactured in the UK could **help local businesses to grow.**

Q.B **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that if you purchased 50 remanufactured RDCs, you could save 12.5 tonnes of reusable parts and material from entering the waste-stream?

FACT#3 In 2015 there were 69,000 RDCs in the UK at their end-of-life available to be remanufactured.
Due to a low demand for remanufactured RDCs, they were disposed of and generated 34,000 tonnes of waste.
(source: Centre for Remanufacture and Reuse).

A greater demand for remanufactured RDC's could help to reduce waste.

Q.C **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know, that you could champion the Corporate Social Responsibility initiative of your company?

FACT#4 In 2016, top 12 retailers in the UK have achieved remarkable efforts to deliver their economic, social and environmental goals.
These goals ranged from investing in local businesses **(e.g. farmers)**, preventing waste **(e.g. food, carrier bags)**
to efficient operations **(e.g. water efficiency)**.
(Source: Corporate Social Responsibility and Sustainability Reports of Asda, Tesco, Sainsbury's, M&S, Waitrose, Co-op)

By choosing to buy remanufactured RDCs you could lead your company's Cooperate Social Responsibility initiative and help them achieve their goals.

Q.D **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that remanufactured RDCs can cost up to 30% less than new ones?

FACT#5. Remanufactured RDCs are indistinguishable from new ones.
Remanufacturing of RDCs is a **manufacturing process** that takes place in an **industrial set up**, as a result the end-of-life cabinet is reproduced to a **"good-as-new"** state.
Up to 50% of components in remanufactured RDCs are new.
(Source: Centre for Remanufacture and Reuse)

By choosing to buy remanufactured RDCs you can save money.

Q.E **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

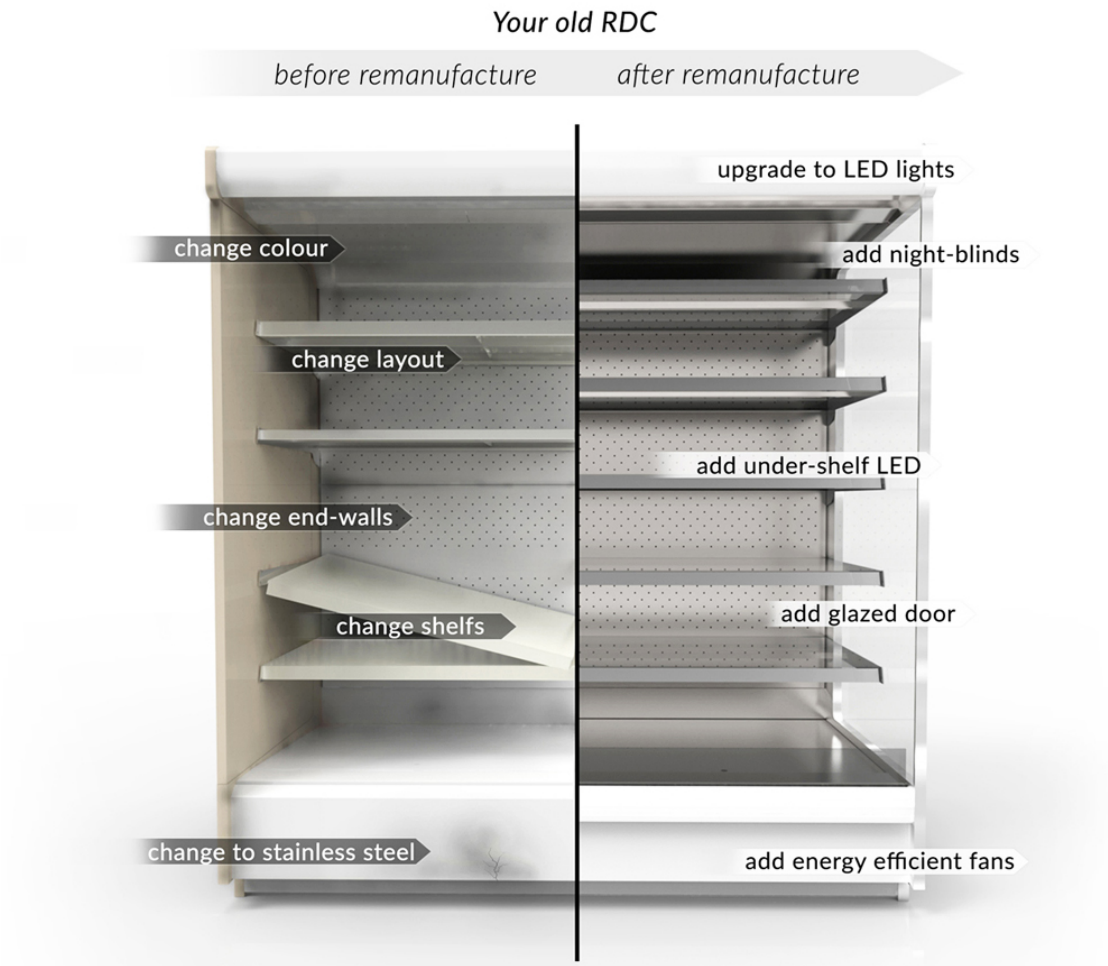
Did you know that by buying remanufactured RDCs you can help reduce the carbon footprint of your company?

FACT#6. The production of 50 new RDCs can generate 21,100 kg of CO_{2e}.
While carbon emissions associated with remanufacture of the same type RDCs are 10,250 kg CO_{2e}. Remanufactured RDCs have 51% less carbon footprint than new ones.
(Source: D.Bibalou, Carbon Calculator)

By choosing to buy remanufactured RDCs you could reduce the environmental impact of your company.

Q.F **Based on this fact, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely



Q.G **Based on this illustration, how likely would you consider buying factory-remanufactured RDCs for your stores?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Thank you for your contribution.

If you wish to share any comments or information, please use the space below.

Appendix E. Chapter 6 and 7: RDC Manufacturers' Survey

PhD Research Questionnaire

Developing a Circular Economy in the Retail Refrigeration Industry

Refrigerated Display Cabinets (RDCs)
Remanufacture
Circular Economy

By **Żaneta Muranko**
London South Bank University

Study Title:

Developing a Circular Economy in the Retail Refrigeration Industry

Please type your given participant's number in the text box below:

P... (e.g. P10, P11, P12...)

PARTICIPANT'S CONSENT

- I have read the attached information sheet on the research in which I have been asked and agree to participate and have been given a copy to keep. I have had the opportunity to discuss the details and ask questions about this information.
- The Researcher has explained the nature and purpose of the research and I believe that I understand what is being proposed.
- I understand that my personal involvement and my particular data from this study will remain strictly confidential. Only the Lead Researcher - Żaneta Muranko, involved in the study will have access.
- I have been informed about what the data collected will be used for, to whom it may be disclosed, and how long it will be retained.
- I have received satisfactory answers to all of my questions.
- I hereby fully and freely consent to participate in the study which has been fully explained to me.
- I understand that I am free to withdraw from the study at any time, without giving a reason.

Please tick the box below to consent and begin the questionnaire.

☐ **I have read the above information and I consent to take part in the study.**

Demographic Information

Q.I **What is your gender?**

- ○ Female
- ○ Male
- ○ I prefer not to say

Q.II **What is your age?**

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56-65
- ○ 66-75
- ○ 75+
- ○ I prefer not to say

Q.III **Which of the following best describes your role in the industry?**

- ○ Upper management
- ○ Middle management
- ○ Junior Management
- ○ Administrative staff
- ○ Support staff
- ○ Consultant
- ○ Contractor
- ○ Other (please specify):_____
- ○ I prefer not to say

Q.IV **What sector do you work in?**

You can select more than one answer to this question.

- ○ Manufacture
- ○ Remanufacture
- ○ Refurbishment
- ○ Repair
- ○ Maintenance
- ○ Other (please specify): _____
- ○ I prefer not to say

Questionnaire

Q.1 In your opinion, **what factors are the most important to your clients and have the biggest influence on their decision to purchase refrigerated display cabinets (RDCs)?**

*Please select **minimum 1 and maximum 5 answers** to this question.*

- ○ Design of cabinets
- ○ Price of cabinets
- ○ Time of the whole process (from order to delivery)
- ○ Delivery distance
- ○ B2B relationships
- ○ Quality of cabinets
- ○ Carbon footprint of cabinets
- ○ Ability to customise cabinets
- ○ Running costs of cabinets
- ○ Manufacturer's reliability
- ○ Warranty length of cabinets
- ○ Safety of cabinets
- ○ Sustainability of cabinets
- ○ Longevity of cabinets
- ○ Company policies
- ○ Ability to remanufacture/refurbish cabinets
- ○ Reliability of cabinets
- ○ Other (please specify):_____

The next part of the survey relates to the remanufacture of refrigerated display cabinets (RDCs).

Please read the following statements and select your answers on the scales.

All scales have 7 points and opposite answers on each side.

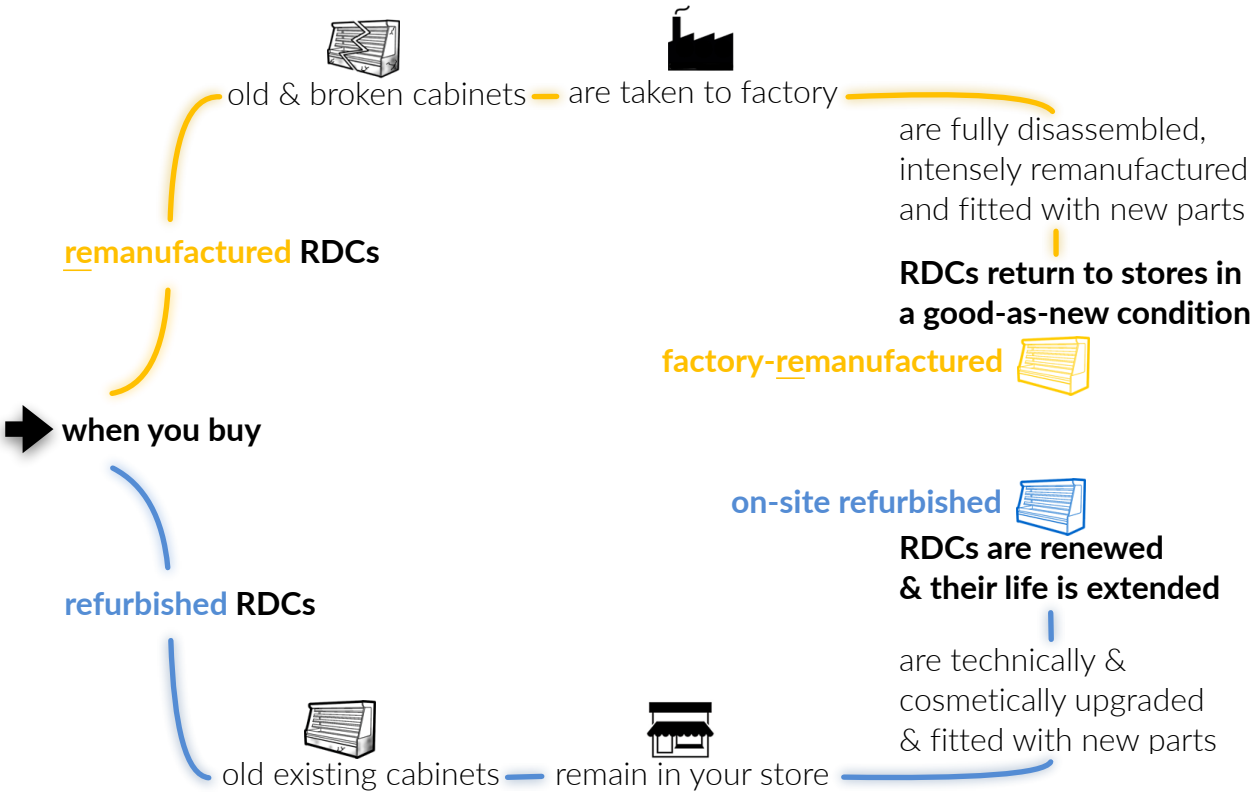
Q.2 **How strongly would you agree or disagree** that the term remanufactured means the same as refurbished in context **of refrigerated display cabinets (RDCs)?**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

WHAT IS DIFFERENT BETWEEN remanufacture and refurbishment ?

Remanufacture and refurbishment
are commonly mistaken to be the same process.

The infographic below clarifies the differences between both processes.
This information is particularly **important**,
because the next questions will ask about the both processes **independently.**



Q.3 **Prior to this survey, were you aware that refrigerated display cabinets (RDCs) can be factory-remanufactured ?**

- ○ Yes
- ○ No

Q.4 **Prior to this survey, were you aware that refrigerated display cabinets (RDCs) can be on-site refurbished?**

- ○ Yes
- ○ No

Based on the definition on the previous page, please rate the following statements related to factory-remanufacture only (not on-site refurbishment).

Q.5 I believe that **producing factory-remanufactured** refrigerated display cabinets (RDCs) for my clients **is/would be**:

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
good	○	○	○	○	○	○	○	bad
convenient	○	○	○	○	○	○	○	inconvenient
necessary	○	○	○	○	○	○	○	unnecessary
profitable	○	○	○	○	○	○	○	expensive

Q.6 **For my business, producing factory-remanufactured RDCs is/would be:**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
good	○	○	○	○	○	○	○	bad

Q.7 **Producing factory-remanufactured RDCs can/could benefit my business.**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.8 **It is expected of me to produce factory-remanufactured RDCs** for my clients.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.9 **My clients think that I should produce factory-remanufactured RDCs** for them.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.10 **When it comes to producing factory-remanufactured RDCs, do you care what your clients think you should do?**

	definitely	moderately	slightly	neither	slightly	moderately	definitely	
yes	○	○	○	○	○	○	○	no

Q.11 **A lot of people like me, produce factory-remanufactured RDCs** for their clients.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.12 **I believe that other manufacturers in the UK produce factory-remanufactured RDCs** for their clients.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.13 **When it comes to producing factory-remanufactured RDCs, I think it would be good to do as other manufacturers do.**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.14 **If I wanted to, I would be able to produce some factory-remanufactured RDCs** for my clients this year.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.15 **How often are you given an opportunity to produce factory-remanufactured RDCs?**

	extremely often	often	quite often	undecided	quite rarely	rarely	almost never	
often	○	○	○	○	○	○	○	never

Q.16 **I would produce factory-remanufactured RDCs, if I was given an opportunity to.**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.17 **I would like to produce factory-remanufactured RDCs** for my clients this year.

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.18 **I produced some factory-remanufactured RDCs for clients in the past year.**

- ○ Yes (please go to Q.19)
- ○ No (please go to Q.21)

---

*Answer this question, only if you selected **YES in Q.18***

Q.19 **What percentage of all RDCs that you produced in the last year were factory-remanufactured?**

- ○ none
- ○ 0-10%
- ○ 10-20%
- ○ 20-30%
- ○ 30-40%
- ○ 40-50%
- ○ 50-60%
- ○ 60-70%
- ○ 70-80%
- ○ 80-90%
- ○ 90-100%
- ○ I prefer not to say

---

*Answer this question, only if you selected **YES in Q.18***

Q.20 **Why did you choose to produce factory-remanufactured RDCs** for your clients in the past year?

You can give more than one answer to this question.

- ○ Producing factory-remanufactured RDCs is profitable.
- ○ I am expected to produce factory-remanufactured RDCs.
- ○ Factory-remanufactured RDCs have a lower Carbon Footprint.
- ○ It is company's policy to produce factory-remanufactured RDCs.
- ○ Other (please specify): _____
- ○ I prefer not to say.

Answer this question, only if you selected ***NO in Q.18***

Q.21 **Why did you decide not to produce any factory-remanufactured RDCs** for your clients in the past year?

You can give more than one answer to this question.

- ○ Remanufacturing process is too complex.
- ○ My clients don't want to buy remanufactured RDCs.
- ○ I prefer to produce new RDCs.
- ○ I'm unconvinced of the benefits of factory-remanufacturing of RDCs.
- ○ I don't know enough about how to factory-remanufacture RDCs.
- ○ It's against company's policy to produce remanufactured RDCs.
- ○ Other (please specify): _____
- ○ I prefer not to say.

Q.22 **Based on the following characteristics, please compare factory-remanufactured (not on-site refurbished) against new RDCs.**

Factory-remanufactured RDCs in my opinion are:
Please, select your answers on the table below.

	better than new	the same as new	worse than new
Quality	○	○	○
Performance	○	○	○
Appearance	○	○	○
Longevity	○	○	○
Warranty	○	○	○

Q.23 **Based on the associated costs, please compare factory-remanufactured (not on-site refurbished) against new RDCs.**

Factory-remanufactured RDCs in my opinion are:
Please, select your answers on the table below.

	cheaper than new	the same as new	more expensive than new
Price of cabinets	○	○	○
Operational energy cost	○	○	○
Maintenance cost	○	○	○

Q.24 **In your opinion, how much less than new should factory-remanufactured RDCs cost?**

- ○ the same price
- ○ 0-10% less
- ○ 10-20% less
- ○ 20-30% less
- ○ 30-40% less
- ○ 40-50% less
- ○ 50-60% less
- ○ 60-70% less
- ○ 70-80% less
- ○ 80-90% less
- ○ 90-100% less
- ○ I don't know.

Q.25 **If there was a new Industry Standard for the quality of factory-remanufactured RDCs, how likely would this encourage you to produce them?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.26 **If factory-remanufactured RDCs were included in the Enhanced Capital Allowance (ECA) scheme, how likely would this encourage you to produce them?**

*note: **The ECA scheme** currently provides eligible products with **20% tax relief, that can be fully claimed** on purchase of equipment included in the scheme (Source: Department of Energy & Climate Change (2015), The Energy Technology List: Call for Evidence)*

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.27 If there was **a tool or a system that could make manufacturing of factory-remanufactured RDCs easy, how likely would this encourage you to produce them?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

The next part of this survey will be related to Circular Economy.

Please read the following statements and give your answers on the scales

Q.28 **Prior to this survey, how familiar were you with the concept of Circular Economy?**

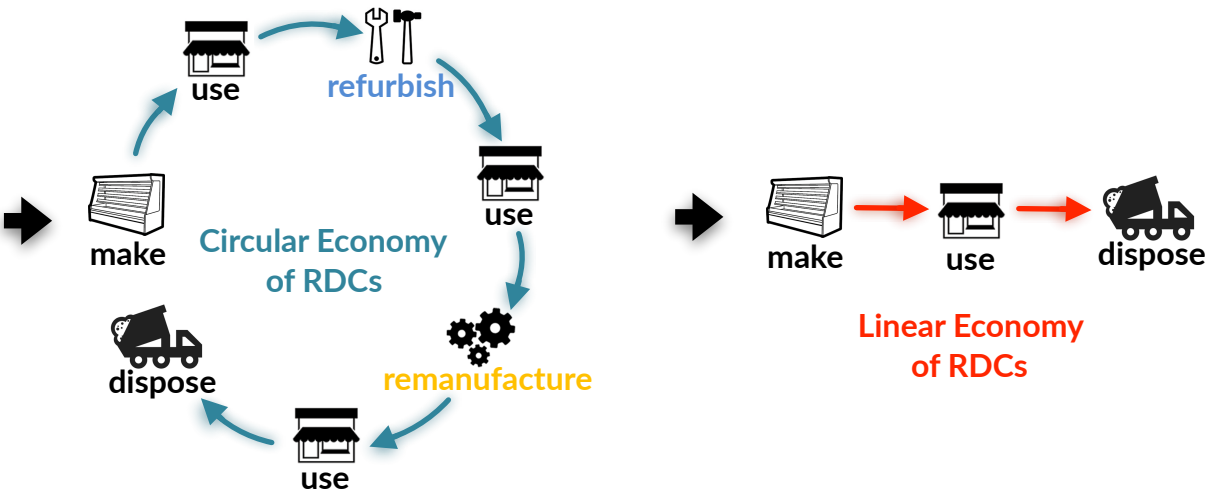
	extremely familiar	moderately familiar	slightly familiar	somewhat familiar	not familiar at all	
familiar	○	○	○	○	○	unfamiliar

WHAT IS a Circular Economy?

Circular Economy is a system which focuses on keeping products and resources in use for as long as possible before they are completely disposed of.

Circular Economy can be practiced though processes such as:
factory-remanufacture and refurbishment.

Please see the infographic below explaining the concept and move on to next question.



Based on the definition of Circular Economy, please rate the following statements.

Q.29 How strongly would you agree or disagree, **that your business decisions could help to develop a Circular Economy in the retail refrigeration sector?**

	strongly	moderately	slightly	neither	slightly	moderately	strongly	
agree	○	○	○	○	○	○	○	disagree

Q.30 How likely would you choose to **work with a company, that incorporates a Circular Economy into their business practice?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.31 If the government provided **financial incentives** (e.g. tax rebates) **supporting a Circular Economy, would that encourage you to practice it?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Q.32 **How important are the following to you?**
Please, select your answers on the table below.

	Extremely important	**Very** important	**Moderately** important	**Slightly** important	**Not at all** important
National economic growth	○	○	○	○	○
National resource security and resilience	○	○	○	○	○
Prosperity and growth of local businesses in the UK	○	○	○	○	○
More education & training opportunities the UK	○	○	○	○	○
More skilled job opportunities in the UK	○	○	○	○	○
Nation's health and well-being	○	○	○	○	○
Clean and sustainable living environment	○	○	○	○	○
Reduction of waste & air, water and soil pollution	○	○	○	○	○
Reduction of carbon emissions	○	○	○	○	○

Finally, in the last part of this survey you will be shown 7 pieces of short information.

Please read them carefully and answer questions A to G.

Did you know that your production of remanufactured RDCs could help create jobs in the UK?

FACT#1 In 2016 there were **1.6 million** people unemployed in the UK.
3,050 new jobs could be created to annually remanufacture 58,000 RDCs.
(source: Office of National Statistics; Centre for Remanufacture and Reuse).

An increased production of remanufactured RDC's could help provide jobs in the UK manufacturing sector. This would provide the opportunity for manufacturers to train (e.g. apprentices) and hire more staff (temporary and permanent).

Q.A **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that production of remanufactured RDCs could help revitalise the UK manufacturing sector?

FACT#2 In 2016, UK retailers spent £55 million on RDCs imported from outside the UK (EU and non-EU).
This represents the purchase of 200,000 units.
(Source: HM Revenue & Customs)

An increased production of RDC's remanufactured in the UK could **help local businesses to grow.**

Q.B **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that if you produced 50 remanufactured RDCs, you could save 12.5 tonnes of reusable parts and material from entering the waste-stream?

FACT#3 In 2015 there were 69,000 RDCs in the UK at their end-of-life available to be remanufactured.
They were disposed of and generated 34,000 tonnes of waste.
(source: Centre for Remanufacture and Reuse).

An increased production of RDCs could help to reduce waste.

Q.C **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know, that your company could champion the Corporate Social Responsibility initiative of your clients?

FACT#4 In 2016, top 12 retailers in the UK have achieved remarkable efforts to deliver their economic, social and environmental goals.
These goals ranged from investing in local businesses **(e.g. farmers)**, preventing waste **(e.g. food, carrier bags)**
to efficient operations **(e.g. water efficiency)**.
(Source: Corporate Social Responsibility and Sustainability Reports of Asda, Tesco, Sainsbury's, M&S, Waitrose, Co-op)

By remanufacturing RDCs you could contribute to retailers' Cooperate Social Responsibility initiative and work with them together to achieve their goals.

Q.D **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that remanufacturing RDCs can bring your company **profit**?

FACT#5. Remanufactured RDCs are indistinguishable from new ones.
Remanufacturing of RDCs is a **manufacturing process** that takes place in an **industrial set up**, as a result the end-of-life cabinet is reproduced to a **"good-as-new"** state.
At least **50%** **of components in remanufactured RDCs are reused.**
(Source: Centre for Remanufacture and Reuse)

By choosing to produce remanufactured RDCs you can make profit.

Q.E **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

Did you know that by producing remanufactured RDCs you can help reduce the **carbon footprint** of your company?

FACT#6. The production of 50 new RDCs can generate 21,100 kg of CO_{2e}.
While carbon emissions associated with remanufacture of the same type RDCs are 10,250 kg CO_{2e}. Remanufactured RDCs have 51% less carbon footprint than new ones.
(Source: D.Bibalou, Carbon Calculator)

By choosing to produce remanufactured RDCs you could reduce the environmental impact of your company.

Q.F **Based on this fact, how likely would you consider producing factory-remanufactured RDCs for your clients?**

	extremely	moderately	slightly	neither	slightly	moderately	extremely	
likely	○	○	○	○	○	○	○	unlikely

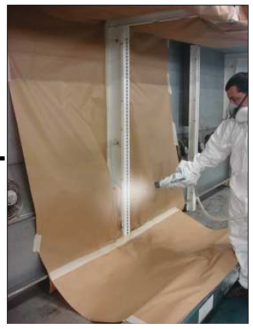
Thank you for your contribution.

If you wish to share any comments or information, please use the space below.

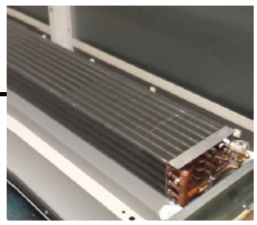
Appendix F. Chapter 8: Persuasive Communication

1 – Cabinet is stripped

2 – Once at carcass stage, key vars are sprayed



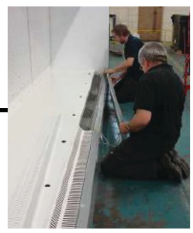
3 – New coil and fans are fitted, if required

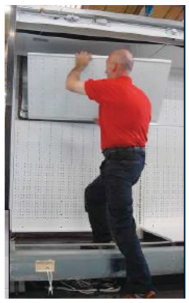


4 – New electrical tray and new controllers can be added

5 – New internal and external parts are manufactured

6 – Cabinet is re-assembled with new and remanufactured parts





Appendix G. Ethical Approval

London South Bank
University

Direct line: 020 7815 7492
E-mail: seethics@lsbu.ac.uk
Ref: 18July2016

Monday 1st August 2016

Dear Miss Zaneta Muranko

RE: Developing A Circular Economy by Changing Behaviour In The Retail Refrigeration Industry

Thank you for submitting this proposal.

I am pleased to inform you that full Chair's Approval has been given by Dr. Daqing Chen, on behalf of the School of Engineering.

I wish you every success with your research.

Yours sincerely,

Chair, Research Ethics Coordinator
School of Engineering