Investigating the effect of disposition options of reverse logistics on sustainability performance in the Australian manufacturing industry

by

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DEDICATION

To my lovely parents and husband

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Abstract

The growth of manufacturing activities has contributed to the use of more resources and rising environmental concerns because of increasing waste generated during production and consumption. Reverse logistics (RL) can reduce waste by choosing appropriate disposition options for returned and used products. Product disposition is a key component of the RL process. The main aim of this research is to investigate the impact of RL disposition options on the perceived triple-bottom-line sustainability performance of a firm.

A comprehensive review of literature reveals that there are limited empirical studies to explore the relationship between RL and sustainability performance and social performance of RL has been largely neglected. Some studies examined RL from the perspective of GSCM. When RL is investigated in the context of GSCM, it is compared to other green practices and more attention is paid to its environmental performance. Most of the studies examined RL without considering disposition options. Majority of the previous studies have been conducted in developing countries, less attention is paid to developed countries. The target population of this study was manufacturing firms in Australia due to the importance of RL in this industry. Three sectors were chosen for the study including “Machinery and Equipment Manufacturing”, “Transport Equipment Manufacturing”, and “Furniture Manufacturing”.

This research decomposes RL into five commonly adopted disposition options including reuse, repair, remanufacturing, recycling, and disposal. Also, this research investigates how institutional pressures and resource commitment as external and internal factors can impact the adoption of RL and perceived sustainability performance of firms. This research conducted an online questionnaire survey to collect data. The data of 120 survey responses were analysed using confirmatory factor analysis (CFA) and structural equation modelling (SEM) to answer the research questions. This research also examined the differences among respondents regarding the adoption of RL and their perceptions of sustainability performance using the analysis of variance (ANOVA). This research explored the level of RL implementation and how sustainability performance was perceived in the context of RL in the Australian manufacturing industry.

The research concludes that RL is a relatively new practice in Australia as the level of its implementation is medium. The most adopted disposition options are repair and disposal, while reuse is the lowest adopted option. Among the three dimensions of sustainability performance, social performance has the most contribution to sustainability performance while economic performance is identified as the weakest construct. Regarding the impact of RL disposition options on the perceived sustainability performance of firms in the Australian manufacturing industry, the results of this study show that all disposition options affect sustainability performance except for remanufacturing. Moreover, the results confirm the significant role of resource commitment in the adoption of RL and sustainability performance. In relation to institutional pressures, in the context of Australia, it does not significantly contribute to companies' decision to implementing RL although institutional pressures can positively affect sustainability performance.

This study offers a clear understanding of the current situation of RL implementation in the Australian manufacturing industry. One of the major barriers to RL implementation is a lack of awareness of RL and its benefits. Therefore, the research outcomes will contribute to the increase of organisations' awareness about how RL benefits sustainability, which can affect organisations' attitudes toward RL implementation. The research provides empirical evidence on the business value of RL implementation in improving sustainability performance through choosing the appropriate RL disposition option for the business.

Keywords: Reverse logistics, Disposition options, Sustainability performance, Sustainable development, Factor analysis, Structural equation modelling

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List of Abbreviations

3C	Computer, Communication, and Consumer
ABS	Australian Bureau of Statistics
AEE	Asian Emerging Economies
AFS	Australian Forestry Standard
AMC	Australian Maritime College
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
CEO	Chief Executive Officers
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CIO	Chief Information Officer
CR	Composite Reliability
C.R.	Critical Ratio
EFA	Exploratory Factor Analysis
EMS	Environmental Management System
FA	Factor Analysis
FSC	Forest Stewardship Council
GOF	Goodness-Of-Fit
GSCM	Green Supply Chain Management
IFI	Incremental Fit Index
KMO	Kaiser-Meyer-Olkin
LCA	Life Cycle Assessment
MCDM	Multi-Criteria Decision-Making
NCPS	National Centre of Ports and Shipping
NFI	Normed-Fit Index
PRQ	Primary Research Question
RBV	Resource-Based View
RL	Reverse Logistics

RMSEA	Root Mean Square Error of Approximation
RoHS	Restriction of Hazardous Substances
SEM	Structural Equation Modelling
SMEs	Small and Medium-sized Enterprises
SRQ	Subsidiary Research Questions
SSHREC	Social Sciences Human Research Ethics Committee
WEEE	Waste Electrical and Electronic Equipment

Chapter 1 Introduction

1.1 Research background

Industrialisation and economic development have contributed to increased market demand for products as well as an overall rise in manufacturing activities (Shahbazi et al., 2013). The ever-growing manufacturing activities require, in turn, increasing resource inputs, resulting in environmental concerns about pollution and waste during production and consumption. Reverse logistics (RL) is a crucial component of green supply chain management (GSCM), which can help reduce the waste generated by the handling and disposition of returned and used products through a range of disposition options (Hervani et al., 2005, Pokharel and Mutha, 2009). In addition, RL plays a key role in the manufacturing industry by propelling companies to embrace green practices more generally.

The manufacturing industry is a fundamental part of the Australian economy; it is also one of the largest employers in the country (Group, 2019). RL can help the industry meet one of its biggest challenges: namely, rising energy price, even for manufacturing companies that are relatively less energy-consuming (Group, 2019). By implementing RL, companies can reduce energy and resource consumption (Agrawal et al., 2016b, Kazancoglu et al., 2020). In addition, Australia has the highest waste generation and waste disposal rates among developed countries after the US (Lee, 2012, Pickin and Randell, 2017). Previously, waste management in Australia focused mainly on recycling and hazardous waste management (Lee, 2012); but rising government and public awareness of environmental issues has led to the recognition of the need to develop a comprehensive approach to managing waste in the Australian manufacturing industry (Lee, 2012). RL can contribute to such an approach.

RL is a logistics function focusing on the backward flow of products from customers to suppliers (Hazen, 2011). In recent years, RL has attracted significant attention among both practitioners and academics due to environmental directives and governmental legislation, consumer concerns and the growing sense of social responsibility for the environment, increasing awareness of the limits of natural resources, and recognition of RL's economic potential. As a relatively new practice, RL can contribute to achieving sustainable production and consumption (Khor et al., 2016). There are significant differences between RL and forward logistics in terms of their processes and purposes (Tibben-Lembke and Rogers, 2002, Bai and Sarkis, 2013). Forward logistics concerns the activities that are necessary to get products to customers, while RL deals with the activities associated with taking back the products from customers, so as to recapture value through reprocessing or proper disposal (Hansen et al., 2018). Planning and forecasting for RL are more difficult than for forward logistics due to the high level of uncertainty when it comes to the quantity, quality, and delivery dates of returned products involved in RL (Flapper, 1995, Guide Jr et al., 2000, Lee and Chan, 2009, Jain and Khan, 2017, Bai and Sarkis, 2013). In addition, the number of origin and destination points are different in RL versus forward logistics. While forward logistics moves a product from one origin to many destinations, RL is the movement of products in the opposite direction—i.e., from many origins to one destination (Fleischmann et al., 1997, Lee and Chan, 2009, Hansen et al., 2018).

Product returns can be categorised into different groups, including manufacturing, distribution, and customer-related returns (Rogers and Tibben-Lembke, 1999, Flapper, 2003). The key activities of the RL process include product acquisition/gatekeeping, collection, inspection/sorting, disposition and redistribution (Rogers and Tibben-Lembke, 1999, Fleischmann et al., 2000, Guide and Wassenhove, 2003b). Product disposition involves decisions about what to do with used or returned products, and this process is a key part of RL (Prahinski and Kocabasoglu, 2006). Reuse, repair, remanufacturing, recycling, and disposal have been considered as the common disposition options for RL by several authors (Thierry et al., 1995, De Brito and Dekker, 2002, Pokharel and Mutha, 2009).

In general, sustainability has become a key strategy for almost all businesses in the twenty-first century because of its contributions to profitability, growth, and even the survival of businesses (Corbett and Klassen, 2006, Kolk and Pinkse, 2008). Sustainability in supply chains has gained more attention in recent years due to environmental concerns and legislation, increasing market and economic competitiveness, and the growing awareness of firms' social responsibility (Agrawal et al., 2016b). Sustainability, in the triple-bottom-line approach developed by Elkington (2001), involves balancing environmental, economic, and social issues. Organisations can gain more profit and sustain their activities over the long term by adopting sustainability principles (Székely and Knirsch, 2005). Thus, sustainability development is considered as a strategic goal for organisations due to its impact on competitive advantage (Hart, 2005, Pfeffer, 2010). Organisations need to evaluate and analyse the environmental and social performance of their business in addition to their economic performance (Agrawal et al., 2016b).

Well-managed RL programs can lead to sustainable development and create competitive advantage through profit gains, cost reduction and improvement in customer satisfaction (Rogers and Tibben-Lembke, 1999, Stock et al., 2002, Masudin et al., 2021, Ivanova et al., 2022). RL can generate tangible and intangible values by recapturing value from used or returned products and extending the life of products, allowing manufacturers to avoid purchasing more raw materials and wasting labour and time. In addition, RL can play a key role in enhancing customer satisfaction and securing customer loyalty by enabling firms to identify and remove faulty products (Adebayo, 2022). Furthermore, RL can result in improvements of future products or new product designs by incorporating feedback from customers and gaining insights into the reasons for returned products (Aitken and Harrison, 2013).

1.2 Justification of research

Product disposition is a key component of the RL process. Each disposition option affects sustainability performance in a different way, and choosing a proper disposition option can help organisations improve sustainable development. The impact of each disposition option on triple-bottom-line sustainability performance is an under-explored area. In addition, with sustainable development being a strategic intent for organisations, it is necessary to take sustainability into account when exploring RL issues (De Brito and Dekker, 2002, Álvarez-Gil et al., 2007).

There is a research gap, however, when it comes to investigating the relationship between RL and sustainability performance (Govindan et al., 2015b, Govindan and Soleimani, 2017, Wang et al., 2017). Most relevant studies have evaluated RL by focusing on factors associated with economic and environmental performance (Agrawal et al., 2016b). Wang et al. (2017) claimed that although the economic dimension of RL has been investigated the most out of the three dimensions of sustainability, there are research opportunities for developing a comprehensive understanding of RL's economic implications. At the same time, the social dimension of sustainability has not been explored adequately, particularly in relation to RL (Sarkis et al., 2010b, Vahabzadeh and Yusuff, 2015, Wang et al., 2017, Mckenzie, 2004). RL as an organisational strategy can help organisations reduce resource consumption and waste (Sarkis et al., 2010b), and improve profitability through cost reduction, customer service improvement, and increased revenues (Jack et al., 2010, Daugherty et al., 2001). RL can have significant effects on social issues along with economic and environmental issues. Accordingly, the inclusion of the social dimension in the analysis of sustainability performance will provide a more complete, holistic picture of how RL may impact on the sustainability performance of firms (Sarkis et al., 2010b).

Overall, there is a dearth of research on examining the relationship between RL and the triple-bottom-line sustainability performance (Wang et al., 2017, Agrawal et al., 2016b). Furthermore, while product disposition is a key component of the RL process, little attention has been devoted to disposition decisions in the process (Agrawal et al., 2016a). Most studies have considered only environmental and economic dimensions of RL disposition decisions (Dewulf et al., 2010, Kim et al., 2008, Kerr and Ryan, 2001, Ferrer and Ayres, 2000); understandings of decisions regarding final product disposition will be more complete if the social dimension of RL is also considered. In sum, there is no comprehensive and empirical study exploring the triple-bottom-line sustainability performance outcomes derived from the use of RL disposition options. The present study bridges this research gap by investigating the relationship between RL disposition options and the triple-bottom-line sustainability performance.

To this end, the study focuses on the five commonly accepted disposition options, investigating the impact of each on sustainability performance from economic, environmental, and social perspectives. An evaluation of how each disposition option impacts on sustainability performance can help firms make informed decisions on choosing the appropriate disposition options, with a view to achieving long-term sustainable growth. The target population of this research is manufacturing companies in Australia. Most studies on RL have been conducted in developing countries; less attention has been devoted to developed countries. In the context of Australia specifically, no study to date has investigated the impact of RL disposition options on sustainability performance.

A number of external and internal factors can affect organisational decisions about adopting business practices that may contribute to improving sustainability performance. For example, institutional theory is used to explore how institutional pressures affect firms' decisions regarding adopting practices, procedures, and policies (Dimaggio and Powell, 1983), and also how organisations should behave and act in relation to environmental pressures (Meyer and Rowan, 1977, Grewal and Dharwadkar, 2002, Powell and Dimaggio, 2012). Dimaggio and Powell (1983) stated that managerial actions are affected by three types of institutional pressures—namely, coercive, mimetic, and normative pressures—that form a set of values, norms, and rules to create similar structures across organisations. Institutional theory can shed light on what drives organisations to adopt GSCM practices (González-Benito and González-Benito, 2006), insofar as institutional pressures play a key role in affecting the decisions of firms regarding the implementation of GSCM practices like RL (Lin and Sheu, 2012). Despite the importance of institutional theory for research in the operations and supply chain management area, the impact of institutional pressures on chain members' adoption of practices remains under-explored (Cai et al., 2010). The objective of the present study is to use institutional theory to explore the drivers behind organisational behaviour when it comes to adopting RL practices, and how those practices impact on sustainability performance.

In addition to external drivers, internal resources also facilitate organisations to adopt environmentally sustainable practices (Clemens and Douglas, 2006). Resources are fundamental drivers of implementing strategies and firms' performance (Conner, 1991). Resource commitment helps firms develop RL programs (Khor and Udin, 2013). Conversely, because RL programs need intensive resources for implementation and maintenance, reluctance to allocate sufficient financial, managerial, and technological resources can be a barrier to developing effective RL programs (Daugherty et al., 2001). Thus, committing resources to RL programs plays a key role in achieving performance outcomes (Daugherty et al., 2001, Richey et al., 2005, Skinner et al., 2008). The present study thus investigates how the commitment of managerial, technological, and financial resources affects organisations' RL implementation and their perceived sustainability performance.

1.3 Research objectives and questions

The aim of this study is to investigate the impact of RL disposition options on the perceived triple-bottom-line sustainability performance of firms in the Australian manufacturing industry. The research objectives of this study are to:

- Examine the level of RL implementation in the Australian manufacturing industry.
- Investigate how the three dimensions of sustainability performance are perceived in the context of RL in the Australian manufacturing industry.
- Explore the impact of RL disposition options on the perceived triple-bottom-line sustainability performance of firms in the Australian manufacturing industry.
- Examine the effects of institutional pressures and resource commitment on the adoption of RL and perceived sustainability performance of firms in the Australian manufacturing industry.

To achieve these research objectives, a primary research question (PRQ) is framed:

PRQ: How do RL disposition options affect the perceived sustainability performance of firms in the Australian manufacturing industry?

To answer the PRQ, the following subsidiary research questions (SRQ) are developed.

SRQ1: How are RL disposition options adopted in the Australian manufacturing industry?

SRQ2: How is sustainability performance perceived in the context of RL in the Australian manufacturing industry?

This study considers institutional pressures as external factors and resource commitment as an internal factor that may affect firms' adoption of RL and their perceived sustainability performance. To investigate their impact, two further SRQs are developed:

SRQ3: How do institutional pressures affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

SRQ4: How does resource commitment affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

1.4 Thesis outline

This thesis is organised into six chapters. Chapter 1 provides the general background of the research, presents research justification, and frames the research objectives and questions. Chapter 2 provides a comprehensive review of the literature on the sustainability performance of RL as well as the effect of RL disposition options on sustainability performance. The chapter also discusses the RL process, along with the drivers of and barriers to RL implementation. Chapter 3 explains the methodology used to conduct the study, including the research approach, research design, data collection method, and analysis. Chapter 4 analyses the quantitative data and presents the results. Chapter 5 discusses the findings used to address the research questions. Finally, Chapter 6 draws conclusions of this research. It also highlights the key contributions of the study, discusses the research limitations and recommends areas for future research.

Chapter 2 Literature Review

2.1 Introduction

This chapter reviews literature related to sustainability issues in the context of RL, as well as literature on performance evaluations of the RL process with reference to the three dimensions of sustainability—that is, the environmental, economic, and social. The chapter starts with a discussion of logistics management and a background for RL and explains the process of RL , then drivers along with barriers to RL implementation are discussed. Then the three dimensions of sustainability performance and their indicators are examined. This chapter also discusses the relationship between RL and sustainable development. Finally, institutional theory and resource commitment are discussed to examine how external and internal factors can affect firms' adoption of RL and their perceived sustainability performance of RL.

2.2 RL and logistics management

Logistics is an essential component of supply chain management; it includes the transportation and storage of products and inventory management. Meanwhile, supply chain management encompasses a wider domain that goes beyond logistics-related activities, covering issues related to purchasing, partnerships, and customer services (Varma et al., 2006). Logistics plays a critical role for companies due to the increasing length and complexity of supply chains (König and Spinler, 2016). It includes the optimal use of labour, materials, and machinery. When companies concentrate on their core competencies, they tend to outsource their logistics activities to third-party logistics service providers (König and Spinler, 2016).

Reverse logistics is a part of the logistics process: it aims to reclaim value from the returned products in an environmentally friendly manner (Carter and Ellram, 1998). Conversely, forward logistics involves all the activities involved in supplying final products to customers, but without taking into account any responsibility for returned or end-of-life products (Lambert and Cooper, 2000, Varma et al., 2006). The differences between RL and forward logistics manifest themselves in operations such as forecasting, packaging, distribution, pricing, inventory management, and communication and marketing, as well as in features such as the origins and destinations of products, the quality of products, the cost of operations, and the visibility of products (Tibben-Lembke and Rogers, 2002). Most of the research in the supply chain and logistics management areas only focus on forward logistics, neglecting RL activities (Rogers et al., 2012, Wang et al., 2017, Hansen et al., 2018).

2.2.1 Definitions of RL

The definition of RL has changed over time. Murphy and Poist (1988) defined RL by referring to the reverse flow of goods. The term "environment" appeared in the definition of RL by Carter and Ellram (1998), who described RL as an environmentally friendly approach. Rogers and Tibben-Lembke (1999, p. 2) provided a useful definition of RL by introducing the purpose of RL: "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal", which is the operational definition of RL as according to The Council of Logistics Management. Stock (1998, p. 20) defined RL as "The term most often used to refer to the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair and remanufacturing". Stock's definition refers to the different disposition options used in RL processes. As these examples suggest, different scholars have defined RL in different ways, and the scope of RL has been expanded over time along with research interest in the topic. RL also covers the logistics activities of transportation and inventory management, with a focus on getting products back from the customers (Goldsby and Stank, 2000). Products are returned for different reasons, including commercial returns (customers change their mind or are dissatisfied with products), damage or quality problems, overstocks or manufacturing problems, the return of products for repair, and others (Daugherty et al., 2005).

2.2.2 RL processes

Researchers have also described RL process in different ways. Figure 2.1 illustrates this process, drawing on studies conducted by Rogers and Tibben-Lembke (1999), Fleischmann et al. (2000), Fleischmann (2001), and Guide and Wassenhove (2003a). RL starts with end users, from whom to-be-returned products are collected through product acquisition; the products are then inspected and sorted into various groups. The next step is to make an appropriate disposition decision. Such decisions include reuse, repair, remanufacturing and recycling for recapturing value, or disposal. Hence the key RL processes include product acquisition, collection, inspection/sorting, and disposition.

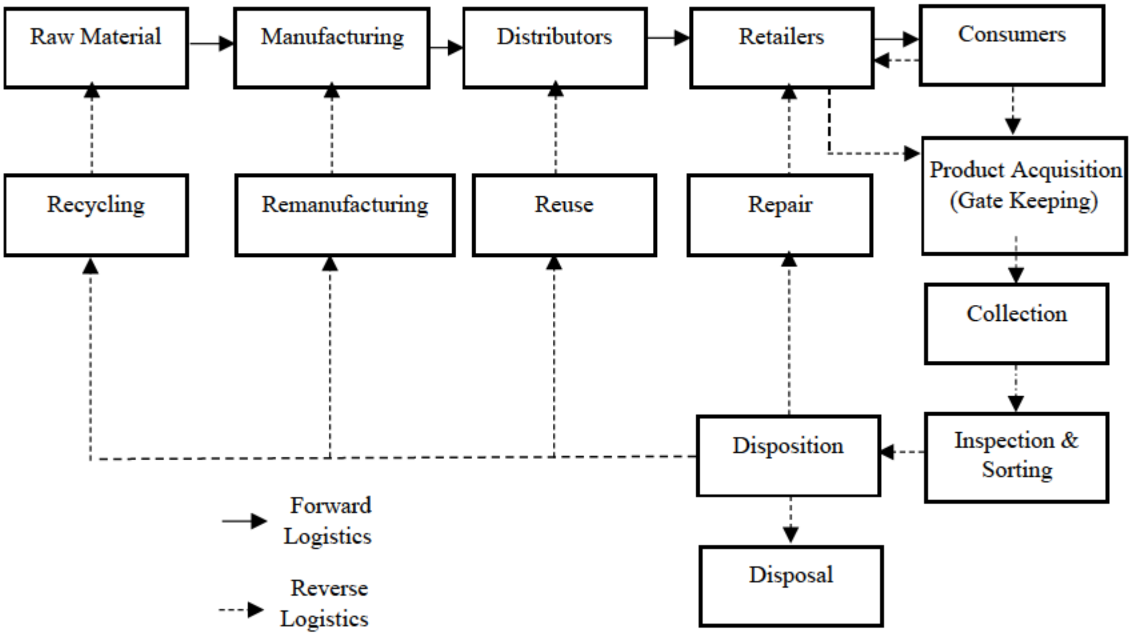

Figure 2.1: Fundamental flow of forward and RL processes (adapted from (Agrawal et al., 2015)

Product acquisition/gatekeeping

The process of acquiring used products from end users for further processing falls under product acquisition, which is crucial for the success of RL because of uncertainty regarding delivery dates and also the quantity and quality of returned products (Agrawal et al., 2015). Gatekeeping is a set of practices usually implemented by retailers (Agrawal et al., 2015). In this stage, retailers make a decision about whether products should be sent for further processing or returned to consumers (Agrawal et al., 2015).

Collection

After acqusition, products are collected and sent to other facilities for inspection, sorting, and disposition. Kumar and Putnam (2008) categorised collection methods into three groups: 1) manufacturers directly collect from customers, 2) manufacturers collect via retailers, and 3) manufactures collect through third-party logistics firms. The selection of collection methods is dependent on the collection cost structure and collection quantity (Atasu et al., 2013). The selection of collection centres and recovery facilities must be considered in designing RL to operate efficiently (Pochampally and Gupta, 2004). Two take-back approaches were defined by Webster and Mitra (2007); these implementations afford different degrees of control over product returns. The first approach is called collective take-back, where the manufacturer, by paying a collection fee to the government, takes no responsibility for and exerts no control over collecting returns. The second approach is called individual take-back, where the manufacturer has complete control over returns.

Inspection and sorting

The products are inspected and sorted after collection. Product returns may be manufacturing-related, distribution-related, or customer-related (Rogers and Tibben-Lembke, 1999, Guide and Wassenhove, 2003b), and the returned products may differ greatly in terms of quality and condition. It is therefore necessary to inspect the products separately in order to sort them into different groups for disposition (Agrawal et al., 2015).

Disposition

Once the products are inspected and sorted, the next phase is to make decisions about their disposition. Product disposition is a key component in the RL process (Prahinski and Kocabasoglu, 2006), with researchers identifying different disposition options. Norek (2003) identified five disposition options, including sell as new; repair or repackage and resell as new; repair or repackage and resell as used; resell at a lower price to a salvage house; and sell by the pound to a salvage house. Other scholars have converged on the following five disposition options: reuse, repair, remanufacturing, recycling, and disposal (Thierry et al., 1995, Fleischmann et al., 1997, De Brito and Dekker, 2002, Mutha and Pokharel, 2009).

Reuse: Reuse involves only minor inspection, cleaning and maintenance (Fleischmann et al., 2000), without disassembly, reprocessing, and reassembly activities (Matsumoto, 2010). This process requires less work in comparison with other options (Fleischmann et al., 2000).

Repair: Repair denotes the process of repairing and servicing returned products, and sending them back to retailers or distributors—depending on where the products are from and what contractual agreement is in place (Fleischmann et al., 2000). It is preferable for a decentralised repairing centre to be near customers (Fleischmann et al., 2000).

Remanufacturing: Remanufacturing refers to value recovery from products with high value (Blackburn et al., 2004). Remanufacturing involves a process of replacing obsolete or faulty parts with new or refurbished ones. In this process, the identity and functionality of the original product materials are maintained (Eltayeb et al., 2011).

Recycling: Recycling refers to material recovery from products with low value (Blackburn et al., 2004); it involves processes that extract reusable materials from used products. The identity and functionality of original product materials are lost in the process (Khor et al., 2016). Recycling is chosen when the original product or component can be used for another product, or for purposes of subassembly (Skinner et al., 2008).

Disposal: The last option is disposal, which is the process of landfilling or incinerating products or components. This option is chosen when the products cannot be sold or reused, and all other disposition options are unfeasible (Khor et al., 2016).

Some researchers have argued that the quality and quantity of returned products and the timing of returns are the main criteria for disposition (Guide Jr et al., 2000, Fernandez et al., 2008), while others hold that the level of disassembly, complexity, and residual value of products determine the selection of disposition options (Gobbi, 2011, Krikke et al., 1998). Agrawal et al. (2016a) suggested that the selection of a disposition option is based on the quality, selling price, and logistics cost of the products sold to customers, together with market demand for those products. Some scholars have used multi-criteria decision-making models to model the selection of the best disposition options (Wadhwa et al., 2009, Senthil et al., 2012). For example, Wadhwa et al. (2009) developed a decision model based on cost/time, environmental impacts, market factors, quality factors, and legislative impacts.

2.2.3 Drivers of and barriers to RL implementation

Drivers for implementing RL can be divided into three categories including economic benefits (direct and indirect), environmental legislation, and corporate citizenship (De Brito and Dekker, 2004). Direct economic benefits can be obtained through the RL process by reducing the consumption of raw materials and waste materials, and by recapturing value from product recovery and reduced disposal costs (Govindan and Bouzon, 2018). At the same time, RL can bring indirect gains related to marketing, competition, and strategic actions such as anticipating legislation, creating market protection, building firms' green image (Lubin and Esty, 2010), and improving connections with customers and suppliers (De Brito and Dekker, 2004). In addition, customer satisfaction plays a key role for organisations when it comes to achieving competitive advantage. Taking back used products at the end of the products' life and engaging in activities such as recycling, can improve customer service and satisfaction. Improved customer satisfaction and loyalty can result, in turn, in increased revenues (Carbone and Moatti, 2008, Olorunniwo and Li, 2011, Govindan and Bouzon, 2018).

Environmental legislation refers to any jurisdiction enacting laws that require companies to take responsibility for recovering their products (De Brito and Dekker, 2004). Such legislation may include, for example, recycling quotas, packaging regulations, manufacturing take-back responsibility and extended producer responsibility (De Brito and Dekker, 2004, Byrne and Deeb, 1993). RL enables companies to comply with existing legislations (Carter and Ellram, 1998, Ravi and Shankar, 2005, Chileshe et al., 2018). Some companies, by adopting a "green policy," demonstrate their commitment to incoporating environmental concerns into their business practices. Implementing RL is one of the green supply chain practices that can reduce firms' environmental footprint (Carbone and Moatti, 2008, Huang et al., 2017).

In addition to economic benefits and compliance with legislations, another main driver for RL implementation is corporate citizenship. Corporate citizenship refers to a set of values or principles that may drive a company to implement RL (De Brito and Dekker, 2004, Rahimi and Ghezavati, 2018). In exemplifying corporate citizenship, companies demonstrate that they have a sense of responsibility towards society and the environment (Scott et al., 2011, Chileshe et al., 2018).

Despite the presence of these drivers for adopting RL, its implementation is not free from barriers. One of the major barriers to RL implementation is financial constraints. Some researchers have noted that RL is often considered expensive due to the costs associated with the collection, transportation, and reprocessing of end-of-life products, as well as the costs of personnel training and information and technological systems (Ravi and Shankar, 2005, Rogers and Tibben-Lembke, 2001, Dhanda and Peters, 2005, Bouzon et al., 2018, Kaviani et al., 2020). In addition, there are operational difficulties in implementing RL, caused by uncertainty about returns with respect to their quality, quantity, and delivery date (Ravi and Shankar, 2005, Keh et al., 2012, Waqas et al., 2018, Ali et al., 2018). The lack of necessary information and inadequate technological systems are other key barriers to implementing RL (Ravi and Shankar, 2005, Waqas et al., 2018, Bouzon et al., 2018). Furthermore, lack of commitment by top management to RL activities and insufficient awareness about RL benefits can impede RL implementation (Ravi and Shankar, 2005, Phochanikorn et al., 2019, Kaviani et al., 2020).

2.3 Sustainability performance

Sustainability has attracted significant attention in the last decades due to environmental concerns and legislative requirements, challenging markets, increased economic competitiveness, and a broad awareness of social responsibilities (Ansari and Kant, 2017, Agrawal et al., 2016b, Qorri et al., 2022). Sustainability has been defined as a mode of "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 8). Sustainability has become a strategic issue for firms because of its significant impact on their profitability and growth--and even their survival (Lee and Lam, 2012, Álvarez-Gil et al., 2007). Sustainability can be considered as an integration of environmental, economic, and social objectives that provides a balance between these three dimensions (Gunasekaran and Spalanzani, 2012, Carter and Rogers, 2008, Elkington, 2001). Nowadays firms have to take responsibility for the environment and society. As Hubbard (2009) stated, almost 75 per cent of large international organisations are under pressure to consider sustainability issues in their business activities, and to develop non-financial performance measures in addition to the traditional ones. Generally speaking, sustainable development is considered as a critical goal for organisations due to its impact on achieving long-term competitiveness (Hart, 2005, Pfeffer, 2010), and sustainability has made firms rethink their strategies and situations in the market (Lubin and Esty, 2010, Lee and Lam, 2012).

2.3.1 Environmental performance and measurement

The environmental performance of an organisation can be defined as its capability to reduce pollution, waste, energy consumption, the consumption of harmful/hazardous/toxic materials, and the frequency of environmental accidents (Zhu et al., 2008b). Judge and Douglas (1998) described the environmental performance of an organisation as the organisational effectiveness required to meet and exceed societal expectations regarding environmental concerns. Several instruments were developed to measure the environmental performance of an organisation. Maxwell and Van Der Vorst (2003) suggested that the environmental performance of an organisation can be measured by indicators such as energy and material consumption, air and water pollution, waste generation and the usage of toxic/harmful materials. Detr (1999) defined the relevant environmental indicators as climate change (e.g., contributing to greenhouse gas reduction), air quality, noise, land use and biodiversity, and waste management.

2.3.2 Economic performance and measurement

The economic performance of an organisation mainly focuses on its profitability and growth (Judge and Douglas, 1998). Such performance can be measured by profitability, return on investment, market share, revenue generation, and productivity (Zhu and Sarkis, 2004, Mollenkopf and Closs, 2005, Stock et al., 2006). Diabat et al. (2013) categorised economic performance into positive and negative economic performance. They defined benefits obtained through green supply chain management (GSCM) practices as positive economic performance; such benefits include reduced cost for purchasing materials and consuming energy, and reduced fees for waste treatment, discharge, and environmental accidents. Conversely, costs related to the adoption of GSCM practices, including the costs of investment, purchasing environmentally friendly materials, and operational and training costs, can be viewed as negative economic performance. While it may seem that adopting GSCM practices is costly and has a negative impact on economic performance in the short term, such practices can contribute to improved performance in other areas over the long term (Diabat et al., 2013).

2.3.3 Social performance and measurement

Wood (1991, p. 693) defined social performance as "a business organisation's configuration of principles of social responsibility, processes of social responsiveness, and policies, programs and observable outcomes as they relate to the firm's societal relationships". Various indicators are used to measure the social performance of an organisation, such as quality of management, health and safety issues, wages and benefits, equal opportunity policies, training/education, prohibitions of child labour and forced labour, support for freedom of association, support for human rights, and provision of services (Dixon et al., 2005). Safety and health issues, access, and equity were defined as social indicators by Detr (1999). Sarkis et al. (2010b) identified other social indicators, such as internal human resources, attitudes toward the external population, stakeholder participation, and macro social issues. A number of researchers, however, have noted that the social dimension of sustainability is under-explored, and worthy of further study (Seuring, 2013, Seuring and Müller, 2008, Gold et al., 2010, Moreno-Camacho et al., 2019).

2.4 RL and GSCM

Green supply chain management is concerned with the responsibility that a firm has towards its products, from purchasing raw materials up to the final use and disposal of products (Hart, 1997);

relevant activities thus include design, purchasing, manufacturing, assembly, packaging, logistics, and distribution (Handfield et al., 1997, Zsidisin and Siferd, 2001). The aim of green supply chain management is to eliminate or minimise material waste, energy consumption, and other negative environmental impacts (e.g., air, water, or land pollution) through all steps of a product's life cycle (Hervani et al., 2005). RL is considered a green supply chain practice, and some scholars have investigated the effects of RL from the perspective of the GSCM practices, measuring them against the effects of other GSCM practices on the various dimensions of sustainability and performance outcomes. To gain a good understanding of what GSCM can achieve, it is necessary to examine GSCM practices and their performance outcomes.

2.4.1 GSCM practices and performance outcomes

In today's competitive world, organisations are constantly seeking to develop new approaches to enhance their competitiveness. A key question is whether adopting GSCM practices as a form of environmental improvement can lead to improved competitiveness and economic performance (Bacallan, 2000, Rao, 2002, Rao and Holt, 2005). Bacallan (2000) noted that organisations can improve their competitiveness by complying with environmental regulations, addressing their customers' concerns about environmental issues, and mitigating the environmental impact of their production and service activities.

Previous studies have found a positive relationship between economic performance and adopting RL along with other GSCM practices (Rao and Holt, 2005, Tippayawong et al., 2015). For example, Rao and Holt (2005) evaluated the potential link between GSCM and improving competitiveness and economic performance in a sample of leading-edge ISO14001-certified companies in South East Asia. Their findings showed that greening the inbound function and production phase results in greening the outbound phase, leading to significant improvements in competitiveness and economic performance. In another study, the positive influence of GSCM practices on Thai Electronic firms' financial performance was investigated (Tippayawong et al., 2015). The results of this study showed that green manufacturing, green logistics (including RL), and green sourcing practices were the main factors affecting GSCM, and that green manufacturing and green logistics practices were strongly correlated with financial performance.

While adopting GSCM practices may seem costly for organisations, especially in the initial stages (Min and Galle, 2001), many studies have shown that GSCM adoption can be a source of competitive advantage and a business opportunity for sustainable development (Heese et al., 2005, Diabat et al., 2013). Previous studies found that in addition to strengthening economic performance outcomes, adopting GSCM practices results in enormous gains in social and operational outcomes. For example, green practices as well as their drivers and outcomes in Malaysia were identified by Eltayeb et al. (2010) through interviews with three organisations. They found that eco-design, green purchasing, and RL are the most commonly adopted green practices, and that those practices result in cost reductions, improved image, and economic and environmental outcomes.

While there are several studies investigating the relationship between RL (along with other GSCM practices) and performance outcomes, the findings are not inclusive and they differ across different industries. For example, while Younis et al. (2016) found a significant positive relationship between RL and social performance, Geng et al. (2017) found no significant correlation between the two. Similarly, a positive connection between RL and environmental performance was found by Diabat et al. (2013), Geng et al. (2017)_ENREF_39, Seman et al. (2019) and Pinto (2020), while Younis et al. (2016) and Jaaffar and Kaman (2020) found no significant relationship.

Mutangili (2019) considered RL as one of the green procurement practices that can improve the performance outcomes of a business through positive environmental impacts and appropriate use of materials by consumers. Wu et al. (2015) claimed that the recovery and recycling system had the most significant effect on economic performance. They studied the interrelations among ten criteria within GSCM practices in the Vietnamese automobile manufacturing industry. They found that manufacturers can improve economic and environmental performance by reducing environmental impacts, the costs of energy consumption, materials purchasing, waste treatment, and disposal release through establishing a RL system (i.e. a recovery and recycling system).

In other research, Govindan et al. (2015a) used an intuitionistic fuzzy DEMATEL method to show the relationships between GSCM practices such as RL and environmental and economic performance. In order to validate the proposed method, a case study in the automotive industry was carried out. They revealed that internal environmental management, green purchasing, ISO 14001 certification as an environmental management system, and RL had the most significant impact on both environmental and economic performance. They also argued that future research should consider social performance dimensions such as employee's health and safety issues.

Some studies have investigated green practices from the broader perspective of supply chain management (Azevedo et al., 2010, Azevedo et al., 2011). Azevedo et al. (2011) conducted five case studies in the Portuguese automotive SC to identify the types of green practices that automotive companies apply and their effects on economic, operational, and environmental performance. The results show that RL, minimisation of waste, and compliance with ISO 14001 as an environmental management system are the most important green practices in the Portuguese automotive industry. Further, environmental cost, quality, and efficiency are the most important measures mediating the effect of green practices on SC performance.

Most studies have examined the relationship between RL and other GSCM practices, on the one hand, and performance outcomes, on the other hand, using tangible measures such as environmental, economic, and operational performance (Azevedo et al., 2010, Vijayvargy et al., 2017). In contrast, little attention has been devoted to the intangible performance outcomes of GSCM practices, such as customer loyalty and satisfaction and organisational image (Eltayeb et al., 2011). Intangible performance outcomes are difficult to quantify, but they can result in satisfaction of customers, suppliers, employees, and the general public, customer loyalty, brand value, improved publicity, and increased market share (Jayaraman and Luo, 2007).

2.4.2 GSCM and sustainability performance

Since sustainable development has become a strategic intent of many organisations, some scholars believe that the social dimension of GSCM performance outcomes should be considered along with economic and environmental dimensions. For these scholars, it is important to explore how adopting GSCM practices can lead to improved triple-bottom-line sustainability performance (Vijayvargy et al., 2017). For example, Kushwaha and Sharma (2016) did a theoretical study to investigate how green practices such as RL will affect firm performance and sustainable development. They also conducted a study of the relationship between firm performance and sustainable development through the adoption of green practices in the automobile industry. They found that there was a positive relationship between green practices adoption and firm performance and sustainable development. They also found that firm performance had a positive relationship with sustainable development because of adoption of green practices. The study was limited by a lack of empirical data.

Govindan et al. (2014) discussed three supply chain management paradigms—namely, lean, resilient, and green paradigms—and analysed their impacts on supply chain sustainability performance. They found that cleaner production along with other green practices, such as ISO 14001 certification as an environmental mangement sytem and RL, had the most significant impact on the environmental, economic, and social sustainability of supply chains, whereas in the context of the Portuguese automotive supply chain, there was no significant impact of ISO 14001 certification and RL on social sustainability. They recommended that future research should consider scales for SCM practices and sustainability indicators.

Other studies have investigated the influence of GSCM practices on corporate performance in particular industries, and considered the social dimensions of GSCM performance outcomes along with economic, environmental, and operational dimensions (Geng et al., 2017, Younis et al., 2016). Younis et al. (2016) evaluated the impact of GSCM practices on corporate performance in manufacturing firms in the UAE. The results showed that RL was the second most frequently adopted GSCM practice in the UAE, and that different GSCM practices influence the dimensions of corporate performance in different ways. For example, only RL had a significant impact on social performance by improving employee job satisfaction and their health and safety with no impact on economic and environmental performance. Through a systematic literature review, Geng et al. (2017) identified the relationship between RL (and other GSCM practices) and firm performance in the manufacturing industry in Asian emerging economies (AEE). The results showed that GSCM practices produce better outcomes in terms of economic, environmental, and operational performance, but have no significant effect on social performance. The results also revealed that, of all the green practices, RL had the lowest impact on economic performance. This finding may be due to the high investment cost of RL implementation and a lack of recycling infrastructure and associated technologies in the AEE. In addition, the absence of a relationship between RL and social performance may be due to the AEEs' unfamiliarity with the culture of recycling, such that RL is considered an impractical choice. The scholars suggested that empirical evidence is needed to explore further the relationship between RL and social performance.

Based on the discussion in Section 2.4, Tables 2.1 and 2.2 illustrate GSCM practices and their effects on each dimension of the triple-bottom-line sustainability performance and their relevant indicators. Table 2.3 is a combination of Tables 2.1 and 2.2, which provides a holistic picture of GSCM practices and their respective impact on each dimension of sustainability performance. In summary, when RL is investigated in the context of GSCM, it tends to be studied from a broad perspective as a single factor. This approach does not consider the relationships among RL process, e.g. the different disposition options, and their possible performance outcomes. Furthermore, RL is frequently compared with other GSCM practices in terms of environmental performance, even though RL can contribute to sustainable development through economic and social benefits as well.

Table 2.1: GSCM practices and sustainability performance

Authors	Supplier environmental collaboration			Eco-design			Green purchasing			RL			Customer environmental collaboration			Environmental management system			Carbon management			Environmental friendly packaging			Investment recovery			Internal environemnatl managemnet			Cleaner production		
	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social	Economic	Environmental	Social
Wu et al. (2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																		
Govindan et al. (2015a)	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓								✓	✓				
Azevedo et al. (2011)	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓									
Eltayeb et al. (2011)				✓	✓	✓	✓	✓	✓	✓	✓	✓																					
Diabat et al. (2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓						
Laosirihongthong et al. (2013)				✓	✓	✓	✓	✓	✓	✓	✓	✓																					
Govindan et al. (2014)										✓	✓	✓				✓	✓	✓													✓	✓	✓
Geng et al. (2017)	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓													✓	✓	✓			
Younis et al. (2016)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																		
Eltayeb et al. (2010)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																		
Mutangili (2019)							✓	✓		✓	✓																						
Seman et al. (2019)								✓			✓			✓															✓				
Abdel-Baset et al. (2019)	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓					✓	✓													
Pinto (2020)	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓								✓	✓					✓	✓		✓	✓	
Jaaffar and Kaman (2020)					✓			✓			✓												✓										

Table 2.2: Sustainability indicators (GSCM practices and sustainability performance)

Authors	**Economic**										**Environmental**							**social**									
	Reduced cost	Profitability	Delivery improvement	Sales growth	Return on investment	Productivity improvement	Market share growth	Efficiency	Quality improvement	Inventory reduction	Reduced energy and resource consumption	Waste reduction	Reduction in pollution	Reduction of hazardous and toxic materials	Compline with environmental regulations	Decrease of frequency for environmental accidents	Firm' s Environmental image	Customer satisfaction	Firm' s corporate image	Stakeholders' satisfaction	Customer loyalty	Customer satisfaction	Product image	Health and safety of employees	Social commitment	Employee job satisfaction	Preserve environment
Wu et al. (2015)	✓		✓						✓		✓	✓	✓					✓									
Govindan et al. (2015a)		✓				✓	✓				✓	✓	✓	✓													
Azevedo et al. (2011)	✓							✓	✓			✓						✓									
Eltayeb et al. (2011)	✓	✓		✓		✓					✓		✓	✓	✓				✓								
Diabat et al. (2013)	✓		✓						✓	✓		✓	✓	✓		✓	✓		✓	✓							
Laosirihongthong et al. (2013)	✓	✓									✓		✓	✓	✓				✓		✓	✓	✓				
Geng et al. (2017)		✓	✓	✓			✓		✓	✓	✓	✓	✓						✓		✓	✓	✓	✓			
Younis et al. (2016)	✓		✓		✓		✓		✓		✓	✓	✓	✓		✓	✓		✓					✓	✓	✓	✓
Eltayeb et al. (2010)	✓	✓	✓	✓		✓	✓	✓	✓				✓		✓				✓								
Pinto (2020)			✓	✓		✓					✓	✓	✓														
Jaaffar and Kaman (2020)											✓		✓	✓	✓												

Table 2.3: A holistic picture of GSCM practices and their respective impacts on each dimension of sustainability performance

GSCM practices	Sustainability indicators																										
	Economic										Environmental							social									
	Reduced cost	Profitability	Delivery improvement	Sales growth	Return on investment	Productivity improvement	Market share growth	Efficiency	Quality improvement	Inventory reduction	Reduced energy and resource consumption	Waste reduction	Reduction in pollution	Reduction of hazardous and toxic materials	Compline with environmental regulations	Decrease of frequency for environmental accidents	Firm's environmental image	Customer satisfaction	Firm's corporate image	Stakeholders' satisfaction	Customer loyalty	Customer satisfaction	Product image	Health and safety of employees	Social commitment	Employee job satisfaction	Preserve environment
Supplier environmental collaboration	5	3	6	3	1	3	4	2	6	2	5	7	7	3	1	2	2	2	4	1	1	1	1	2	1	1	1
Eco-design	6	5	5	4	1	4	4	1	5	2	8	6	10	6	4	2	2	1	6	1	2	2	2	2	1	1	1
Green purchasing	7	4	5	3	1	4	3	2	5	1	7	6	9	6	4	2	2	2	5	1	1	1	1	1	1	1	1
RL	7	5	6	4	1	4	4	2	6	2	8	7	10	6	4	2	2	2	6	1	2	2	2	2	1	1	1
Customer environmental collaboration	5	3	6	3	1	3	4	2	6	2	5	7	7	3	1	2	2	2	4	1	1	1	1	2	1	1	1
Environmental management system	2	1	1	0	1	1	1	1	2	1	1	3	2	2	0	1	1	1	1	1	0	0	0	0	0	0	0
Carbon management	0	1	0	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Environmental friendly packaging	1	0	1	1	0	1	0	1	1	0	2	2	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Investment recovery	1	0	1	0	0	0	0	0	1	1	0	1	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0
Internal environmental managemnet	0	2	2	2	0	2	2	0	1	1	3	3	3	1	0	0	0	0	1	0	1	1	1	1	0	0	0
Cleaner production	0	0	1	1	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of papers	12																										
The number in each cell refers to the number of articles researched																											

2.5 RL and sustainable development

RL implementation can improve the performance of sustainable supply chain management (Tseng et al., 2019, Kaihan and Chin, 2021, Lai et al., 2022), making a significant contribution to improving the overall sustainability performance of firms (Sarkis et al., 2010b). For example, via RL the economic performance of businesses can be improved through cost savings (Jack et al., 2010, Fernando et al., 2022) and increased revenue from the sale of recovered and remanufactured products (Mollenkopf and Closs, 2005). In addition, by taking back products and thus reducing firms' carbon footprint, RL can migitate significantly the impact of climate change and global warming (Carter and Rogers, 2008). RL can contribute to social performance outcomes through improved customer satisfaction by acting in a socially and environmentally responsible manner that can gain real economic benefits (Glenn Richey et al., 2005, Li and Olorunniwo, 2008). Likewise, RL can result in improved customer loyalty through a greater focus on faulty products (Aitken and Harrison, 2013). Thus, it is crucial for organisations to manage their RL process in a way that addresses environmental, economic, and social issues all at once (Pourmehdi et al., 2022).

An efficient and effective RL process can create competitive advantage through cost savings in procurement, inventory carrying, distribution, and transportation (Li and Olorunniwo, 2008, Srivastava and Srivastava, 2006, Kannan et al., 2009), positive impact on environmental performance (Huang et al., 2010), and improved corporate image (Carter and Ellram, 1998). In order to achieve the benefits brought by RL, firms have to continuously monitor and evaluate their RL performance. For instance, Olugu and Wong (2011) used a fuzzy logic approach for performance evaluation of the RL process in the automotive industry.

According to the literature, there is only a small number of studies that consider sustainability issues from the RL point of view. For example, Huang and Yang (2014), Ye et al. (2013), Huang et al. (2015), Phoosawad et al. (2019) found that implementing RL can have significant impacts on organisations' environmental and economic performance in the manufacturing industry. In the retail industry, De Oliveira Neto and De Sousa (2014) found that RL implementation resulted in environmental and economic advantages. Wanjiku and Mwangangi (2019) showed the significant influence of RL on the performance outcomes of the food and beverage industry in Kenya. Moreover, Ye et al. (2013) investigated the impact of RL implementation on the economic and environmental performance of firms in the Chinese manufacturing industry. The results show that RL has a significant effect on economic performance by reducing operation costs and increasing market share and revenue. In addition, RL implementation can enhance environmental performance by reducing the amount of waste generated as well as resource consumption. The results of this study are in line with Huang et al. (2015)'s study of the Taiwanese computer, communication, and consumer (3C) electronics retail industry.

Although a range of studies have been conducted in different countries and industries to examine the impacts of RL implementation, a majority of the studies have focused on environmental and economic performance. There are, however, some exceptions. For example, Sarkis et al. (2010b) linked the various sustainability indicators to different RL practices and developed a profile of RL for social sustainability. They categorised social indicators related to RL into four main groups, and concluded that RL, by addressing different aspects of social sustainability through promoting recycling and reuse as well as resource conservation, can bring social improvements in supply chains.

2.6 RL disposition options and performance measurement

As noted previously, many existing studies have focused on evaluating RL performance in general, without considering the RL process and the related disposition options. Nevertheless, research shows that disposition decisions have significant impacts on sustainability performance (Agrawal et al., 2016a). Since there are different disposition options during the RL process, an evaluation of how each disposition option affects sustainability performance can enable firms to make informed decisions about which method of disposition is most appropriate for achieving sustainability goals. However, such evaluation has been largely incomplete. For example, Vahabzadeh et al. (2015) examined the impact of RL disposition options on only one dimension of sustainability, i.e., the environmental dimension, although they did consider six disposition options and five environmental indicators. The results show that disposal and reselling of the returned products were the best and worst disposition options, respectively. They also found that the final decision would be more effective if the economic and social dimensions of RL were also considered.

Some scholars have gone beyond examining the impact of RL disposition options on environmental outcomes by considering economic performance as well. For instance, Khor et al. (2016) studied the effects of disposition options (repair, recondition, remanufacture, recycle, and disposal) on measures of profitability and sales growth as well as environmental performance in Malaysian electrical and electronic equipment manufacturing firms. Another study (Skinner et al., 2008) investigated the effect of different disposition options on economic and operational performance. The results show that only disposal and recycling strategies impact on RL operational performance outcomes, but that they do so quite differently. While disposal had a positive effect on operational performance, recycling had a negative influence.

In evaluating the disposition process, some scholars have utilised multi-criteria decision-making (MCDM) methods. For example, Jindal and Sangwan (2016) evaluated different types of disposition options according to operating cost, value-added recovery, environmental impact, market demand, technical/operational feasibility, and corporate responsibility. They found that operating cost was the most important factor, followed by value-added recovery, market demand, technical/operational feasibility, environmental impact and corporate social responsibility. Based on these results, repair was considered the best option due to the low operating cost, high value-added recovery, high technical/operational feasibility, and low environmental impact. Similarly, Agrawal et al. (2016a) presented a Fuzzy MCDM framework for selecting the best disposition options in the RL process. Based on their literature review and discussions with experts, they found that economic benefits, environmental benefits, corporate social responsibility, stakeholder’s needs, and RL resources were the main criteria for selecting the best disposition option. A case study of an Indian electronic firm showed that economic benefits were the most significant criterion, and that repair was the best option in this case. In future research in this area, it will be useful to carry out a survey and more case studies to verify the outcomes, instead of relying on a single case study.

As mentioned previously, reuse, repair, remanufacturing, recycling, and disposal are the most common disposition options in RL. Scholars have investigated the effect of each of these options on various sustainability dimensions, and the subsections that follow review their main findings.

2.6.1 Recycling and performance measurement

Recycling is a product disposition option that is generally viewed as an environmentally friendly strategy. Recycling involves activities that lead to the production of new materials from waste.

Recycled materials have a lower carbon footprint in comparison with the use of raw materials to produce finished goods (Ravi, 2012). Zhou et al. (2019) confirmed that end-of-life vehicle recycling management can significantly enhance the sustainability performance of the automobile supply chain. Also, Oliveira Neto and Correia (2019) revealed the economic and environmental benefits of recycling through two case studies in the construction industry in Brazil.

Other scholars have focused on the environmental advantages of recycling, like Hart (2005), Kang (2015) . Oliveira and Magrini (2017) compared the environmental impacts of recycling and incineration when it comes to the disposal of plastic containers for lubricant oil in Brazil. The findings revealed that scenarios featuring a higher rate of recycling and incineration had lower environmental impacts. Chen et al. (2009) investigated the recycling business and an alternative policy of dynamic recycling fee rates in Taiwan. They found that recycling had a notable impact on environmental and financial improvements through increased collection rates, the reduction of household waste, and increased resource recovery. In addition, the recycling business had a positive impact on social issues by creating significant number of job opportunities, especially for those who are not well-educated. However, Agan et al. (2013) found no significant connection between recycling and economic performance among small and medium-sized enterprises (SMEs) in Turkey. The reason is that recycling requires significant investment in activities such as collecting, sorting, and cleaning; likewise, depending on the product, melting, reprocessing, and other activities may be involved. Not all of these activities are well-established in Turkey. Of the three dimensions of sustainability, the study pays more attention to the environmental dimension of recycling than to the social or economic dimensions.

2.6.2 Remanufacturing and performance measurement

Remanufacturing is another product disposition option; this option makes returned products as good as new ones. Remanufacturing makes a key contribution to sustainable development. Among a range of criteria, cost and profit are the most crucial factors for the competitiveness of remanufactured products in the potential market (Shakourloo, 2017). For instance, Sabharwal and Garg (2013) assessed the economic viability of remanufacturing by using the graph-theoretic method for obtaining the maximum and minimum value of remanufacturing cost benefits. Due to the high investment required for infrastructure, a manufacturer may consider remanufacturing if there is a considerable cost saving in remanufacturing products compared to manufacturing new products.

Yalabik et al. (2014) developed an economic model of remanufacturing to compare the profitability of a green company, which produces remanufactured products for lease and for secondary markets, with a traditional company, which is a non-remanufacturer, in terms of market, cost, and product-type conditions. The findings suggested that green companies typically obtain more profit and are more environmentally friendly in comparison with traditional firms. However, they found that when the secondary market is relatively small, traditional firms can generate higher profit, as is also the case when the cost of remanufacturing is relatively high. Zanghelini et al. (2014) employed life cycle assessment (LCA) method to evaluate the environmental performance of three waste management alternatives (remanufacturing, recycling, and landfilling) for an air compressor in a Brazilian company. They found that remanufacturing was the best option: it can reduce environmental impacts by more than forty per cent in comparison with landfilling, by reducing raw materials consumption and manufacturing processes.

2.6.3 Reuse and performance measurement

O'connell et al. (2013) investigated how a reuse policy can affect sustainability performance. Using a case study in Ireland, they developed a quantitative model to compare electronic and electrical equipment reuse and non-reuse scenarios in terms of economic and environmental dimensions. They considered some qualitative indicators for the social performance of reuse. The results demonstrated that job-generation potential and its impact on prosperity for low-income families were key social benefits of reuse. In another study, the economic benefits of reusing materials in the building industry were examined (Nußholz and Whalen, 2019). The authors found that reuse can improve economic performance in the building industry by reducing the cost of production processes and secondary materials purchasing.

Tables 2.4 and 2.5 summarise the discussion in Section 2.6. They show a picture of the RL system and disposition options and their effects on each dimension of triple-bottom-line sustainability performance and related sustainability indicators. Table 2.6 combines Tables 2.4 and 2.5 to present a holistic picture of the RL system and disposition options and their respective impact on each dimension of sustainability performance.

In summary, there is a research gap when it comes to investigating RL as an integrated subject. Most of the studies have focused on a single factor or activity such as recycling or remanufacturing (Govindan and Soleimani, 2017). When the relationship between RL and sustainability is considered as a whole, without considering RL disposition options, the results tend to be general and incomplete. Also, most of the studies were conducted in developing countries. Less attention has been paid to developed countries, especially Australia. Further, because previous studies considered different industries in different countries, the results are sometimes conflicting. Since different RL disposition options affect sustainability performance in various ways, an evaluation of how each of these options impacts on sustainability performance can provide useful insights for companies when choosing the most appropriate disposition option. Making the right choice, in this respect, can help companies enhance their sustainability performance.

Table 2.4: The Reverse Logistics (RL) system and disposition options with respect to sustainability performanc

Authors	Economic						Environmental						Social					
	RL disposition options					RL system	RL disposition options					RL system	RL disposition options					RL system
	Reuse	Repair	Remanufacturing	Recycling	Disposal		Reuse	Repair	Remanufacturing	Recycling	Disposal		Reuse	Repair	Remanufacturing	Recycling	Disposal	
Keh et al. (2012)						✓						✓						✓
De Oliveira Neto and De Sousa (2014)						✓						✓						
Ye et al. (2013)						✓						✓						
Huang et al. (2015)						✓						✓						
Agrawal et al. (2016b)						✓						✓						✓
(Vahabzadeh et al., 2015)								✓	✓	✓	✓							
Khor et al. (2016)		✓	✓	✓	✓			✓	✓	✓	✓							
Skinner et al. (2008)			✓	✓	✓													
Jindal and Sangwan (2016)		✓	✓	✓				✓	✓	✓				✓	✓	✓		
Agrawal et al. (2016a)	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Ahmed et al. (2016)	✓	✓	✓	✓			✓	✓	✓	✓			✓	✓	✓	✓		
Hart et al. (2005)										✓								
Kang (2015)										✓								
Oliveira and Magrini (2017)										✓	✓							
Chen et al. (2009)				✓						✓						✓		
Wibowo et al. (2014)				✓						✓						✓		
Sabharwal and Garg (2013)			✓															
Yalabik et al. (2014)			✓						✓									
Zanghelini et al. (2014)									✓	✓	✓							
O'connell et al. (2013)	✓						✓						✓					
Phoosawad et al. (2019)						✓						✓						
Wanjiku and Mwangangi (2019)	✓			✓									✓			✓		
Bahrami and Jafari (2019)										✓								
Nußholz and Whalen (2019)	✓																	
Oliveira Neto and Correia (2019)				✓						✓								

Table 2.5: Sustainability indicators (the RL system and disposition options with respect to sustainability performance)

Authors	Economic											Environmental											social								
	Reduced cost	Profitability	Recovery of assets	Return on investment	Market share growth	Reduction in inventory investment	Recapturing value	Recycle Efficiency	Sales growth	Enhanced company’s market competitiveness	Quality	Reduced energy and resource	Stretching environmental impact beyond compliance	Reduction in pollution	Waste reduction	Compline with environmental regulations	Environmental commitment	Firm’s Environmental image	Land use and biodiversity	Decrease of frequency for environmental accidents	Recognition for superior environmental performance	Green technology innovation	Community complaints	Customer health and safety	Stakeholders participation	Employment stability and employee benefits	Donations to community	Job creation or preservation	Health and safety of employees	Customer satisfaction and loyalty	Firm’s corporate image
Keh et al. (2012)	✓	✓										✓				✓	✓											✓			
Ye et al. (2013)	✓	✓	✓		✓	✓				✓				✓		✓	✓	✓													
Huang et al. (2015)	✓	✓	✓			✓							✓			✓		✓													
Agrawal et al. (2016b)	✓			✓			✓	✓	✓			✓		✓	✓								✓	✓	✓	✓	✓				
Vahabzadeh et al. (2015)														✓	✓				✓												
Khor et al. (2016)	✓	✓	✓		✓	✓			✓					✓	✓		✓	✓		✓	✓										
Skinner et al. (2008)	✓	✓	✓			✓																									
Jindal and Sangwan (2016)	✓						✓				✓	✓			✓													✓			
Ahmed et al. (2016)	✓											✓		✓		✓	✓									✓		✓	✓	✓	
Wibowo et al. (2014)		✓			✓											✓			✓			✓							✓		✓
Wanjiku and Mwangangi (2019)		✓			✓																									✓	

Table 2.6: A holistic picture of the RL system and disposition options and their respective impact on each dimension of sustainability performance

Reverse logistics system and disposition options		**Sustainability indicators**																														
		Economic											**Environmental**												**social**								
		Reduced cost	Profitability	Recovery of assets	Return on investment	Market share growth	Reduction in inventory investment	Recapturing value	Recycle Efficiency	Sales growth	Enhanced company's market competitiveness	Quality	Reduced energy and resource	Stretching environmental impact beyond compliance	Reduction in pollution	Waste reduction	Compline with environmental regulations	Environmental commitment	Firm's Environmental image	Land use and biodiversity	Decrease of frequency for environmental accidents	Recognition for superior environmental performance	Green technology innovation	Community complaints	Customer health and safety	Stakeholders participation	Employment stability and employee benefits	Donations to community	Job creation or preservation	Health and safety of employees	Customer satisfaction and loyalty	Firm's corporate image
RL disposition options	Reuse	1	1	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	2	0
	Repair	4	2	2	0	1	2	1	0	1	0	1	2	0	3	3	1	2	1	1	1	1	0	0	0	0	1	0	2	1	1	0
	Remanufacturing	4	2	2	0	1	2	1	0	1	0	1	2	0	3	3	1	2	1	1	1	1	0	0	0	0	1	0	2	1	1	0
	Recycling	4	4	2	0	3	2	1	0	1	0	1	2	0	3	3	2	2	1	2	1	1	1	0	0	0	1	0	2	2	2	1
	Disposal	2	2	2	0	1	2	0	0	1	0	0	0	0	2	2	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
RL system		4	3	2	1	1	2	1	1	1	1	0	2	1	2	1	3	2	2	0	0	0	0	1	1	1	1	1	1	0	0	0
Number of papers		21																														
The number in each cell refers to the number of articles researched																																

Based on previous research on the economic, environmental, and social performance outcomes of RL (Table 2.1, 2.2, 2.3, and 2.4), this study considers profitability, reduced costs, recapturing value, sales growth, and return on investment as economic indicators (Khor et al., 2016, Agrawal et al., 2016b, Lin et al., 2011). Further, it considers reduced energy and resource consumption, waste reduction, reduction in pollution, and compliance with environmental regulations as environmental indicators (Agrawal et al., 2016b, Lin et al., 2011, Autry et al., 2001, Daugherty et al., 2003, Detr, 1999, Tseng, 2013). Finally, firms' corporate image, customer satisfaction and loyalty, the health and safety of employees, employee job satisfaction, and job opportunities are treated as social indicators (Agrawal et al., 2016b, Younis et al., 2016, Melbin, 1995, Li and Olorunniwo, 2008, Aitken and Harrison, 2013, Jayaraman and Luo, 2007). As RL implementation and sustainability performance may be affected by a wide range of factors, one of the aims of this research is to analyse how RL implementation and sustainability performance may be affected by how organisations will react to internal and external environment. One of the best theories to analyse organisational behaviour regarding the adoption of practices in response to external pressures is institutional theory, which will provide more insights compared to the other theories. This theory provides a theoretical framework to examine the interactions between organisations and their institutional environment. The advantage of this theory is that it provides explanations of why organisations choose certain practices without a visible economic return (Berrone et al., 2010). Also, this research examines the impact of resource commitment as internal factors on the adoption of RL, as resource commitment can make RL programs more effective and efficient, which lead to the superior sustainability performance (Glenn Richey et al., 2005).

The following sections use institutional theory and the concept of resource commitment to examine what external and internal factors may affect RL implementation and sustainability performance.

2.7 Institutional theory

Institutional theory can provide important visions into the adoption of practices and tools within operation management and supply chain management (Koulikoff-Souviron and Harrison, 2008). This theory is an appropriate scheme to examine the RL process due to the its significant impact on the emerging market (Richey et al., 2005) Institutional theory is used to investigate how external pressures can impact a company's decisions on adopting and implementing an organisational practice (Hirsch, 1975, Lai et al., 2006). The theory also applies to firms' attempts to achieve sustainable development (Jennings and Zandbergen, 1995, Bansal, 2005, Berrone et al., 2008). Institutional theory allows researchers to consider the external or industry context in which a company operates, and to explain how companies respond to exogenous pressures (Zhang and Dhaliwal, 2009). Institutional theory is very useful for exploring the issues related to the adoption and implementation of specific practices as well as the development of homogeneity within an industry (Braunscheidel et al., 2011).

Institutional theory implies that organisations can promote their capacity for growth and maintain their position in a competitive environment by satisfying their stakeholders, including governments, regulators, customers, and competitors (Dimaggio and Powell, 1983). Meanwhile, the influence of external pressures on the adoption of organisational practices can be reflected in the sustainability performance of businesses. Jennings and Zandbergen (1995) were amongst the earliest scholars to draw on institutional theory to analyse sustainability, and more specifically the development and adoption of practices to achieve sustainability in organisations. Delmas and Toffel (2004) confirmed the effect of institutional pressures on the adoption of environmental management practices. External pressures imposed on organisations by institutional players can enhance their sustainability performance by forcing them to comply with legal requirements and thereby staying competitive (Khor et al., 2016). Somsuk and Laosirihongthong (2017) considered three organisational theories, including institutional theory, a resource-based view, and a relational view, to examine the drivers of sustainability in the electronics industry in Thailand. Their results show that institutional pressures are the most important external drivers for implementing green supply chain practices; and among institutional pressures, government regulations play the most significant role. Since institutional theory has not been widely used in the area of operations and supply chain management, it is worthwhile drawing on the theory to examine the possible effects of external elements on the adoption of RL. By using institutional theory, the present study provides more insights into why manufacturers implement the RL process, and how external pressures influence the sustainability performance of RL. This study considers government regulations, customer pressures, and competitors' pressures (Dimaggio and Powell, 1983) as key factors affecting the adoption of RL and the perception of sustainability performance.

Dimaggio and Powell (1983) identified three sources of the institutional mechanisms that influence managerial decisions; they label these sources as coercive, mimetic, and normative pressures. Coercive pressures are brought to bear on a dependent organisation by other organisations as well as by cultural expectations in the society where the organisation operates (Dimaggio and Powell, 1983). Government agencies are examples of powerful institutions that may affect an organisation's decisions coercively (Carter and Ellram, 1998, Rivera, 2004).

Government regulations may also be drivers for companies to implement environmental practices (Murphy and Gouldson, 2000), even though managers may consider government regulations as external coercive pressures (Zhu and Sarkis, 2007). If organisations do not comply with environmental regulations, they may be faced with government legal actions such as penalties or the removal of products from the market (Sarkis et al., 2010a). Some studies have revealed a significant association between coercive pressures and the adoption of organisational practices, as well as the performance outcomes of a business. For example, a study conducted by Esfahbodi et al. (2017) shows the significant effect of coercive pressures on the adoption of sustainable supply chain management practices. The study also shows how coercive pressures can boost environmental performance outcomes in the UK manufacturing industry, although economic performance may be hurt. In any case, government regulations are one of the most significant sources of external pressure that can affect the implementation of RL (Carter and Ellram, 1998, Canning, 2006).

Mimetic pressures happen when an organisation intends to mimic the actions of its competitors in order to achieve success (Aerts et al., 2006). Organisations are enclosed within social networks, so they are motivated to imitate the other network members' behaviours (Henisz and Delios, 2001, Mcfarland et al., 2008). Such imitation creates homogeneity among organisations within an industry (Dimaggio and Powell, 1983). Not only do companies mimic the behaviours of organisations that are successful in their industry, but also organisations with which they have social connections (Galaskiewicz and Wasserman, 1989).

Normative pressures arise from increased professionalism, which is related to the establishment of standards for legitimacy within industries (Dimaggio and Powell, 1983). The sources of professionalism are associated with the norms of formal education and training of individuals within a specific industry (Dimaggio and Powell, 1983). As it works to accrue and maintain social legitimacy, each enterprise is liable to the specific norms, standards, and expectations of its stakeholders (Lai et al., 2006). Customer requirements and their increasing environmental awareness play a significant role in the formation of normative pressures for manufacturers to adopt environmental practices (Zhu 2013). Indeed, customer pressures drive organisations both to adopt environmental practices and to achieve performance improvements (Kagan et al., 2003). Saeed et al. (2018) confirmed the significant role of normative pressures in the adoption of GSCM practices in Pakistan. Also, Seles et al. (2016) showed that normative pressures are more effective than coercive pressures when it comes to implementing GSCM practices; this finding conflicts with the results of Lin and Sheu (2012), whose study was conducted in Taiwan. Lin and Sheu (2012) found that coercive pressures have the strongest impact and normative pressures have no impact on the adoption of green practices like green certification and green direct investment. Similarly, Wu et al. (2012) confirmed that normative pressures have no significant moderating effect on the relationship between GSCM drivers and practices in the Taiwan's textile and apparel industry, while coercive pressures have a significant moderating impact.

Prasad et al. (2018) revealed a positive relationship between external pressures and the adoption of organisational practices in the Indian steel industry, although their results did not show a significant impact of external pressures on sustainability performance outcomes. Similarly, Vanalle et al. (2017) claimed that institutional pressures positively affect the adoption of GSCM practices in the Brazilian automotive industry; this result is consistent with the findings of studies conducted by Zhu et al. (2013), (Kuei et al., 2015) in China. Dubey et al. (2017) examined the direct impact of institutional pressures on the sustainability performance of a business in the Indian manufacturing industry and found that coercive pressures have significant impact on the triple-bottom-line sustainability performance, while mimetic pressures only improve social performance and have no significant impact on environmental and economic performance. Regrading normative pressures, there is no significant impact on economic performance. Also, the study conducted by Thong and Wong (2018) showed a significant impact of institutional pressures on the adoption of sustainable supply chain practices and achieving triple-bottom-line performance outcomes in Malaysia.

Some studies have examined the impact of institutional pressures on the adoption of RL and on sustainability performance. For example, Khor et al. (2016), drawing on institutional theory, identified the effect of regulatory and ownership pressure on the relationship between disposition options and business performance. The findings of this study illustrated that in the absence of regulatory pressure, only repair and recycling were profitable for organisations, while remanufacturing had a significant impact on sales growth. Also, it should be noted that ownership pressure can create improvements in all dimensions of performance, especially with respect to product reconditioning and remanufacturing activities. Overall, Khor et al. (2016) concluded that RL implementation could contribute to improvements in performance measurements, especially in the presence of institutional pressures. No comparable study has been conducted vis-à-vis the Australian manufacturing industry, to investigate how institutional pressures affect the adoption of green practices like RL and the sustainability performance outcomes of businesses.

From a different perspective, Ghadge et al. (2017), focusing on small and medium-sized enterprises, examined the drivers of and barriers to the adoption of green practices, and how they influenced the environmental performance of the enterprises. Their results showed that, although environmental regulations and customer pressures act as a driver for companies to adopt green practices, they may also act as barriers and discourage businesses. Compliance with environmental legislations creates a framework for raising environmental awareness and reducing risks; but it may also hinder innovation by pre-determining the best techniques without considering each industry's specifications and also by setting illogical deadlines (Walker et al., 2008). Moreover, the lack of international environmental legislations and global standards brings increased complexity to implementing sustainable practices in global supply chain networks (Giunipero et al., 2012). Lau and Wang (2009) stated that the absence of appropriate environmental regulations makes companies unwilling to implement RL practices. Also, the lack of sustainability awareness among customers can lead to low demand for green products and negatively affect the economic performance of businesses, resulting in a negative impact on companies implementing green practices (Giunipero et al., 2012).

Zhu and Sarkis (2006) stated that all organisations do not encounter the same pressures to implement environmental practices, with different industry sectors being faced with different pressures in different countries. For instance, suppliers of Bristol-Myers Squibb, IBM, and Xerox are required to set up environmental management systems that are in line with ISO 14001, while Ford, GM, and Toyota motivate their suppliers to obtain the ISO certification. Industries like electronics or clothing, which are globally focused, are affected by both national and international pressures when it comes to adopting green practices (Zhu and Sarkis, 2006). Zhu and Sarkis (2007) stated that none of the institutional pressures brings a "win-win" situation in improving the economic and environmental performance of a business. Their results also confirmed that Chinese manufacturers experience increasing institutional pressures from government, customers, and competitors to adopt GSCM practices. Coercive (regulatory) and normative (customer) pressures positively affect environmental performance, especially with respect to adopting eco-design and green purchasing practices. Since implementing eco-design requires more investment, it influences economic performance negatively when there is strong customer pressure. Mimetic (competitor) pressures can improve economic performance through the adoption of some GSCM practices, but they have no significant impact on environmental performance (Zhu and Sarkis, 2007).

Since environmental guidelines and regulatory policies may vary from one country to another, the literature reveals conflicting findings on these issues. Furthermore, different countries and industries may have different points of view on the adoption of RL. It is worthwhile to consider, in the context of the Australian manufacturing industry, the direct impact of institutional pressures on the adoption of RL, as well as their impact on sustainability performance.

2.8 Resource commitment

The resources of firms consist of all assets, capabilities, firm attributes, organisational processes, and information and knowledge used to improve efficiency and effectiveness (Barney, 1991, Daft, 2006). Resources can be both tangible and intangible. Intangible resources refer to knowledge (Winter, 1998), learning (Senge, 1990), core competencies (Winter, 1998, Prahalad and Hamel, 2006), and invisible assets like corporate culture or brand image (Itami and Roehl, 1991). Resources are considered as drivers of firm performance (Conner, 1991), and the level of resource commitment is essential for success (Amaldoss et al., 2000). By concentrating on internal resources, companies can implement strategies more effectively and efficiently (Barney, 1991).

Previous studies have examined resource commitments required for RL processes. For instance, Genchev (2007) considered property-based resources and knowledge-based resources, drawing on Peteraf (1993) findings that a combination of these two resources creates competitive advantage for firms and can bring economic benefits. Property-based resources are related to the assets that a company legally owns. In the context of RL, they can be physical facilities, automated machines used for returns management, and human and financial resources allocated to RL programs. These assets afford the labour and facilities needed to implement RL activities (Genchev, 2007). Knowledge-based resources are related to the firm's skills—e.g., the software it uses to manage returns (Genchev, 2007). These resources are difficult to mimic in the short run, because of the firm-specific pathways that companies take to acquire and develop necessary skills and experience (Barney, 1991, Amit and Schoemaker, 1993).

Financial, managerial, and technological resources have been considered, from a resource-based view, in a number of previous studies (Daugherty et al., 2001, Richey et al., 2004, Golicic et al., 2008). The category of knowledge-based resources covers both managerial and technological resources because these resources can be considered as skills used to manage returns (Genchev, 2007). The more resources that are committed to a program or an initiative, including financial, human and physical resources, the better the likely performance results (Isobe et al., 2000, Sweeney and Szwejczewski, 1996). The present study draws on this work to investigate the commitment of technological, managerial, and financial resources to the RL program in the context of Australian manufacturing industry. RL implementation and maintenance require intensive resources, so unwillingness to allocate sufficient managerial and financial resources is a barrier to the development of efficient RL programs (Daugherty et al., 2001).

Resource commitment plays a significant role in enhancing the performance of RL, so it should be considered as a priority (Tan et al., 2003). Also, the development of RL with sufficient resources provides a strategic way to promote lasting connections with customers (Tan et al., 2003). Some studies have emphasised the significant role played by resource commitment in the context of RL (Richey et al., 2004, Daugherty et al., 2005, Genchev, 2007, Skinner et al., 2008, Jack et al., 2010). Richey et al. (2005), for example, found that resource commitment makes RL processes more effective and efficient. Large companies can allocate more resources to RL, and thus benefit from superior performance, compared to smaller companies. Garbout and Zouari (2015), in their case study of a packaging company, confirmed that allocating appropriate resources to RL programs can result in improved performance. Jack et al. (2010) showed that the commitment of resources to RL programs brings cost savings through improved RL capabilities. In a similar way, Morgan et al. (2018) demonstrated the positive effect of resource commitment on RL capabilities; this positive effect can lead to improved operational performance. The effect of resource commitment on environmental and economic performance in the context of RL was investigated by Huang et al. (2012) in Taiwanese computer, communication, and consumer electronics manufacturing and retail industries. Their findings revealed positive associations between the commitment of resources and RL performance outcomes; these findings are in line with those of Piyachat (2017).

A study conducted by Skinner et al. (2008) examined the role of resource commitment as a moderator of the relationship between RL disposition options and performance outcomes. Their results confirmed that without appropriate resource commitment to RL programs, their performance outcomes can be affected. When limited resources are allocated to RL program, companies tend to dispose of products, because the other disposition options require more resources to reclaim value from products. Conversely, when appropriate resources are committed to RL programs, superior performance outcomes can be achieved through selection of the appropriate disposition option.

Waqas et al. (2018) identified the lack of commitment of managerial, technological, and financial resources as the top barrier to RL implementation in the Pakistani manufacturing industry; this finding is consistent with the literature review conducted by Govindan and Bouzon (2018). Also, Vargas et al. (2018) highlighted the significant role of top management's commitment to the implementation of RL and other sustainable supply chain practices in the context of a developing country (Colombia). In contrast, Khor and Udin (2013) claimed that among different RL disposition options, resource commitment has only a slight impact on repair and disposal activities among electrical and electronic manufacturing firms in Malaysia. There are few empirical studies that investigate the impact of resource commitment on the adoption of RL and sustainability performance. The present study provides more insight into this matter by investigating the direct effect of resource commitment on the adoption of RL and perceived sustainability performance of firms.

2.9 Summary

This chapter reviewed the literature on evaluating the sustainability performance of RL, and more specifically studies of the effects of RL disposition options on sustainability performance. The review encompasses definitions of RL, RL process, drivers of and barriers to RL implementation, and sustainability performance in terms of a triple-bottom-line model of sustainability, according to which sustainable business practices can be measured via environmental, economic, and social indicators. This chapter also examined how institutional pressures as external factors as well as resource commitment as internal factor can impact the adoption of RL and sustainability performance.

The results of the review show that when RL is investigated in the context of GSCM, it is typically only compared to other GSCM practices—meaning that RL processes are not considered in and of themselves. Further, in existing studies, more attention is devoted to the environmental performance of RL, whereas economic and social performance are under-explored. A few empirical studies have investigated the relationship between RL and sustainability performance. However, social performance has been largely overlooked. In addition, most of the studies have examined RL performance without considering individual RL disposition options, even though product disposition is a key component in RL processes. In sum, there is no comprehensive study that examines the effect of RL disposition options on triple-bottom-line sustainability performance. To close these research gaps, a conceptual framework based on the literature review and research questions will be presented in chapter 3.

The next chapter explains the research methodology that will be used to achieve the study's objectives.

Chapter 3 Research methodology

3.1 Introduction

The previous chapter discussed the relevant literature and explained the theoretical framework used to design the research. The literature review revealed that there is no comprehensive study examining the relationship between each of the disposition options used in reverse logistics (RL), on the one hand, and the perceived triple-bottom-line sustainability performance of firms, on the other hand. The present chapter explains how this study was conducted to answer the research questions and achieve the research objectives. Based on the literature review, a conceptual framework was developed, and a survey questionnaire was designed as the main data-collection tool for this research.

This chapter describes the research methodology and philosophy used in this study to investigate the effects that different RL disposition options can have on perceived triple-bottom-line sustainability performance of firms. It discusses the research design, including the study's research questions and conceptual framework; the target population of the study and the process of sample selection; the data-collection method and the design of the research instrument; and, finally, the statistical methods used to analyse the data.

3.2 Research philosophy

When conducting research, it is important to have a well-defined research philosophy, because such philosophies involve important assumptions indicating how a researcher views the world (Saunders et al., 2007). In turn, making these assumptions explicit can help the researcher to understand how his or her research will be conducted (Beamon, 1999). In other words, research philosophy underpins research strategy and method (Saunders et al., 2007). Research philosophy refers to the process of knowledge development in a particular field as well as the nature of that knowledge (Saunders et al., 2007). Figure 3.1 indicates the main dimensions of research, using the model called the research onion. According to this model, research philosophy supports the other layers of the research onion such as research approach, method, strategy, time horizon, and type of data analysis.

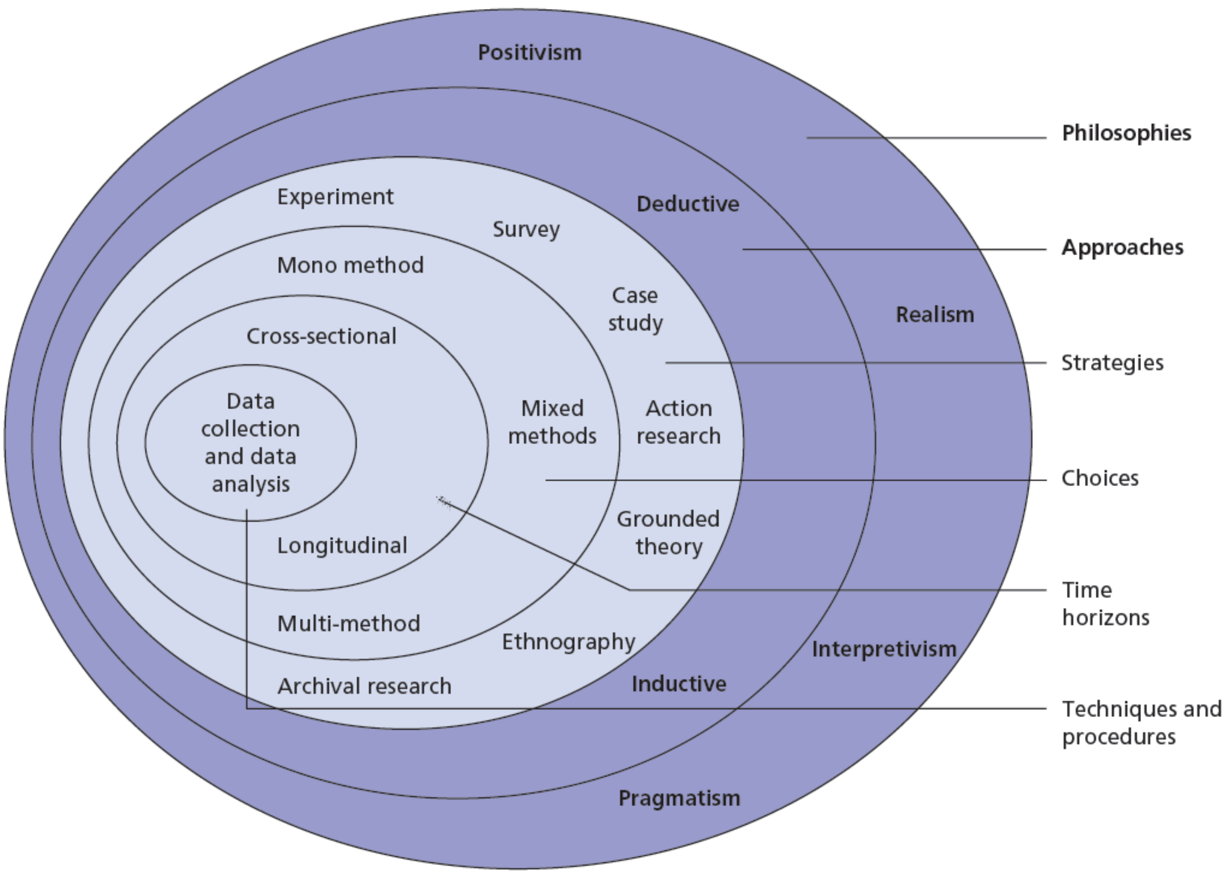

Figure 3.1: Research onion (adapted from Saunders et al. (2007, p. 108)

This study can be categorised as social science research, which focuses on the continually changing social world. In order to know how and why these changes happen, it is necessary to identify the factors that cause such changes (Saunders et al., 2007). The research philosophies underlying such research can be different, depending on the aims of a particular study and the best way to achieve those aims (Stock, 1998). In management research, there are three main research philosophies: positivism, interpretivism, and pragmatism. If the research adheres to the aims of natural science, a positivistic approach would be appropriate (Saunders, Lewis and Thornhill, 2007). When a positivistic philosophy is chosen, it means that the researcher works on observable social reality, and that the results of the research will be law-like generalisations similar to those developed by physical scientists (Remenyi et al., 1998). Positivism is an objective philosophy that involves facts and no impressions; it holds that the meaning of phenomena can be explained as the effects or outcomes of a real cause instead of human beliefs (Guba and Lincoln, 1982, Stock, 1998, Creswell, 2013). It refers to observable social reality, and assumes that the researcher is independent of what is being observed (Guide Jr et al., 2000). In studies that are carried out by positivists, causes specify the effects or outcomes. Therefore, it is essential to identify and assess the causes that affect the results of research (Creswell, 1994, Stock, 1998). Positivists use existing theories to develop hypotheses and verify them by collecting a large amount of quantitative data and analysing them statistically (Saunders et al., 2007, Creswell, 2013).

By contrast, interpretivism is a subjective philosophy based on the assumption that individuals seek to make sense of the world where they live and work through interacting with others and developing subjective understandings of their experience (Stock, 1998, Saunders et al., 2007). Unlike positivists, interpretivists develop theories through communicating with social actors and explicating the meanings of their views of the world (Creswell, 2013, Bryman and Bell, 2015).

There are researchers who are not convinced by either positivism or interpretivism, and who believe that research can best be conducted by integrating these two research paradigms (Brewer and Hunter, 1989). Pragmatist philosophy believes that no single point of view can ever give the whole picture. This research philosophy underpins approaches that combine various aspects and viewpoints; thus, it applies to mixed-methods research (Stock, 1998, Cavana et al., 2001, Saunders et al., 2007, Hair Jr et al., 2015, Bell et al., 2018). The focus of this philosophy is on the specific research questions being asked, and it allows researchers to conduct their research in any way that is appropriate for their purposes (Stock, 1998, Johnson and Onwuegbuzie, 2004, Saunders et al., 2007). Thus, researchers are not limited to any one approach, and can develop knowledge using both quantitative and qualitative methods (Greene and Caracelli, 1997, Stock, 1998, Rocco and Plakhotnik, 2009).

Based on this taxonomy of research philosophies, and given the objectives of the research, the research philosophy underpinning this study is positivistic. The study assumes that a social phenomenon (RL and sustainability performance) can be explained as the effect or outcome of real causes (factors). Accordingly, to answer the research questions proposed by this study, a quantitative method is appropriate.

As Figure 3.1 suggests, the selection of research philosophy only reveals the researcher's philosophical position when conducting research; it is only the outer layer of the research onion (Saunders et al., 2007). The next layer, which is more practical, is the research approach.

3.3 Research approach

A study's research approach refers to the way the study uses theory for research purposes; it has important implications for designing research (Remenyi et al., 1998). According to Saunders et al. (2007), deductive and inductive approaches are the two approaches most commonly used to conduct research.

In the deductive approach, the research process starts with developing a theory and hypothesis (or a set of hypotheses) by focusing on the existing literature and designing a research strategy to test the theory. The deductive approach involves testing hypotheses by collecting a large amount of quantitative data and examining the causal relationships among variables (Saunders et al., 2007). Another feature of the deductive approach is generalisation. In this connection, it is necessary to select an adequate sample size to generalise one's findings (Saunders et al., 2007). The deductive approach moves from the general to the specific, whereas the inductive approach, conversely, moves from the specific to the general. In an inductive approach, the researcher obtains general conclusions from observing the reality through collecting data and developing a theory as a result of the data analysis (Saunders et al., 2007). In this case, because the researcher focuses on understanding the research context, he or she needs to select a small sample size of subjects and collect qualitative data (Saunders et al., 2007).

When there is a wealth of literature that can be used to define a conceptual framework and develop theories, adopting a deductive approach is appropriate (Creswell, 1994). Although RL is relatively new, there is already a wealth of information in areas related to RL and sustainability. Hence, the deductive approach is appropriate for this research.

3.4 Research methods

According to Saunders et al. (2007), qualitative and quantitative methods are two distinctive research methods used to obtain data and solve specific research problems. In order to determine the research method, it is necessary to understand the differences between qualitative and quantitative methods. Qualitative methods are based on words and descriptions, and are often dependent on the interpretations of the researcher exploring the depth and complexity of a phenomenon. Interviews and observations are examples of qualitative research methods. Quantitative methods are based on numerical and statistical data. Such methods are suitable for a large amount of data that can be displayed easily in figures and tables, and for investigating the relationships among different variables. The selection of qualitative or quantitative methods mainly depends on the objectives of the research (Ghauri and Grønhaug, 2005). The aim of a quantitative study is to explore causes and make predictions as well as measure or conduct statistical analysis for purposes of generalisation. By contrast, the objective of qualitative research is not to measure, but rather to describe phenomena or generate theory by concentrating on meanings and phenomena in a particular context (Bryman and Bell, 2015, Burrell and Morgan, 2017).

Because the aim of this study is to investigate how RL disposition options can influence perceived sustainability performance of firms in the Australian manufacturing industry, a quantitative method was chosen for this study. This method is suitable for answering the research questions and achieving the research objectives.

3.5 Research design

Research design is a logical matter rather than a logistical one, with the term referring to the structure of an enquiry (Yin, 1989). The research design of a study is defined as an overall plan for making a connection between conceptual research and relevant empirical research (Ghauri and Grønhaug, 2005). The research design is a blueprint that is used to assemble various parts of the work in a logical way, in order to answer the key research questions and accomplish the main purpose of the study. Research design can be understood as a plan for addressing at least four issues: 1) what are the research questions? 2) what data are relevant to the study? 3) what data are to be collected? and 4) how are the results of the study to be analysed? (Philliber et al., 1980). To determine the research design, it is necessary to start with the research questions and conceptual framework.

3.5.1 Research questions

As discussed in chapter 1**,** the main aim of this study is to investigate the impact of disposition options of RL on perceived sustainability performance of firms by using triple-bottom-line performance indicators. To achieve this aim, the primary research question (PRQ) for this study is:

PRQ: How do RL disposition options affect the perceived sustainability performance of firms in the Australian manufacturing industry?

Five disposition options of RL, identified from the literature review, were treated as independent variables, and three dimensions of sustainability performance were treated as dependent variables. To find the relationships between the independent and dependent variables, five hypotheses were developed to test the effect of each RL disposition option on perceived sustainability performance of firms.

H1. The adoption of the reuse option affects perceived sustainability performance of firms:

- H1a. Economic performance
- H1b. Environmental performance
- H1c. Social performance

H2. The adoption of the repair option affects perceived sustainability performance of firms:

- H2a. Economic performance

- H2b. Environmental performance
- H2c. Social performance

H3. The adoption of the remanufacturing option affects perceived sustainability performance of firms:

- H3a. Economic performance
- H3b. Environmental performance
- H3c. Social performance

H4. The adoption of the recycling option affects perceived sustainability performance of firms:

- H4a. Economic performance
- H4b. Environmental performance
- H4c. Social performance

H5. The adoption of the disposal option affects perceived sustainability performance of firms:

- H5a. Economic performance
- H5b. Environmental performance
- H5c. Social performance

Since limited research has been conducted to explore RL implementation in the Australian manufacturing industry, a subsidiary research question (SRQ) was framed to investigate the level of RL implementation in the chosen Australian industry.

SRQ1: How are RL disposition options adopted in the Australian manufacturing industry?

While there are large number of studies on sustainability performance in general, there is a lack of research in the context of the Australian manufacturing industry, where the perceptions of triple-bottom-line sustainability performance may be different. Thus, a second SRQ was developed:

SRQ2: How is sustainability performance perceived in the context of RL in the Australian manufacturing industry?

In addition to questions about what the current RL practices in the Australian manufacturing companies are and how sustainability performance is perceived in the context of RL, there are questions regarding other factors that may affect the adoption of RL and perceived sustainability performance of firms. Both internal and external factors can impact the adoption of RL and perceived sustainability performance of firms, and the present study considered institutional pressures as an external factor and resource commitment as an internal factor in this context. To address questions about the impact of these factors, two further SRQs were developed:

SRQ3: How do institutional pressures affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

SRQ4: How does resource commitment affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

To answer the SRQ3 and SRQ4, four hypotheses were developed to examine the relationship between external as well as internal factors, on the one hand, and the adoption of RL and perceived sustainability performance of firms, on the other hand.

H6. Institutional pressures affect the adoption of RL.

H7. Institutional pressures affect the perceived sustainability performance of a business.

H8. Resource commitment affects the adoption of RL.

H9. Resource commitment affects the perceived sustainability performance of a business.

Based on the literature review, a conceptual framework underpinning these research questions was developed. This framework is presented in the next section.

3.5.2 Conceptual framework

A conceptual framework helps the researcher to choose the right research strategy and select methods that can be used to achieve the research objectives (Rocco and Plakhotnik, 2009). The aim of a conceptual framework is to identify and explain concepts and variables from the literature and describe relationships among those variables (Rocco and Plakhotnik, 2009). As discussed in chapter 2, there is a research gap when it comes to investigating sustainability issues in the context of RL processes. In particular, the social dimension of RL needs to be investigated because of the lack of empirical studies in this area.

Because there is no comprehensive study evaluating the relationship between RL disposition options and sustainability performance of firms, a conceptual framework was developed to investigate how different RL disposition options can affect environmental, economic, and social performance (Figure 3.2). This conceptual framework is required in order to build on previous studies and fill in research gaps. Further, since the purpose of this study is to explore the relationship between RL disposition options and perceived sustainability performance in the Australian manufacturing industry, the conceptual framework treats RL disposition options as independent variables while treating the different dimensions of sustainability performance as dependent variables. The framework illustrates the possible relationships among these variables. The conceptual framework also considers the possible effects of institutional pressures and resources commitment on firms' adoption of RL and their perceived sustainability performance.

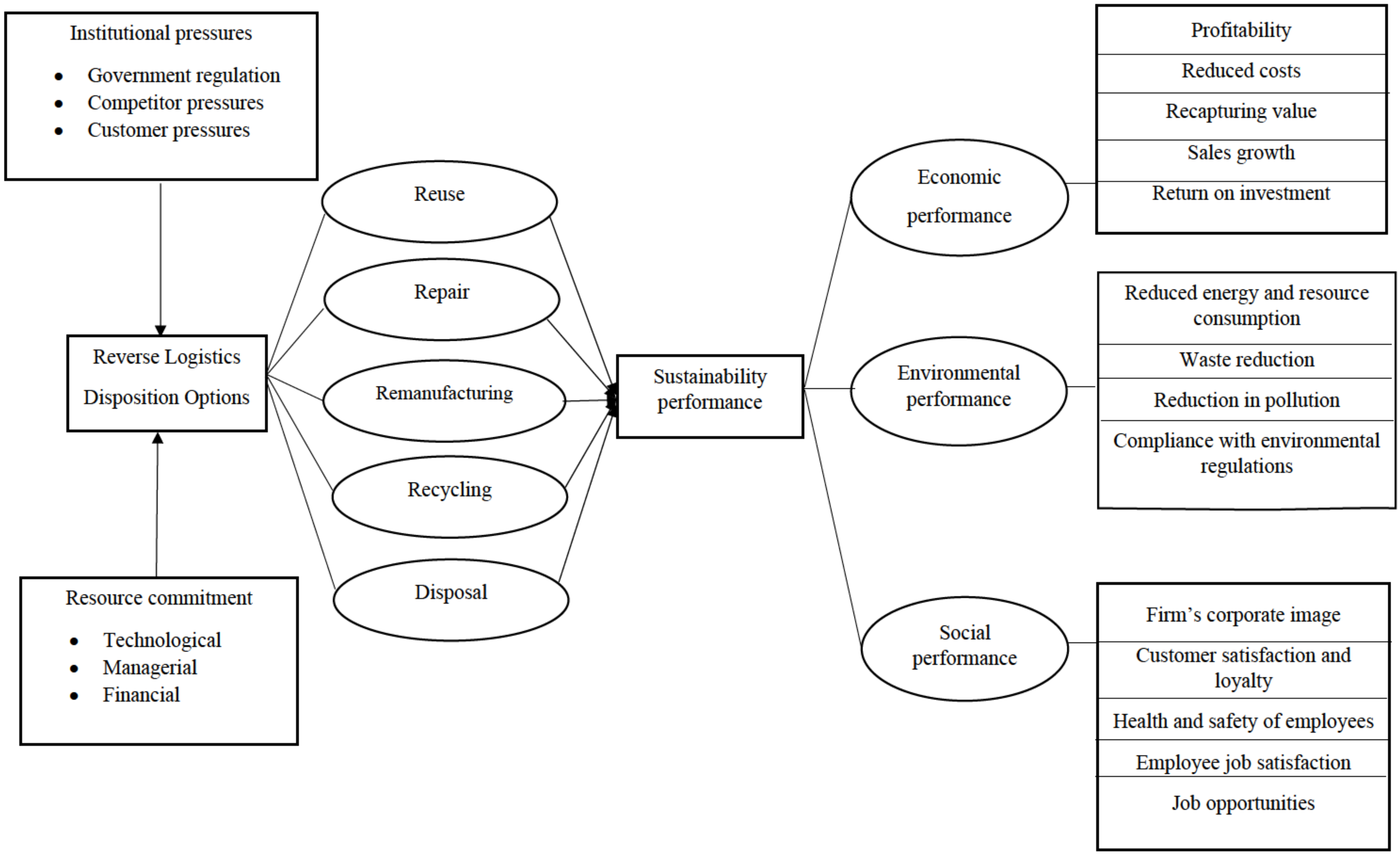

Figure 3.2: Conceptual framework

3.6 Research strategy

There are several research strategies, including experiments, case studies, survey, action research, grounded theory, ethnography, and archival research (Saunders et al., 2007). Selecting an appropriate type of research strategy depends on several criteria, such as the form of the research questions and objectives, the extent of existing knowledge, the amount of time and other resources available, and the researcher’s philosophical underpinnings (Saunders et al., 2007).

Given that the research questions concern the relationship between RL disposition options and sustainability performance on a large scale (i.e., in Australian manufacturing companies), and the questions all begin with HOW; the answers to these questions can be obtained through data analysis of a large sample. A survey is thus the best research strategy for this study. The survey strategy is related to the deductive approach; it is a common and popular research strategy used in business and management research. Surveys allow the researcher to collect quantitative data from a sample of the target population, with the purpose of generalising the findings to the entire target population in a highly economical way (Pinsonneault and Kraemer, 1993). The main difference between a survey and other methods, such as interview approach, is to collect information by gathering data in a structured manner. Quantitative data gathered through the survey can be analysed by using statistical methods, allowing for the relationships among variables to be explored (Saunders et al., 2007). In other words, the survey method provides a quantitative or numerical explanation of the attitudes or views of a target population. It does so by enabling the researcher to study a sample of that target population at a lower cost than that of collecting the data from the whole population (Creswell, 2013).

3.7 Time horizons

The last layer of the research onion is the time horizon. A study can be cross-sectional or longitudinal. When a study is carried out once in a particular period and can be proposed as a snapshot taken at a special time, it is called cross-sectional research. Longitudinal research is conducted repetitively over a long period. Since there were time and cost constraints, this research is a cross-sectional and was conducted once at a specific time.

3.8 Unit of analysis

Determining the unit of analysis is an important aspect of conducting research, because it plays a key role in creating a link between the formulation of problems and the nature of data collected (Brewer and Hunter, 1989). It is the level of aggregation at which the data need to be collected and analysed (Creswell, 2013). According to their research questions and objectives, researchers can select one or more levels as their unit of analysis, ranging from an individual to aggregates such as groups, organisations, and societies (Creswell, 2013, Bell et al., 2018). In this research, the unit of analysis corresponds to individual representatives in the Australian manufacturing industry who hold managerial positions such as Managing Director, Director, Chief Executive Officer, President, General Manager, or Operations Manager. People holding these managerial positions have substantial knowledge about and experience with RL and sustainability performance—knowledge and experience that can help us understand the RL process and their effect on perceived sustainability performance in the Australian manufacturing industry.

3.9 Population of the study, sampling design, and sample size

To achieve a study's research objectives and get correct answers to the research questions, it is necessary to gather data from the right persons (Cavana et al., 2001). Selecting proper samples is important for achieving accuracy and validity in research. For this purpose, Hair Jr et al. (2015) suggested a sampling process that includes defining the target population, providing the sampling frame, choosing the sampling method, determining the sample size, and finally performing the sampling plan.

3.9.1 Target population and sampling frame

The target population is a complete set of people or things with the same features that a researcher intends to explore (Cavana et al., 2001, Creswell, 2013). The target population of this study involves manufacturing firms in Australia. The manufacturing industry is a fundamental part of the Australian economy; it is also one of the largest employers in the country (Group, 2019). The manufacturing industry was chosen for the sample due to the importance of RL in this industry (Rogers and Tibben-Lembke, 1999, Fleischmann et al., 2003). The growth of manufacturing activities contributes to the use of more resources, and hence raises environmental concerns—in part, as a result of increasing waste during production and consumption. Manufacturing sectors in Australia are classified by the Australian Bureau of Statistics (ABS) agency into 15 groups including "Food Product Manufacturing", "Beverage and Tobacco Product Manufacturing", "Textile, Leather, Clothing and Footwear Manufacturing", "Textile, Leather, Clothing and Footwear Manufacturing", "Pulp, Paper and Converted Paper Product Manufacturing", "Printing (including the Reproduction of Recorded Media)", "Petroleum and Coal Product Manufacturing", "Petroleum and Coal Product Manufacturing", "Polymer Product and Rubber Product Manufacturing”, “Polymer Product and Rubber Product Manufacturing”, “Primary Metal and Metal Product Manufacturing”, “Fabricated Metal Product Manufacturing”, “Transport Equipment Manufacturing”, “Transport Equipment Manufacturing”, “Furniture and Other Manufacturing”. This study chose the “Machinery and Equipment Manufacturing”, “Transport Equipment Manufacturing”, and “Furniture Manufacturing” sectors because they are particularly relevant to this research: the high consumption of products in these sectors has resulted in an enormous increase of waste.

Transport equipment manufacturing sector consists of motor vehicle and motor vehicle part manufacturing, motor vehicle body and trailer manufacturing, automotive electrical component manufacturing, shipbuilding, boatbuilding and repair services, railway rolling stock manufacturing and repair services, aircraft manufacturing and repair services. Machinery and equipment manufacturing sector consists of professional and scientific equipment manufacturing, computer and electronic equipment manufacturing, electrical equipment manufacturing, domestic appliances manufacturing, pump, compressor, heating and ventilation equipment manufacturing, specialised machinery, and equipment manufacturing. Furniture manufacturing sector includes wooden furniture and upholstered seat manufacturing, metal furniture manufacturing, mattress manufacturing and other furniture manufacturing.

These three sectors are the largest sectors in the Australian manufacturing industry which cover all the main manufacturing sectors that implement RL disposition options. They are the largest sectors in the Australian manufacturing industry in terms of gross value added, employment and export values. Also, the environmental impacts of these sectors are significant, due to the nature of the multiple activities and processes used to transform raw materials into finished products, which lead to high consumption of materials and generate a high volume of waste. Since

Australia is committed to the 2007 Kyoto Protocol to limit carbon emission as per Australian bureau of statistics (ABS) report, these sectors are experiencing high pressure to implement green practices and achieve sustainable development. Therefore, due to the above justification, the finding of this research can generalise to the whole Australian manufacturing industry.

A complete and precise list of the members of the population from which the sample is taken is called a sampling frame (Hair Jr et al., 2015). There are several resources that can be used to compile a reliable list of manufacturing companies in Australia. Comprehensive lists of firms in these sectors are compiled through the Company 360 database and IBISWorld, and also through their associations' websites. The Company 360 database provides a comprehensive list of more than 40,000 leading public and private Australian companies, with key information about—and the names of key personnel in—each of the businesses. The population size of Machinery and equipment, Transport equipment and Furniture manufacturing sectors are 280, 210, and 110, respectively. In total, the population size for this study is 600. This research entailed inviting people who hold managerial positions to participate in the survey, based on the assumption that they would be the informants who have sufficient knowledge to address the issues covered in the questionnaire survey.

3.9.2 Sampling methods

The purpose of research based on sampling is to find results that can be generalised to the entire population. A population can be very wide or very narrow. It would be ideal if researchers collected data from each member of the target population, but because of constraints such as time, cost and limited access, doing so is not possible. Therefore, researchers need to use a sampling method to select a subset from the target population.

Sampling methods can be classified into two groups: probability and non-probability sampling. In probability sampling, the sample is selected randomly, and every element has an equal probability of being selected. By contrast, in non-probability sampling, the sample is chosen by the researchers without any randomisation (Creswell, 2013). In probability sampling, because of randomisation, the selection bias is minimised, and the sample can thus be considered to be genuinely representative of the target population. As a result, the research findings can be generalised to the target population with an adequate level of confidence (Creswell, 2013, Hair Jr et al., 2015). Based on these considerations, probability sampling is an appropriate method for this research.

Further, stratified random sampling is a type of random sampling. In this method, the sampling frame is divided into a number of subsets, which are called strata, according to one or more distinguishing features (Saunders et al., 2007). Then, a simple random sampling applies to each of the strata. Since this research considered three sectors in the Australian manufacturing industry and population is divided into three subsets, a stratified random sampling technique was used to select the sample of respondents for this study.

3.9.3 Population size and sample size

Determining the proper sample size is an important step in using the method of probability sampling. Sample sizes between 30 and 500 are appropriate for most quantitative research to ensure the basic requirements for validity and reliability (Roscoe, 1975, Sekaran and Bougie, 2016). A larger sample size can reduce sampling error when it comes to generalising the results to the target population (Saunders et al., 2007), and generate better estimations of psychometric attributes, such as validity and reliability (Leong and Austin, 2006). The sample size is calculated according to three factors: the degree of confidence, the standard deviation of the population, and the magnitude of error or desired precision (Zikmund et al., 2013, Hair Jr et al., 2015). The sample size is calculated as follows (Hair Jr et al., 2015):

$$n = \left(\frac{DC \times V}{DP}\right)^2$$

Where:

DC (Degree of Confidence) = The number of standard errors for the degree of confidence defined for the results of the research.

V (Variability) = The standard deviation or heterogeneity of the population.

DP (Desired Precision) = The acceptable magnitude of error, or the acceptable difference between the sample estimated and the population size.

The standard deviation can be obtained from a pilot study; alternatively, as a rule of thumb, the standard deviation can be proposed as one-sixth of the range of values (Zikmund et al., 2013). Because all the questions in the survey questionnaire used a five-point Likert scale, the range is (5-1) = 4. Hence, the value of the standard deviation was calculated as follows:

$$V = \frac{1}{6} \times (5 - 1) = \frac{2}{3}$$

Decisions related to the level of confidence and the magnitude of error are judgement calls by the researcher (Zikmund et al., 2013). At a 95 per cent confidence level, the confidence level score and the desired precision are respectively 1.96 and 0.07 (Zikmund et al., 2013). Thus,

$$n = \left(\frac{1.96 \times \frac{2}{3}}{0.07}\right)^2 = (8.67)^2 = 348$$

As can be seen from this formula, the sample size is independent of the population size. However, some corrections need to be made when the sample size is calculated to be more than five percent of the population size (Zikmund et al., 2013, Hair Jr et al., 2015), or when the population size is less than 10,000 (Saunders et al., 2007). Since the population size for this study is 600, the calculated sample size is 348, which is more than five per cent of the total population; hence, this figure needs to be adjusted. The adjusted sample size is calculated based on the population size as follows:

$$n' = (n \times N)/(n + N - 1)$$

Where n' is the adjusted sample size

n is the initial sample size

N is the population size

Thus,

$$n' = (348 \times 600)/(348 + 600 - 1) = 220$$

Accordingly, the sample size for this study is 220. Saunders et al. (2007) provide the sample sizes for different sizes of the population with at a 95% confidence level. The calculated sample size is consistent with the sample size provided by Saunders et al. (2007)

3.10 Data collection methods

There are several survey-data collection techniques, including face-to-face interviews, questionnaires, telephone interviews, etc. Among these methods, the questionnaire is one of the most broadly used data-collection methods because of its highly structured and standardised design and because, even though it costs less and requires less time than other techniques, it can cover the widest possible geographical area (Saunders et al., 2007, Fowler Jr, 2013). The survey questionnaire is a cost-effective data collection method that consists of a set of predetermined questions in a predetermined order; it provides data about a large sample of individuals' perceptions and point of view for purposes of quantitative analysis (De Vaus, 2013). All the respondents answer the same questions, which are written such that they can be interpreted in the same way by all respondents (Robson, 2002, Saunders et al., 2007). Given that the survey questionnaire technique is part of a quantitative method, the data gathered through this method can be collected from a sample of a specific population presented in a standardised form, such that the respondents' answers can be generalised.

3.10.1 Survey questionnaire design

The design of the questionnaire is a key element in getting reliable outcomes, because it can have noticeable effects on the response rate and on the reliability and validity of the data collected (Saunders et al., 2007). The questions asked in the questionnaire need to be designed precisely and clearly so that respondents will be able to answer them accurately (Priscilla and Dillman, 1994). If there is any ambiguity in the design of the questionnaire, it can result in validity and reliability problems because of its highly structured and standardised nature. In that case, respondents' perceptions and assumptions may conflict with the intentions of the researcher (Saunders et al., 2007). Vague questions will confuse respondents and result in wrong answers, thereby creating measurement errors (Priscilla and Dillman, 1994). The design of a questionnaire can vary, based on how it is administered and the amount of contact information available for the respondents; for example, questionnaires can be both self-administered (via online or postal delivery and collection) and interviewer-administered (via a telephone questionnaire or an in-person structured interview) (Saunders et al., 2007).

The selection of the type of questionnaire is dependent on several criteria related to the research objectives, research questions, and available resources, including the characteristics of the respondents, the size of the sample, the types and number of questions, the length of the questionnaire, available time and finance resources, and so on (Saunders et al., 2007). Considering the financial limitations involved, an online questionnaire is suitable for this research. That said, an online questionnaire has both advantages and disadvantages. In comparison with conducting interviews, the costs related to a web survey are much lower (Veal, 2005). When resources are limited, an online questionnaire is preferable compared to telephone surveys and interviews, because it can cover a wide geographical area due to its low cost (Zikmund et al., 2013). Further, since the online survey is conducted in a strictly confidential and anonymous manner, it elicits more reliable information compared to other methods, because respondents tend to provide truthful and genuine answers if they know that a survey is being carried out anonymously (Zikmund et al., 2013).

A disadvantage of the online questionnaire is that when the questionnaire is sent out, there is no control over the questioning process (Veal, 2005, Saunders et al., 2007). Another disadvantage is that while online questionnaires can provide wider geographical coverage, the response rate tends to be low in this method. The average response rate is 11 per cent less than other survey methods (Fan and Yan, 2010).

Significant factors related to sustainability performance, including sustainability indicators and disposition options in RL, were identified via the literature review presented in the previous chapter. The questionnaire contained items developed based on this detailed review of the literature. More specifically, the questionnaire comprises five sections with closed-ended questions, including multiple-choice questions, checkbox questions, and Likert-scale questions measured on a five-point scale. The first section seeks general information about the respondent and the company that the respondent works for with six questions: two multiple-choice questions for which respondents have to choose only one answer, and four checkbox questions that allow respondents to choose one or more answers. The second section concentrates on the RL disposition options adopted by the firms, and investigates the level of RL implementation in Australian manufacturing firms. As mentioned before, this research considers five RL disposition options: namely, reuse, repair, remanufacturing, recycling, and disposal. Statements were developed for each of the RL disposition options. The third section concerns how sustainability performance is perceived in the context of RL; it explores the importance level of triple-bottom-line sustainability performance in connection with RL for Australian manufacturing firms. Indicators were identified for each dimension of sustainability, with the aim of exploring how RL can affect the sustainability performance of a business. The fourth section consists of five-point scale statements designed to investigate the pressures that induce Australian manufacturing firms to adopt RL disposition options. The last section includes five-point scale statements designed to evaluate the effect of resource commitment on the adoption of RL disposition options.

To measure constructs that cannot be measured directly, it is preferable to use multi-item measures, because a single item may not be able to display a complex construct (Gliem and Gliem, 2003, Meyers et al., 2016). Hence, all the factors in sections B and C were measured by multi-items on the survey: at least three statements for each factor were developed. Multi-item measures are considered to show how people think about a concept or phenomenon by displaying underlying constructs (Gerbing and Anderson, 1988). Likert-type rating scales are used for assessing the respondents' attitudes about the questions asked, and for finding out the level of their agreement or disagreement with respect to various statements (Mciver and Carmines, 1981). There are different scale formats (scales with different numbers of alternatives) to collect the survey responses. Matell and Jacoby (1971) state that the number of scale points does not have any effect on the reliability and validity of an instrument. However, since it is expected that more scale points lead to increased scale variances (Leong and Austin, 2006, Dawes, 2008), the standard five-point Likert scale was used for this study, with scores from 5 to 1 representing, respectively, To a very great extent, To a great extent, To a moderate extent, To a small extent, and Not at all in Section B. Likewise, a five-point Likert scale with scores from 5 to 1 (representing Strongly agree, Agree, Neither agree nor disagree, Disagree, and Strongly disagree) was used for Sections C and D. For Section E, a five-point Likert scale was also used, with scores from 5 to 1 representing Very high, High, Moderate, Slight, and Not at all.

Table 3.1 shows the factors related to RL and sustainability performance constructs, institutional pressures, and resource commitment variables, the number of items used for each factor, the scale type applied, and the references used to develop the questionnaire. The survey items themselves were developed based on items used in previous studies. The survey questionnaire is provided in Appendix A.

Table 3.1: Questionnaire items

Sections	Number of Items	Scale Type	Reference
B: RL disposition options			

Reuse	3	5-point Likert scale	(Beamon, 1999, Wells and Seitz, 2005)
Repair	3	5-point Likert scale	(Thierry et al., 1995)
Remanufacturing	4	5-point Likert scale	(Thierry et al., 1995, Beamon, 1999, King et al., 2006)
Recycling	3	5-point Likert scale	(Thierry et al., 1995, Khor and Udin, 2012)
Disposal	3	5-point Likert scale	(Khor et al., 2016)
C: Sustainability performance			
Economic performance outcomes	5	5-point Likert scale	(Ye et al., 2013, Huang and Yang, 2014, Agrawal et al., 2016b, Khor et al., 2016)

Environmental performance outcomes	4	5-point Likert scale	(Autry et al., 2001, Agrawal et al., 2016b, Khor et al., 2016)
Social performance outcomes	6	5-point Likert scale	(Sarkis et al., 2010b, Aitken and Harrison, 2013, Ye et al., 2013, Ahmed et al., 2016)
D: Institutional pressures	3	5-point Likert scale	(Ye et al., 2013)
E: Resource commitment	3	5-point Likert scale	(Huang and Yang, 2014)
Total	37		

3.10.2 Pre-testing the survey instrument

Before conducting a survey, pre-testing the questionnaire is a crucial step in improving the reliability and validity of the survey instrument and the questions included on it (Czaja, 1998). Pre-testing is the last stage in the development of a questionnaire, and its purpose is to reduce errors (Saunders et al., 2007, Zikmund et al., 2013). Pre-testing is used to refine the questionnaire by diagnosing the errors or misunderstandings in questions that may be apparent only to the population concerned (Reynolds et al., 1993), thereby ensuring that the questionnaire functions as intended (Hunt et al., 1982).

In most instances, a sample size between 10 to 20 is enough for pre-testing (Cavana et al., 2001, Saunders et al., 2007). The draft questionnaire was distributed to 18 persons who are academic staff and PhD candidates at the National Centre of Ports and Shipping (NCPS), Australian Maritime College (AMC), University of Tasmania. The documents that were pre-tested included a hard copy of the invitation letter, the participant information sheet, and the questionnaire. Participants were asked to evaluate the questionnaire regarding its layout and response format; the length of time required to complete it; the number, wording, and ordering of questions; and the item scales used (Grimm, 2010). The documents were revised based on the participants' valuable feedback.

3.10.3 Administering data collection

After conducting the pre-test and revising the documents based on the feedback, the final online version of the questionnaire was set up through the Survey Monkey server. When a researcher needs to collect data from a sample population, it is essential to consider the privacy of the participants and the voluntary nature of their participation (Zikmund et al., 2013). The ethical consideration to keep in mind in doing research is that the researcher must accept participants' decisions about whether or not to take part, and not try to force them to participate or gain their consent (Priscilla and Dillman, 1994). More generally, research ethics involves issues related to the design of research projects, the collection, maintenance, storage, and analysis of data, and the responsible presentation of research results (Saunders et al., 2007). It is crucial to ensure that the way the researcher designs and conducts research is ethically and methodologically appropriate for all who are involved in a study (Saunders et al., 2007). Before starting data collection, it is necessary for researchers to get approval from the Research Ethics Committee at their university to verify that all ethical guidelines have been observed (Guillemin and Gillam, 2004, Saunders et al., 2007).

For the present study, the documents and ethics application were submitted to the Tasmanian Social Sciences Human Research Ethics Committee (SSHREC) at the University of Tasmania for approval. The application was approved by the SSHREC, and the ethics reference number for this study is **H0017560**. An information sheet with a description of the research project as well as the investigators' contact details was provided to all the selected participants, and a link to the information sheet was also attached to the invitation email. Copies of these documents are presented in Appendix B, C and D. The invitation email along with a survey link was sent to all the selected target participants; the email explained the aims of the research and the importance of participants' involvement. All the target participants were informed that their participation in this study was entirely voluntary, and that they had the right to withdraw from it at any time without providing any explanation. In addition, all individual responses collected through the survey were treated in a confidential manner, as mentioned in the invitation email as well as the information sheet.

3.10.4 Response rate

Response rate is the percentage of people who respond to a survey questionnaire. Because participating in surveys is entirely voluntary, they are not expected to get a 100 per cent response rate (Baruch and Holtom, 2008). However, researchers try to get a high response rate to ensure that the results are representative of the target population (Cook et al., 2000, Fowler Jr, 2013). A good response rate reduces nonresponse error, increases statistical power, and guarantees the credibility of results (Dillman, 1991). Acceptable response rates vary, depending on how the survey is administered. For example, the response rate for online surveys is lower than paper-based surveys (Nulty, 2008, Ebert et al., 2018), with the average response rate for online surveys being only around 30 per cent (Kaplowitz et al., 2004, Hamilton, 2009). There are different approaches to increasing the response rate, including pre-notification for potential participants, financial incentives, a clear cover letter, follow-up reminders, personalisation, guaranteeing the anonymity of responses, and finessing the layout/length/colour of the questionnaire (Yu and Cooper, 1983, Dillman, 1991, Fan and Yan, 2010). To maximise the response rate for the present study, the following actions were taken:

- A cover letter was provided; it clearly explained the aims of the research, and noted that all individual responses would be used only for research purposes and treated in a strictly confidential manner—to encourage the selected sample to participate (See Appendix E).
- The survey questionnaire was designed to be easy to read and follow. Clear instructions were provided regarding how to complete the survey and submit it. And for the respondents' convenience, the amount of time required to complete the survey was mentioned in the cover letter.
- To ensure the questionnaires were sent to the right persons, considerable effort was made to identify the most relevant correspondents for each organisation.
- Two follow-up reminders were sent to improve the response rate (See Appendix F). Enough time was given to complete the survey (7-10 days is sufficient for an online survey). After two weeks, the first reminder was sent to thank those who had already completed the survey and provide a reminder to the others who had not. The second reminder was sent five weeks after the initial email.
- An offer was made to provide participants a summary of the results upon request.

With all the efforts made to increase the response rate, 128 questionnaires were collected, representing a response rate of 58.18 per cent.

3.10.5 Control of biases

The existence of biases in business research can pose a threat to the validity and reliability of research. Employing proper bias management strategies is essential to identifying and controlling the sources of biases (Cavana et al., 2001, Creswell, 2013). There are two categories of biases: instrumentation bias and response bias. The concepts studied in social science can be difficult to measure directly, so there is often a need to use survey items to measure those concepts. When the survey instrument is not designed properly, instrumentation biases are likely to occur. Causes of biases related to instrumentation include the use of double-barrelled questions, leading and loaded questions, words with multiple meanings, wording ambiguity, and questions marked by over-generalisation or over-specificity. As discussed earlier, care was taken to design the survey instrument in a way that minimised potential biases. In addition, the questionnaire was pre-tested by experts and PhD students before it was finalised by the researcher and the supervisory team.

Response bias happens when the respondents do not give truthful answers, whether consciously or unconsciously. Conscious misrepresentation may occur because of reasons related to wanting to appear intelligent, conceal personal information, or avoid embarrassment, while unconscious misrepresentation may happen due to the features of the survey instrument, such as the format and content of questions. For the present study, the research ensured the anonymity of the respondents, and designed the survey such that it avoided sensitive questions. In addition to possible response bias, another disadvantage in using a survey instrument is non-response bias.

Non-response bias occurs when there is a significant difference between those who responded to the survey and those who did not. Participants' unwillingness to complete the survey may stem from a variety of causes, include privacy policies enforced by their companies, a lack of knowledge about or interest in the research topic, and shortage of time. However, as discussed in the previous section, several strategies were taken to increase the response rate and reduce the non-response error.

3.10.6 Validity and reliability of the questionnaire

In order to implement an appropriate research methodology, it is essential to consider the validity and reliability of the data-collection instrument. Validity can be described as the degree to which a concept is precisely measured in quantitative research. The validity of research is confirmed when measurement tools measure the different dimensions of a phenomenon or a concept accurately. Reliability refers to the consistency of a measurement tool. In other words, reliability concerns the accuracy of an instrument and the degree to which the measurement tool gets consistent results when the process of data collection is repeated.

Content validity concerns whether the instrument sufficiently covers the whole area related to a given variable. To ensure content validity, the questionnaire was pre-tested by academics, who offered their expert opinions about how well the instrument measured the concepts associated with the research. The questionnaire was revised based on their feedback. To evaluate the reliability of the questionnaire, Cronbach's alpha was used to examine the degree of internal consistency among a set of questions. When the number of responses reached 30, Cronbach's alpha was calculated for the entire questionnaire and for each variable of the questionnaire separately. All the values of Cronbach's alpha were higher than the recommended value of 0.7

(Hair Jr et al., 2015). Thus, the reliability of the questionnaire was confirmed, and the data collection was therefore continued.

3.11 Data analysis

Data analysis is a process of summarising large quantities of raw data and transforming them into information that can be interpreted (Judd et al., 2011). The survey data used in this study were edited and coded before being entered into IBM SPSS software (version 24.0).

Various methods can be utilised for analysing data. Data collected through the survey questionnaire were analysed with quantitative methods, including factor analysis and structural equation modelling. The demographic data was analysed to get demographic information regarding respondents and ensure their representativeness with respect to the target population. In addition, the demographic variables were considered as independent variables; in this way, the study investigated how these variables may influence the adoption of RL disposition options and the three dimensions of sustainability performance. The remaining data were analysed to assess the validity and reliability of the findings and, finally, to test the hypotheses and discover the relationships among variables. The data analysis process will be explained in more detail in the next chapter.

3.12 Summary

This chapter discussed in detail the research design and method used by this study to answer the research questions. It reviewed a range of research philosophies, approaches, methods, and strategies, so as to contextualise and explain the procedure used in this study to investigate the effects of RL disposition options on perceived sustainability performance in Australian manufacturing companies. The research questions and conceptual framework were discussed. Based on the proposed framework, a survey questionnaire was designed and made available online. The validity and reliability of the questionnaire were evaluated, and bias management strategies were applied to ensure the quality of the research. The process of data analysis used for the study was also outlined, setting up the next chapter's detailed discussion of exactly how the data were analysed.

Chapter 4 Data analysis and results

4.1 Introduction

The previous chapter discussed the research methodology used by this study. The aim of this chapter is to explain the data analysis process and present the results and findings of the quantitative analyses to test the hypotheses and answer the research questions including coding technique, demographic data analysis, factor analysis, assessment of validity and reliability of constructs and using structural equation modelling to test the research hypotheses and answer the research questions. The analysis of variance is used to investigate how demographic variables as independent variables can affect the adoption of RL disposition options and sustainability performance of firms. The analysis results through the structural equation modelling technique are used to answer the main research question and find the relationship between reverse logistics (RL) and disposition options and sustainability performance. Also, the results of structural equation modelling are used to answer the third and fourth secondary research questions and explore the impact of internal and external factors on the adoption of RL and sustainability performance.

4.2 Selection of statistical techniques

To analyse data, appropriate statistical techniques are needed. Parametric and non-parametric statistics are two major statistical procedures. It is proposed that when a measurement scale is nominal or ordinal and the sample size is small, non-parametric statistics should be used, while the parametric statistics should be used when the measurement scale is interval or ratio scales and the sample size is large (Zikmund et al., 2013). The parametric statistics are more powerful than non-parametric statistics because of using more information in the calculation. It is obvious that there are two main criteria including sample size and measurement scale that need to be checked to choose the appropriate statistical techniques.

Parametric statistics are based on the assumption that sample data derived from a population follows the normal distribution (Zikmund et al., 2013). If it does not follow the normal distribution, or data is nominal or ordinal, the non-parametric statistics are appropriate (Zikmund et al., 2013). According to the central limit theorem, when the sample size is large enough, the sample is normally distributed evenly if the variable does not follow the normal distribution in the population (Hogg et al., 1977, Kwak and Kim, 2017). Another criterion is the measurement scale. This study employs a five-point Likert scale with scores from 5 to 1 for Sections B, C, D and E of the questionnaire. Although Likert scales are basically ordinal measurement scale, they can be treated as interval scale when there is equal distance between the neighbouring scores. Many researchers argue that Likert scale can be treated as continuous interval scale especially in social science (Stevens, 1946, Lord, 1953, Knapp, 1990, Harwell and Gatti, 2001, Allen and Seaman, 2007). In this study, it is assumed that there are equal intervals between the points on the scale. For example, the interval between 1 and 2 is equal to the interval between 3 and 4. Since the sample size of this study is 220, which is large enough and the measurement scale can be considered interval, the parametric statistics are appropriate for this study.

4.3 Data coding and data screening

Data coding is a primary stage for analysing data. Coding of quantitative data is the process of classifying non-numerical data into categories and assigning numerical codes to them. The aim of data coding is to convert the data into a form that is ready for computer processing with statistical software (Zikmund et al., 2013). Thus, it is necessary to code the data before entering it into IBM SPSS software. For instance, the first question in the questionnaire is about the job position of the respondents in their company (President, CEO, Director, Managing Director, General Manager, Operations Manager and Other), so a number is assigned to each job position, rather than using the positions (Field, 2013). There are six questions for demographic information (A) in the questionnaire. For Part A, the first listed response has been coded as 1, the second as 2 and so on as recommended by Pallant and Manual (2013). For Sections B, C, D and E, a number has been assigned to each of the 37 statements included in these four parts. The responses for Section B have been coded as 5 = To a very great extent, 4 = To a great extent, 3 = To a moderate extent, 2 = To a small extent, 1 = Not at all, 0 = Not applicable. The responses for Section C and D have been coded as 5 = Strongly agree, 4 = agree, 3 = Neither agree nor disagree, 2 = Disagree, 1 = Strongly disagree, 0 = Don't know. The responses for Section E have been coded as 5 = Very high, 4 = High, 3 = Moderate, 2 = Low, 1 = Very low, 0 = Don't know.

After data coding, the data is entered into SPSS software (version 24.0). It is essential to carry out data screening prior to any data analysis. The data screening is conducted to ensure the data is valid and reliable for analysis. The assessment of the variables' frequency helps the researcher identify the missing values for each variable. To recognise the outliers, frequency, mean, standard deviation, minimum, maximum, skewness, kurtosis and box plot for each variable were checked by using SPSS. Among the 128 responses returned by the participants, eight were excluded because of the large number of missing values (Sreejesh, 2014). The remaining 120 responses were complete and included in the analysis.

4.4 Respondents' demographics

Demographic information helps investigate the respondents' characteristics. The first part of the questionnaire (Section A) contains six questions related to the company/respondent profile including the respondents' job position in the company, the number of years that the company has been established, the number of employees in the company, the sector that the company operates in, the place where products are made (Australia or overseas), environmental certifications that have been obtained by the company.

4.4.1 Job position

It is essential that a survey questionnaire is answered by someone who has a good understanding and knowledge on what you want to ask. People who hold managerial positions in the company were invited as they have valuable knowledge and experience. Table 4.1 presents the information regarding the respondents' position in their company. Around 13 per cent and 9 per cent were Managing Directors and Directors respectively, while around 6 per cent were Chief Executive Officers (CEO) and Presidents. 55 per cent of the respondents were General Managers and Operational Managers. The remaining 17 per cent of the respondents held other positions in their companies including Business Development Manager, State Manager, Production Manager, Supply Chain Manager and Chief Information Officer (CIO). The result shows that the questionnaire has been completed by people who hold senior positions or above in their companies, therefore the answers can be considered reliable.

Table 4.1: Job positions

Answer Choices	Responses	Per cent
President	1	0.83

CEO	6	5.00
Director	11	9.17
Managing Director	16	13.33
General Manager	30	25.00
Operations Manager	36	30.00
Other	20	16.67
Total	120	100

4.4.2 Company's age and size

Tables 4.2 and 4.3 show the years that the companies have been established and the number of employees respectively. Only 25 per cent of the companies have been established less than 20 years indicating that most of the companies have been in business for a long time with well-established organisational structure and business functions and operations. In Australia, businesses are categorised into three groups based on the number of employees, small, medium and large. Small businesses have less than 20 employees, medium businesses 20–199 employees, and large businesses more than 200 employees. The result shows that most of the companies were in the category of large businesses (around 52 per cent), while around 38 and 10 per cent were in the category of medium and small businesses respectively.

Table 4.2: Company's age

Answer Choices	Responses	Per cent
Less than 5 years	6	5.00
5-10 years	13	10.83
11-20 years	11	9.17
More than 20 years	90	75.00
Total	120	100

Table 4.3: Company’s size

Answer Choices	Responses	Per cent
Less than 20	12	10.00
20-199	46	38.33
More than 200	62	51.67
Total	120	100

4.4.3 Australian manufacturing sectors

Manufacturing sectors in Australia are classified by the Australian Bureau of Statistics (ABS) agency. This study has considered “Machinery and Equipment Manufacturing”, “Transport equipment manufacturing”, and “Furniture manufacturing” sectors because they tend to have high consumption of products and large amount of waste. According to Table 4.4, 45 per cent of companies were in the machinery and equipment manufacturing sector, around 36 per cent in the transport equipment manufacturing sector and around 19 per cent in the furniture manufacturing sector.

Table 4.4: Manufacturing sectors

Answer Choices	Responses	Per cent
Machinery and Equipment Manufacturing	54	45.00
Transport Equipment Manufacturing	43	35.83
Furniture Manufacturing	23	19.17
Total	120	100

4.4.4 The location of production and adoption of environmental certifications

Table 4.5 presents the place where products are made. This question is a multiple-choice question, companies can make their products in Australia or overseas or both. Around 44 per cent of companies produce their products in Australia only, while around 22 per cent of companies produce their entire products overseas. Also, around 34 per cent of them produce their products in both, Australia and overseas. This means that over 55 per cent of participated companies had productions overseas.

Table 4.5: The location of production

Answer Choices	Responses	Per cent
Australia	53	44.17
Overseas	26	21.67
Both	41	34.16
Total	120	100

Table 4.6 shows the environmental certifications have been adopted by companies including ISO 14000, ISO 14001, Environmental Management System (EMS). Only around 27 per cent of companies do not adopt any environmental certifications and around 12 per cent of companies adopt other certifications including ISO 14040,14044, 5000, 9001, Forest Stewardship Council (FSC) certification and Australian Forestry Standard (AFS) certification.

Table 4.6: Environmental certifications

Answer Choices	Responses	Per cent
ISO 14000	2	1.67
ISO 14001	33	27.50
Environmental Management System (EMS)	17	14.17
ISO 14000/ISO 14001/Environmental Management System (EMS)	25	20.83
Do not adopt	32	26.67
Other	11	9.16

Total	120	100

4.5 Means of the main constructs

This section examines the means of two main constructs including RL and sustainability performance. As mentioned before, a five-point Likert scale with scores from 5 to 1 was used to rate the extent of adoption of RL disposition options, which 3 is in the middle point. Table 4.7 indicates the means of the five RL disposition options. It concludes that the most adopted RL disposition option in the Australian manufacturing industry is disposal (Mean= 3.30), followed by repair (Mean= 3.16), recycling (Mean= 2.78), remanufacturing (Mean= 2.60) and the lowest adopted disposition option is reuse (Mean= 2.50). Totally, the Australian manufacturing companies adopt RL in the medium level (Mean= 2.87).

Table 4.7: Descriptive analysis of RL disposition options

Variables	No of items	Minimum	Maximum	Mean	Std. Deviation	Rank
Reuse	3	.00	5.00	2.50	1.19	**5**
Remanufacturing	4	.00	5.00	2.60	1.39	**4**
Recycling	3	.00	5.00	2.78	1.33	**3**
Repair	3	.00	5.00	3.16	1.16	**2**
Disposal	3	1.00	5.00	3.30	1.08	**1**
RL	16	1.13	4.53	2.87	0.86	

The descriptive statistics of the three dimensions of sustainability performance of RL is shown in Table 4.8. As mentioned before, the Likert scale used for sustainability performance dimensions is from 5 to 1, which 3 is in the middle point. Table 4.8 shows that amongst the three dimensions of sustainability performance, the value of environmental outcome is the highest (Mean= 3.93) and closely followed by social outcome (Mean= 3.72) and the lowest value of sustainability outcome is related to economic outcome (Mean= 3.70). Overall, sustainability performance shows the relatively high level of attainment in the context of RL (Mean= 3.78).

Table 4.8: Descriptive analysis of sustainability performance outcomes of RL

Variables	No of items	Minimum	Maximum	Mean	Std. Deviation	Rank
Economic	5	0.40	5.00	3.70	0.70	**3**
Environmental	4	1.50	5.00	3.93	0.63	**1**
Social	6	2.00	5.00	3.72	0.63	**2**
Sustainability	15	1.47	5.00	3.78	0.55	

4.6 Validation of measurement instruments

The concepts and phenomena investigated in social science research (e.g., perceptions or beliefs) cannot be measured directly. Instead, they are measured through a set of observed variables (Ahire and Devaraj, 2001, Schreiber et al., 2006). A measure represents the theoretical concept of interest and the construct that aims to measure along with measurement errors (Bagozzi et al., 1991, O'leary-Kelly and J. Vokurka, 1998). Measurement errors can be random or systematic (Fiske, 1982). These measurement errors can have negative influences on the validity of the research and result in misleading findings and conclusions (Bagozzi et al., 1991). Hence, before testing the theory and relationship between constructs, it is essential to examine the validity and reliability of the measures to ensure the variables of a construct are measuring that construct (Bagozzi et al., 1991, Drost, 2011). To establish the construct validity of a measure, it is necessary to examine the unidimensional, convergent validity, discriminant validity and reliability of the measure.

4.7 Factor analysis

Factor analysis (FA) specifies the theoretical constructs of research that underlie a data set and tests the relationship between the observed indicators and their underlying latent variables (Henson and Roberts, 2006, Byrne, 2013) . FA describes a large number of observed indicators or items with a small number of underlying latent variables or factors (Henson and Roberts, 2006). FA is used to evaluate dimensionality and the construct validity of measures and examine to what extent the constructs display the underlying variables (Kieffer, 1999, Tabachnick et al., 2007). The aim of FA is to help researchers to identify the number and nature of the latent factors (Brown and Moore, 2012). A factor is a latent variable that impacts on more than one observed item or indicator, which explains the variation and covariation among these observed items (Brown and Moore, 2012).

FA methods are categorised into two groups; Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) (Thompson, 2004). EFA explores the factor structure underlying a set of observed indicators without applying a prior-specified factor structure (Thurstone, 1947, Suhr, 2006, Byrne, 2013). EFA is used when there is no rich literature and prior knowledge of underlying factors and the aim is to generate a theory. In contrast, CFA is used when a researcher has a theory about factor structure (Williams et al., 2010). CFA confirms the factor structure of a set of observed indicators and helps researchers to test the theory and hypothesis to explore the relationship of the observed indicators and their underlying latent variables (Jöreskog, 1969, Hurley et al., 1997, Byrne, 2013). Since there is strong literature related to RL and sustainability performance, using the CFA method is appropriate for this study.

CFA is a form of structural equation modelling which is concerned with measurement models that describes the relationships between observed indicators or items and latent factors or variables (Brown and Moore, 2012, Adachi, 2016). In this case, the theoretical constructs of the research are verified empirically by evaluating the relationships between observed indicators and latent variables (Brown and Moore, 2012). CFA involves two main categories: First-order measurement model and second-order measurement model (Hartono et al., 2014). In the first-order measurement model, the relationship between the observed items and latent variables is analysed to evaluate how well the latent variables are measured. When the structure involves several latent variables with their constructs, the second-order measurement model is used. In this model, the relationship between the latent variables and their constructs is examined as well as the relationship between the latent variables and their observed items. CFA is a more powerful method compared to EFA method for assessing the construct validity because it represents an overall model fit along with accurate criteria for evaluating the discriminant and convergent validity (Bagozzi et al., 1991).

As can be seen in the conceptual framework presented in the previous chapter, there are two main constructs in this study as dependent and independent variables (RL and sustainability performance). Given the moderate size of the sample in comparison with a large number of observed items (survey items), CFA was carried out for these two constructs separately (O'leary-Kelly and J. Vokurka, 1998, Sezen, 2008). Also, some external and internal factors have been considered including institutional pressures and resource commitment which may affect the adoption of RL, so CFA was conducted for these variables and their measurement models were examined separately.

4.7.1 Data sample adequacy

Before conducting CFA, there is a need to investigate the suitability of the data sample for this kind of analysis (Williams et al., 2010, Baglin, 2014). The size of the data sample is important for conducting CFA (Williams et al., 2010). Also, the sample to variable ratio (N:P) is useful to ensure the sample size is large enough for CFA (Kline, 2014). Different studies have recommended different rules of thumb for appropriate sample size. According to some scholars, the sample size should be 100 or more (Gorsuch, 1983, Hair et al., 1995, Kline, 2014). In this study, sample size is 220 which is considered adequate for CFA. Cattell (2012) suggests that the ratio of a sample size to a number of variables should be in the range of three to six. Also, Williams et al. (2010) declared that the minimum acceptable range for factor analysis is the ratio 3:1. The ratio for this study is about 6:1, which is proper for CFA.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to test the suitability of the data. The KMO measure examines the adequacy of the data sample for CFA which ranges from zero to one. According to Kaiser and Rice (1974), values between 0.8 and 0.9 are meritorious, between 0.7 and 0.8 are middling and less than 0.5 are unacceptable. Generally, the minimum acceptable value is 0.5 for KMO and the value greater than 0.7 shows that the data sample is highly appropriate for FA. The KMO measure of sampling adequacy for RL and sustainability performance construct were 0.823 and 0.846 (> 0.7) respectively, which indicate meritorious data adequacy. The KMO measure of sampling adequacy for institutional pressures and resource commitment as latent variables were 0.733 and 0.748 (> 0.7) respectively that show the middling data adequacy.

Bartlett's test of sphericity tests the null hypothesis that the correlation matrix has an identity matrix (Tobias and Carlson, 1969). When the correlation matrix of variables is an identity matrix, it illustrates that the data is not appropriate for CFA (Tobias and Carlson, 1969). If the p-value is < 0.05, the null hypothesis is rejected. For this study, Bartlett's test of sphericity was significant (p-value= 0) which means that the correlation between variables is non-zero and data is suitable for CFA. The results of KMO and Bartlett's test of sphericity for RL construct, sustainability performance construct, institutional pressures and resource commitment as latent variables are shown in Table 4.9.

Table 4.9: KMO and Bartlett's Test

Construct	**KMO**	**Bartlett's Test**		
		Chi-Square	**Df**	**Sig.**
RL	.823	1108.213	120	.000
Sustainability Performance	.846	933.750	105	.000
Institutional pressures	.733	282.259	3	.000
Resource commitment	.748	223.517	3	.000

4.7.2 RL measurement model

As mentioned earlier, CFA includes two main categories including first-order measurement model and second-order measurement model. The CFA was conducted for the RL construct with 16 items based on five factors. The following sections examine the relationship between observed items and latent variables as well as the relationship between latent variables and their construct by providing the first-order and second-order measurement models of RL construct. Also, the model fit indices were investigated to verify the models.

4.7.2.1 First-order measurement model

In this model, RL disposition options including reuse, repair, remanufacturing, recycling and disposal are latent variables or factors that cannot be measured directly. They are measured by observed items or indicators. In the RL first-order measurement model, five factors are assessed by 16 items. In this stage, the adequacy of the observed items for the latent variables is assessed. CFA was conducted to evaluate the dimensionality of the items to make sure the validity of the observed variables (Long, 1983). To achieve the unidimensionality, it is essential to consider and measure the items with the acceptable factor loadings (Awang et al., 2010). Indeed, factor loading shows the level of a regression path from a latent variable to its observed items. To assure the unidimensional of a measurement model, any item with factor loading below the cut-off value 0.4 needs to be removed (Hulland, 1999, Saris et al., 2009, Hair et al., 2011, Hair et al., 2013). The CFA was performed by AMOS software version 24. The statements for items (Q1-Q16) are summarised in Table 4.10. Figure 4.1 shows the first-order measurement model for RL construct.

Table 4.10: A summary of statements for items (Q1-Q16)

Question number	Statement
Q1	Accepting customer returns of unused or slightly used products.
Q2	Returning reusable products to retailers, or distributors, or any place in the forward or reverse supply chain as needed.
Q3	Selling reusable products.
Q4	Accepting faulty products from customers for repair.
Q5	Fixing or replacing broken or damaged parts.

Q6	Carrying out only limited product disassembly and reassembly in the repair process.
Q7	Accepting used products from customers for remanufacturing.
Q8	Disassembling used products up to part level.
Q9	Inspecting all parts of used products and repairing or reworking repairable parts or components.
Q10	Replacing obsolete or defective parts or components with new or refurbished ones.
Q11	Accepting used products from customers for recycling.
Q12	Cleaning, sorting and separating used products into different material categories.
Q13	Extracting and recovering recyclable materials from used products.
Q14	Dispose of faulty parts as waste.
Q15	Dispose of used parts as waste.
Q16	Conducting appropriate treatment of waste.

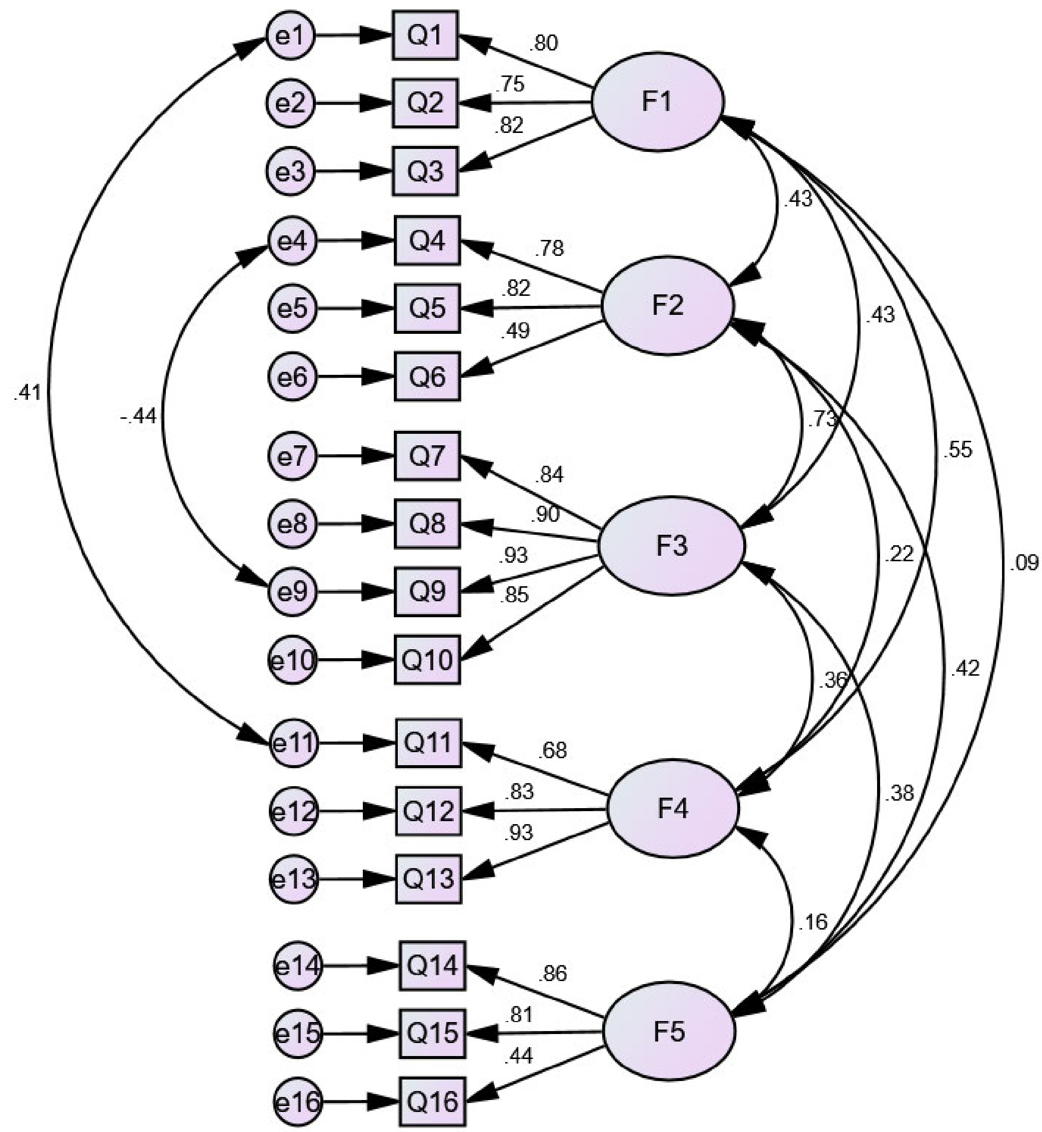

Figure 4.1: RL first-order measurement model

Table 4.11 indicates the standardised regression weights for the default model, which demonstrates that all the relationships between the observed items and latent variables are significant and there is no item with factor loadings below the cut-off value of 0.4, which means the latent variables have been well measured by the observed items. Accordingly, there is no need to remove any items.

Table 4.11: Standardised Regression Weights - Default model

Items		Factors	Estimate			P	
Q3	<---	F1	.819			***	
Q2	<---	F1	.746			***	
Q1	<---	F1	.799			***	
Q6	<---	F2	.487			***	
Q5	<---	F2	.815			***	
Q4	<---	F2	.783			***	
Q10	<---	F3	.847			***	
Q9	<---	F3	.929			***	
Q8	<---	F3	.898			***	
Q7	<---	F3	.839			***	
Q13	<---	F4	.931			***	
Q12	<---	F4	.828			***	
Q11	<---	F4	.678			***	
Q16	<---	F5	.439			***	
Q15	<---	F5	.813			***	
Q14	<---	F5	.865			***	

Three asterisks (***) indicates significance smaller than .001

Before proceeding with the result of the CFA, it is necessary to examine the model fit indices to ensure how fit the model is to the data. There are several model fit indices that are reported by AMOS. There is no agreement between researchers regarding which ones to use. Considering and analysing all of them is confusing. Cangur and Ercan (2015) recommended Normed chi-square (CMIN/DF), Root Mean Square Error of Approximation (RMSEA), and Comparative Fit Index (CFI) are the most important indices in model fit. Model fit indices can be categorised into three groups including Absolute fit indices, Incremental fit indices and Parsimonious fit indices. According to Hair et al. (1995) and Holmes-Smith et al. (2006) , using at least one index from each category is sufficient to examine the model fit. Five most common goodness-of-fit (GOF) indices were used to assess the model fit as follows:

- Absolute fit: Root Mean Square Error of Approximation (RMSEA) was considered to evaluate the absolute fit. The recommended value of this index should be less than 0.1 (Jöreskog and Sörbom, 1993, Byrne, 2013).
- Incremental fit: It was measured by the Comparative Fit Index (CFI), Incremental Fit Index (IFI) and Normed-Fit Index (NFI). The Recommended values of these three indices are values higher than 0.9 (Jöreskog and Sörbom, 1993, Marsh and Hau, 1996, Hair et al., 2013).
- Parsimonious Fit: Normed chi-square (CMIN/DF) were used to assess the parsimonious fit. This index modifies the bias nominated by the non-normal data distribution. It should be less than 3 to achieve the desired model fit (Jöreskog and Sörbom, 1993, Kline, 2015).

When the model fit indices are close to good fit values, drawing some covariance between the residuals of observed variables can modify the model fit (Zahoor et al., 2017). It is essential to examine modifications indices that illustrate the presence of covariance between error variables and make a connection between them (Ullman, 2006). To enhance the model-fit, the covariance among e1 & e11 as well as e4 & e9 were considered because they bring the largest modification indices. Table 4.12 shows the model fit indices for the RL first-order measurement model. The CMIN/DF is 1.25 which is less than 3. The CFI, IFI and NFI are 0.98, 0.98 and 0.901 respectively which are higher than 0.9. The value of RMSEA is 0.046 which is less than 0.1. As can be seen, the hypothesised model is a good fit to the data.

Table 4.12: Model fit summary (RL construct)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	60	115.514	92	.049	1.256
Saturated model	152	.000	0		
Independence model	32	1168.780	120	.000	9.740

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.901	.871	.978	.971	.978
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.046	.003	.071	.572
Independence model	.271	.257	.285	.000

4.7.2.2 Second-order measurement model

In the RL second-order measurement model, the disposition options along with their construct (RL) are considered. In this stage, the CFA was conducted for the RL construct with 16 items under five factors. The second-order measurement model investigates the relationship between the latent variables or factors and their construct to assess how well the construct is measured by their underlying factors as well as the relationship between the latent variables and their observed items. Figure 4.2 shows the second-order measurement model for RL construct.

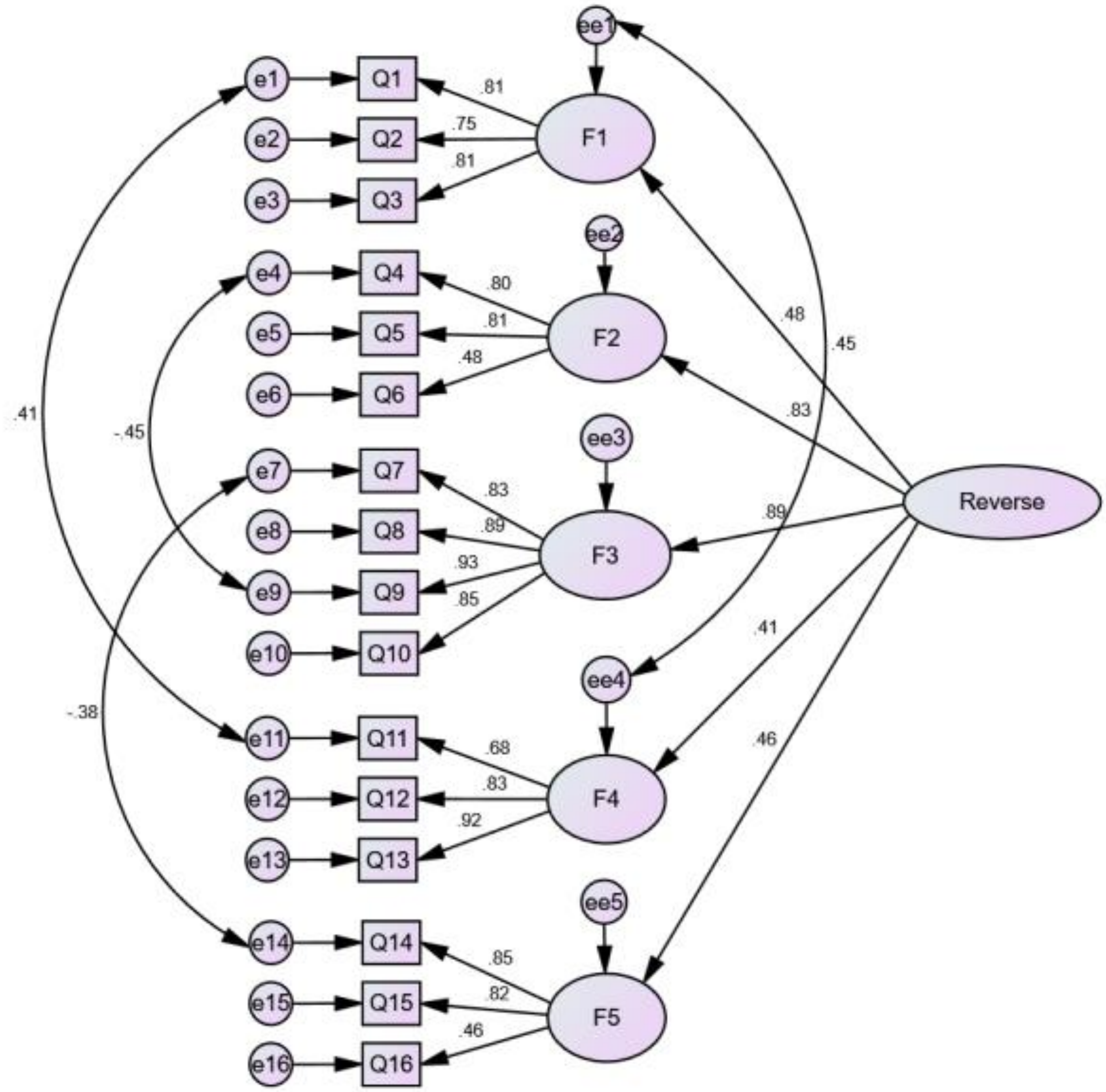

Figure 4.2: RL second-order measurement model

Table 4.13 indicates the standardised regression weights for the default model, which shows that all the relationships are significant and there is no item with factor loadings below the cut-off value of 0.4 which assures that the latent variables have been measured properly.

Table 4.13: Standardised Regression Weights - Default model

Factors		Construct	Estimate	P
F1	<---	Reverse	.483	***
F2	<---	Reverse	.826	***
F3	<---	Reverse	.892	***
F4	<---	Reverse	.411	***
F5	<---	Reverse	.456	.006

Items		Factors	Estimate	P
Q3	<---	F1	.814	***
Q2	<---	F1	.746	***
Q1	<---	F1	.805	***
Q6	<---	F2	.477	***
Q5	<---	F2	.806	***
Q4	<---	F2	.795	***
Q10	<---	F3	.847	***
Q9	<---	F3	.931	***
Q8	<---	F3	.895	***
Q7	<---	F3	.832	***
Q13	<---	F4	.925	***
Q12	<---	F4	.833	***
Q11	<---	F4	.682	***
Q16	<---	F5	.457	***
Q15	<---	F5	.822	***
Q14	<---	F5	.851	***

Three asterisks (***) indicates significance smaller than .001

As discussed before, it is necessary to examine the model fit indices to ensure how well the model fits with the data. The model fit indices were close to the recommended values. To improve the model fit, some covariances were considered between e1&e11, e4&e9, e7&e14 and ee1&ee4. Table 4.14 illustrates the model fit indices after modification.

Table 4.14: Model fit summary (RL construct)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	57	112.706	95	.104	1.186
Saturated model	152	.000	0		
Independence model	32	1168.780	120	.000	9.740

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.904	.878	.984	.979	.983
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.040	.000	.065	.718
Independence model	.271	.257	.285	.000

4.7.3 RL construct validity

To assess construct validity, Campbell and Fiske (1959) proposed two aspects including convergent validity and discriminant validity. Convergent validity is the extent to which multiple methods to measure the same construct are in agreement and lead to the same results (Campbell and Fiske, 1959). The convergent validity of RL construct have been examined by the factor loading of the items, average variance extracted (AVE) and composite reliability (CR) (Hair Jr et al., 2016). As discussed before, CFA is a powerful tool to ensure the construct validity by estimating the factor loadings of the observed items (Bagozzi et al., 1991). All the factor loadings for the items related to RL construct were higher than the cut-off value of 0.4. The AVE value should be greater than 0.5 (Bagozzi and Yi, 1988, Hair et al., 2006) and CR value should exceed 0.7 (Hair et al., 2013).

Discriminant validity is the extent to which a construct differs from one another (Fornell and Larcker, 1981). When two or more constructs are unique and distinctive**,** the latent variables of each construct should not correlate highly. Discriminant validity of a construct can be assessed by using the criterion of Fornell & Larcker (Fornell and Larcker, 1981). According to the Fornell & Larcker criterion, discriminant validity can be evaluated by comparing the square root of AVE and correlation coefficients between variables (Fornell and Larcker, 1981, Hair Jr et al., 2016). A latent variable should describe better the variance of its own items instead of the variance of other latent variables. Therefore, when the square root of AVE of each latent variable is larger than its correlation coefficients with other latent variables, it ensures the discriminant validity of the construct (Fornell and Larcker, 1981). Table 4.15 indicates the CR values, AVE values and the correlation coefficients between the variables.

Table 4.15: Composite reliability (CR), average variance extracted (AVE), the square root of AVE (in bold and diagonal) and correlation coefficients between latent variables (off-diagonal)

			Latent variables				
Latent variables	CR	AVE	Reuse	Repair	Remanufacturing	Recycling	Disposal
Reuse	0.831	0.622	**0.789**				
Repair	0.743	0.530	0.372	**0.728**			
Remanufacturing	0.930	0.769	0.400	0.602	**0.877**		
Recycling	0.858	0.671	0.498	0.236	0.353	**0.819**	
Disposal	0.765	0.536	0.139	0.309	0.376	0.229	**0.732**

As can be seen in Table 4.15, the CR for all latent variables are higher than the recommended value of 0.7 and AVE values for all latent variables are higher than 0.5. Also, the square root of AVE for each variable in the diagonal is greater than its correlation coefficients with other variables in the relevant rows and columns (off-diagonal). This output of analysis confirms that the discriminant validity of the RL construct.

4.7.4 RL construct reliability

Reliability is the stability of measurement or consistency of measurement under different situations which leads to the same results (Cronbach, 1951, Bollen, 1989, Nunnally, 1994). In other words, Reliability shows the degree to which measurements are repeatable (Drost, 2011). In this study, the internal consistency was evaluated. Internal consistency measures the reliability of a construct and consistency among items and explores how well a set of items can measure a construct (Cortina, 1993, Drost, 2011). The most popular method for investigating internal consistency is Cronbach's alpha. Cronbach's alpha increases when the intercorrelations between items increase which means that all the items measure the same construct properly. According to Meyers et al. (2016), the value of 0.6 for Cronbach's alpha is acceptable. Generally, the alpha value of 0.7 or more is more appropriate (Nunnally, 1994, Tabachnick et al., 2007, Hair Jr et al., 2015). Table 4.16 shows the Cronbach's alpha values for five variables of RL construct. Since all the values are above 0.7, internal consistency has been confirmed among data related to each variable and reliability of RL construct is acceptable.

Table 4.16: Cronbach's alpha value of RL disposition options

Latent variables	Cronbach's alpha
Reuse	0.838
Repair	0.731
Remanufacturing	0.929
Recycling	0.848
Disposal	0.726

4.7.5 Sustainability performance measurement model

The CFA was conducted for sustainability performance construct with 15 items based on three factors. In the subsequent sections, the first and second-order measurement models for sustainability performance construct are examined.

4.7.5.1 First-order measurement model

In this model, three dimensions of sustainability performance including economic, environmental, and social are latent variables that cannot be measured directly. They are measured by 15 observed items. In first-order measurement model of sustainability performance construct, three factors are assessed by 15 items. This phase assesses how well the latent variables are measured. Table 4.17 illustrates the statements for items (Q17-Q31). Figure 4.3 indicates the first-order measurement model for the sustainability performance construct.

Table 4.17: A summary of statements for items (Q17-Q31)

Question number	Statement
Q17	Improving profitability
Q18	Effective in recapturing value
Q19	Increased sales growth
Q20	Improving return on investment
Q21	Reduced costs
Q22	Reducing overall energy and resource consumption
Q23	Reducing the amount of waste generated
Q24	Reducing pollution to water, air and land
Q25	Exceeding environmental regulations
Q26	Improving customer satisfaction
Q27	Improving customer loyalty
Q28	Creating more job opportunities
Q29	Improving firm’s corporate image
Q30	Improving health and safety of employees
Q31	Improving employee job satisfaction

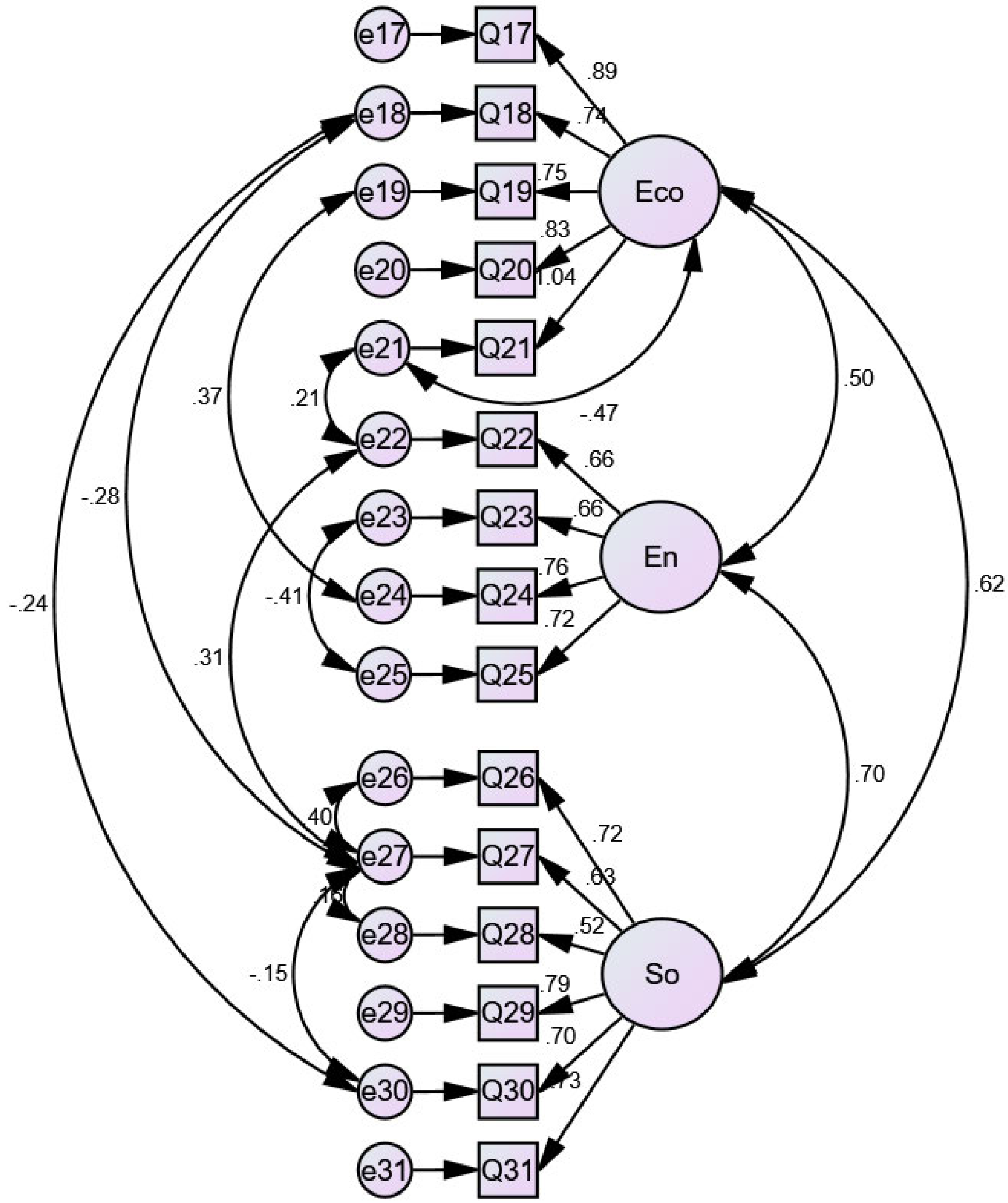

Figure 4.3: Sustainability performance first-order measurement model

The standardised regression weights for the default model are indicated in Table 4.18. The table confirms that all the relationships between the observed items and latent variables are significant. Also, all the factor loadings are greater than the cut-off value of 0.4, so there is no need to delete any items.

Table 4.18: Standardised Regression Weights - Default model

Items		Factors	Estimate	P
Q21	<---	Eco	1.035	***
Q20	<---	Eco	.832	***
Q19	<---	Eco	.746	***
Q18	<---	Eco	.743	***
Q17	<---	Eco	.891	***
Q25	<---	En	.723	***
Q24	<---	En	.759	***
Q23	<---	En	.664	***
Q22	<---	En	.661	***
Q31	<---	So	.729	***
Q30	<---	So	.698	***
Q29	<---	So	.793	***
Q28	<---	So	.525	***
Q27	<---	So	.634	***
Q26	<---	So	.718	***

Three asterisks (***) indicates significance smaller than .001

As already mentioned, before proceeding with the result, the model fit indices are evaluated. Some modifications were applied to enhance the model fit. Table 4.19 shows the model fit indices for first-order measurement model of sustainability performance construct. The CMIN/DF is 1.267 that is less than 3. The CFI, IFI and NFI are 0.98, 0.98 and 0.901 respectively which are higher than 0.9. The value of RMSEA is 0.047 that is less than 0.1. So, the table shows how well the model fits the data.

Table 4.19: Model fit summary (Sustainability performance construct)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	58	97.545	77	.057	1.267
Saturated model	135	.000	0		
Independence model	30	981.882	105	.000	9.351

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.901	.865	.977	.968	.977
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.047	.000	.074	.540
Independence model	.265	.250	.280	.000

4.7.5.2 Second-order measurement model

In this model, three dimensions of sustainability performance along with their construct were considered to examine how well the construct is measured by its underlying factors. The CFA was conducted for sustainability performance construct with 15 items under three factors. Figure 4.4 shows the second-order measurement model for the sustainability performance construct.

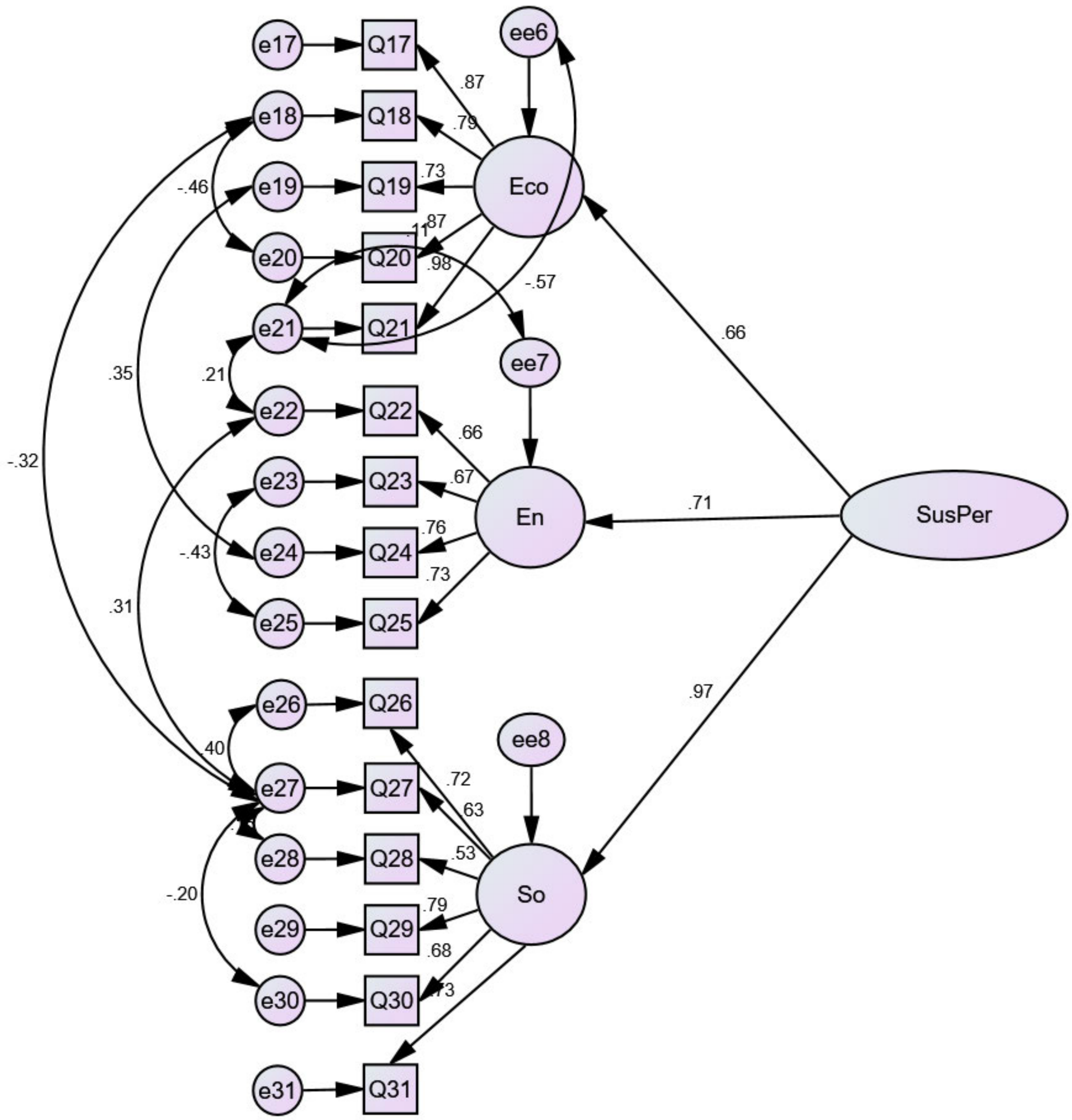

Figure 4.4: Sustainability performance second-order measurement model

The standardised regression weights for the default model are presented in Table 4.20. All the relationships are significant and the standardised regression weights range from .529 to .982, which are acceptable. Hence, there is no need to remove any items.

Table 4.20: Standardised Regression Weights - Default model

Factors		Construct	Estimate	P
En	<---	SusPer	.710	***
So	<---	SusPer	.974	***
Eco	<---	SusPer	.663	***

Items		Factors	Estimate	P
Q21	<---	Eco	.982	***
Q20	<---	Eco	.871	***
Q19	<---	Eco	.729	***
Q18	<---	Eco	.790	***
Q17	<---	Eco	.867	***
Q25	<---	En	.729	***
Q24	<---	En	.755	***
Q23	<---	En	.670	***
Q22	<---	En	.663	***
Q31	<---	So	.735	***
Q30	<---	So	.681	***
Q29	<---	So	.790	***
Q28	<---	So	.529	***
Q27	<---	So	.631	***
Q26	<---	So	.721	***

Three asterisks (***) indicates significance smaller than .001

The model fit indices are summarised in Table 4.21. It should be mentioned that some modifications were applied to improve the model fit.

Table 4.21: Model fit summary (Sustainability performance construct)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	59	92.356	76	.098	1.215
Saturated model	135	.000	0		
Independence model	30	981.882	105	.000	9.351

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.906	.870	.982	.974	.981
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.043	.000	.070	.640
Independence model	.265	.250	.280	.000

4.7.6 Sustainability performance construct validity

The construct validity of sustainability performance was evaluated by considering convergent and discriminant validity. Convergent validity of the construct was examined by factor loadings, the CR and the AVE. Also, the discriminant validity was assessed by Fornell & Larcker criterion through the AVE and the correlation coefficients. The CR values, AVE values and the correlation coefficients between the variables are summarised in Table 4.22 for convergent and discriminant validity. Since the CR and AVE values are greater than 0.7 and 0.5 respectively and the square root of AVE values are greater than correlation coefficients, it approves the construct validity of sustainability performance.

Table 4.22: Composite reliability (CR), average variance extracted (AVE), the square root of AVE (in bold and diagonal) and correlation coefficients between latent variables (off-diagonal)

			Latent variables		
Latent variables	CR	AVE	Economic	Environmental	Social
Economic	0.929	0.726	**0.852**		
Environmental	0.798	0.530	0.482	**0.728**	
Social	0.840	0.548	0.593	0.549	**0.740**

4.7.7 Sustainability performance construct reliability

To measure the reliability of sustainability performance construct, Cronbach's alpha was used to verify the internal consistency. Tables 4.23 illustrates that the alpha values for three latent variables are higher than 0.7 which confirms the construct reliability of sustainability performance.

Table 4.23: Cronbach's alpha value of sustainability performance

Latent variables	Cronbach's alpha
Economic	0.877
Environmental	0.780
Social	0.842

4.7.8 Institutional pressures and resource commitment measurement model

In this study, institutional pressures and resource commitment were considered as external and internal factors respectively which can have impacts on the adoption of RL. The CFA was conducted for both. Since these are latent variables measured by three items without any construct, only considering the first-order measurement model is sufficient. The aim of the measurement model is to examine whether the observed items measure the latent variables properly. The statements for items (Q32-Q34) are shown in Table 4.24.

Table 4.24: A summary of statements for items (Q32-Q34)

Question number	Statement
Q32	Government regulations
Q33	Customer pressures
Q34	Competitor pressures

Figure 4.5 shows the first-order measurement model for institutional pressures variable. In this model, institutional pressure is a latent variable which is measured by three observed items including government regulations, customer pressures and competitor pressures.

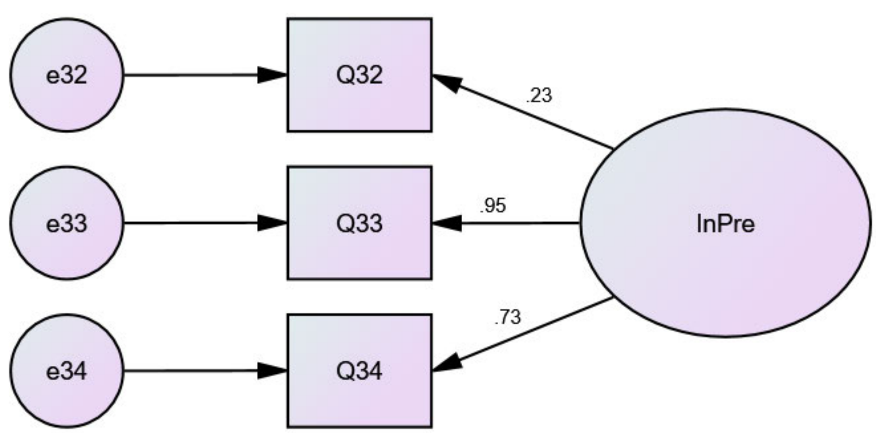

Figure 4.5: Institutional pressures first-order measurement model

The standardised regression weights for the default model are shown in Table 4.25. As can be seen, the factor loading for item 32 is lower than the cut-off value of 0.4, so this item is removed, and the model was rerun.

Table 4.25: Standardised Regression Weights - Default model

Items		Factors	Estimate	P
Q34	<---	InPre	.730	***
Q33	<---	InPre	.949	***
Q32	<---	InPre	.229	***

Three asterisks (***) indicates significance smaller than .001

Figure 4.6 indicates the first-order measurement model after removing Q32. Table 4.26 shows the standardised regression weights for the default model after removing item 32, the factor loadings for items 33 and 34 are higher than the cut-off value of 0.4. Also, the relationships between the latent variable and two observed items are significant.

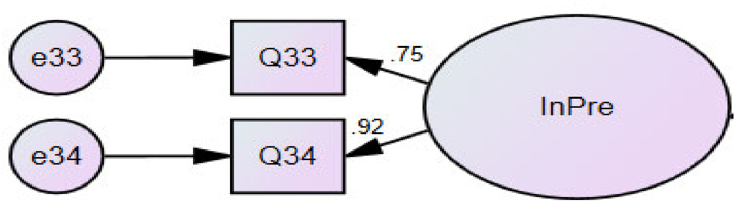

Figure 4.6: Institutional pressures first-order measurement model (After removing Q32)

Table 4.26: Standardised Regression Weights - Default model (After removing Q32)

Items		Factors	Estimate	P
Q34	<---	InPre	.920	***
Q33	<---	InPre	.753	***

Three asterisks (***) indicates significance smaller than .001

Before continuing with the result, the model fit indices are evaluated. The model fit indices are shown in Table 4.27 which confirms how well the model fits with the data; CMIN/DF= 2.393 (< 3), CFI, IFI and NFI are 0.98, 0.98 and 0.97 respectively (> 0.9) and RMSEA= 0.078 (< 0.1).

Table 4.27: Model fit summary (Institutional pressures-latent variable)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	16	9.574	4	.048	2.393
Saturated model	20	.000	0		
Independence model	10	325.306	10	.000	32.531

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.971	.926	.983	.956	.982
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.078	.009	.198	.114
Independence model	.515	.468	.564	.000

Resource commitment is a latent variable which cannot be measured directly. Three observed items were considered to measure the latent variable including technological, managerial and financial resources. The statements for items (Q35-Q37) are noted in Table 4.28. The first-order measurement model for resource commitment variable is illustrated in Figure 4.7.

Table 4.28: A summary of statements for items (Q35-Q37)

Question number	Statement
Q35	Technological resource
Q36	Managerial resource
Q37	Financial resource

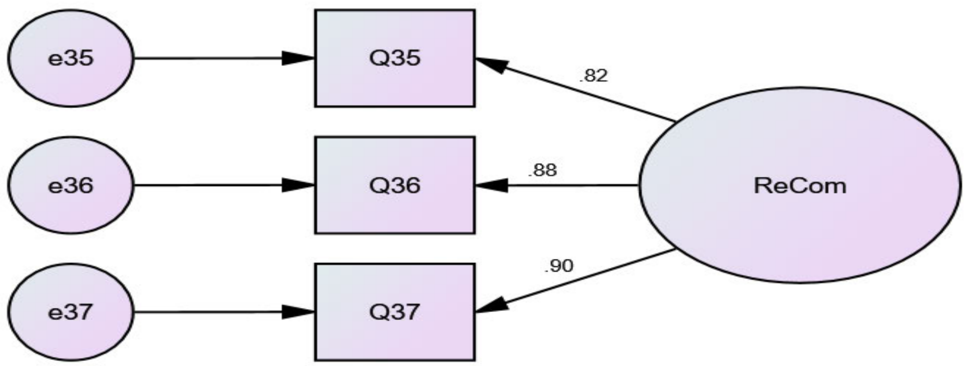

Figure 4.7: Resource commitment first-order measurement model

Table 4.29 confirms that there is no need to remove any item because the factor loadings for all items are higher than the cut-off value of 0.4 as well as the relationship between the latent variable and three observed items are significant.

Table 4.29: Standardised Regression Weights - Default model

Items		Factors	Estimate	P
Q37	<---	ReCom	.896	***
Q36	<---	ReCom	.884	***
Q35	<---	ReCom	.825	***

Three asterisks (***) indicates significance smaller than .001

As discussed before, it is essential to examine the indices of model fit. The model fit indices are summarised in Table 4.30 which verifies the model fits with the data.

Table 4.30: Model fit summary (Resource commitment-latent variable)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	16	9.574	4	.048	2.393
Saturated model	20	.000	0		
Independence model	10	325.306	10	.000	32.531

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.971	.926	.983	.956	.982
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.078	.009	.198	.114
Independence model	.515	.468	.564	.000

4.7.9 Validity and reliability of institutional pressures and resource commitment variables

The validity of these latent variables (institutional pressures and resource commitment) was examined by considering factor loadings and calculating the average variance extracted (AVE) and composite reliability (CR). To evaluate the reliability of these two latent variables, Cronbach's alpha is used to verify the internal consistency. Table 4.31 indicates the AVE, CR and Cronbach's alpha values, which confirms the validity and reliability of variables. The AVE and CR values are higher than 0.5 and 0.7 respectively and the alpha values are higher than the recommended value of 0.7.

Table 4.31: Average variance extracted (AVE), Composite reliability (CR) and Cronbach's alpha values

Latent variables	AVE	CR	Cronbach's alpha
Institutional pressures	0.707	0.827	0.818
Resource commitment	0.755	0.902	0.901

4.8 Relationships between the dimensions of sustainability performance

Correlation analysis is a statistical method to evaluate whether there are possible associations between variables. This type of analysis is used to measure the strength and direction of a relationship between two continuous variables. Correlation coefficient is utilised to measure correlation. The bivariate Pearson correlation is used to explore the possible relationships among the three dimensions of sustainability performance. The bivariate Pearson correlation examines whether there is a statistically significant linear relationship between two variables and the strength and direction of this relationship. A Pearson correlation's coefficient defined as a measurement of correlation is a number between -1 and +1, which indicates to what degree two variables are linearly related. The value of the correlation coefficient reveals the strength of the association and its sign (positive or negative) shows the direction. Table 4.32 illustrates the correlations between the three dimensions of sustainability performance.

Table 4.32: The correlations between the three dimensions of sustainability performance.

Correlations				
		Economic	Environmental	Social
Economic	Pearson Correlation	1	.482**	.593**
	Sig. (2-tailed)		.000	.000

	N	120	120	120
Environmental	Pearson Correlation	.482**	1	.549**
	Sig. (2-tailed)	.000		.000
	N	120	120	120
Social	Pearson Correlation	.593**	.549**	1
	Sig. (2-tailed)	.000	.000	
	N	120	120	120
**. Correlation is significant at the 0.01 level (2-tailed).				

Since the p-values are zero (less than 0.05), the values of the correlation coefficient are statistically significant, so the null hypothesis (there is no relation between the variables) is rejected and the variables correlate significantly. The correlation coefficient between economic and environmental performance is 0.482, this positive value indicates by improving the economic performance, the environmental performance will be enhanced and vice versa. While this value is less than 0.5, there is a moderate relationship between them. The correlation coefficient between economic and social performance is 0.593 (higher than 0.5), which shows these two variables are strongly related. The direction of the relationship between economic and social performance is positive. The correlation coefficient related to environmental and social performance is 0.549 (higher than 0.5), which reveals that there is a strong relationship between them, and environmental performance increases simultaneously with the social performance and vice versa. It should be noted that the strongest correlation is between economic and social performance with a correlation coefficient of 0.593.

4.9 ANOVA analysis

In this section, the demographic information on the participating businesses is utilised to examine the possible relationships with the adoption of RL disposition options as well as the participants' perceptions of the three dimensions of sustainability performance. Since Section A (demographic information) involves questions using a nominal or ordinal scale, to investigate their impact on the adoption of RL disposition options and the participants' perceptions of sustainability performance, analysis of variance (ANOVA) is used.

Analysis of variance is a statistical method used to test the means differences of a dependent variable measured at the interval or ratio scale by an independent variable measured at a nominal or ordinal scale with at least three groups (Fisher, 2006). In other words, this type of analysis compares means among at least three independent groups and examines whether there are any statistically significant differences between the means of groups (Fisher, 2006). The null hypothesis indicates there are no significant differences among means (Means are all equal). When the p-value is less than 0.05, the null hypothesis is rejected and shows the means differences are significant.

The aim of this section is to examine whether there are any differences in the adoption of RL options and the participants' perceptions of three dimensions of sustainability performance by the job position, company's age, size, sector, the location of production and the adoption of environmental certifications. Since the effect of job position on the adoption of RL options does not make sense, only its impact on the perception of sustainability performance is examined. Table 4.33 indicates the possible effects of job position on the perception of sustainability performance. The participants are categorised into three main groups, top-level managers including President, CEO, CIO, Director and Managing Director; middle-level managers including General Manager, Operational Manager, Regional Manager, Plant Manager; first-level managers including Site Manager, Office Manager, Sales Manager. The p-values are larger than 0.05, so there are no significant differences among means of perceptions of sustainability performance between people with different job positions.

Table 4.33: One-Way ANOVA (The perception of three dimensions of sustainability by job position)

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Economic	Between Groups	.728	2	.364	.721	.488
	Within Groups	59.009	117	.504		
	Total	59.737	119			
Environmental	Between Groups	.406	2		.501	.607
	Within Groups	47.393	117	.405		
	Total	47.799	119			
Social	Between Groups	.373	2	.187	.465	.629
	Within Groups	46.996	117	.402		
	Total	47.369	119			

Table 4.34 indicates the output of the analysis of variance to examine the potential relationships between the adoption of RL disposition options, the perception of sustainability performance and the age of companies.

Table 4.34: One-Way ANOVA (The adoption of RL disposition options and the perception of three dimensions of sustainability by the company's age)

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.

Reuse	Between Groups	2.746	3	.915	.637	.592
	Within Groups	166.586	116	1.436		
	Total	169.332	119			
Repair	Between Groups	7.999	3	2.666	2.017	.115
	Within Groups	153.333	116	1.322		
	Total	161.332	119			
Remanufacturing	Between Groups	7.758	3	2.586	1.347	.263
	Within Groups	222.734	116	1.920		
	Total	230.492	119			
Recycling	Between Groups	5.115	3	1.705	.959	.415
	Within Groups	206.329	116	1.779		
	Total	211.444	119			
Disposal	Between Groups	4.706	3	1.569	1.356	.260
	Within Groups	134.223	116	1.157		
	Total	138.930	119			
Economic	Between Groups	6.433	3	2.144	4.667	.004*
	Within Groups	53.304	116	.460		
	Total	59.737	119			
Environmental	Between Groups	1.580	3	.527	1.322	.271

	Within Groups	46.219	116	.398		
	Total	47.799	119			
Social	Between Groups	.719	3	.240	.596	.619
	Within Groups	46.650	116	.402		
	Total	47.369	119			

As can be seen in Table 4.34, the p-values for RL disposition options are larger than 0.05, so there are no significant differences in the means of the adoption of RL disposition options in the companies with different age. In other words, the age of companies does not have any significant effect on the adoption of RL disposition options. As the p-value related to the economic variable is less than 0.05 (Highlighted in red colour), companies with different establishment time view the impact of RL on economic sustainability performance differently.

When the output of analysis reveals significant differences among means of different groups, there is a need to use a Post Hoc Test to determine which groups exactly are different from each other. In order to use Post Hoc Tests, it is necessary to examine whether the variance among groups is equal or not. The Levene’s Test is used to examine the equality of variances. It is utilised to test the null hypothesis that the variances among groups are equal. Regarding the Levene’s Test, the p-values for variables were larger than 0.05, so the null hypothesis is accepted. For this study, Turkey’s Test is appropriate among Post Hoc Tests because the variances are equal for all samples and the sample sizes are not equal between groups. Post Hoc Test was performed to determine the mean differences belong to which groups. Table 4.35 illustrates that 5-10-year-old companies and those established for more than 20 years view the impact of RL on economic sustainability performance differently.

Table 4.35: Post Hoc Test (Multiple comparisons)

Dependent Variable		(I) Company Age	(J) Company Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Economic	Tukey HSD	1.00	2.00	.03761	.33456	.999	-.8345	.9097
			3.00	.03434	.34404	1.000	-.8624	.9311
			4.00	-.50556	.28582	.294	-1.2506	.2395
		2.00	1.00	-.03761	.33456	.999	-.9097	.8345
			3.00	-.00326	.27771	1.000	-.7272	.7206
			4.00	-.54316*	.20113	.039*	-1.0674	-.0189
		3.00	1.00	-.03434	.34404	1.000	-.9311	.8624
			2.00	.00326	.27771	1.000	-.7206	.7272
			4.00	-.53990	.21652	.066	-1.1043	.0245
		4.00	1.00	.50556	.28582	.294	-.2395	1.2506
			2.00	.54316*	.20113	.039*	.0189	1.0674
			3.00	.53990	.21652	.066	-.0245	1.1043

*. The mean difference is significant at the 0.05 level.

The result of the analysis of variance by considering company's size is summarised in Table 4.36.

Table 4.36: One-Way ANOVA (The adoption of RL disposition options and the perception of three dimensions of sustainability by the company's size)

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Reuse	Between Groups	15.430	2	7.715	5.865	.004*
	Within Groups	153.903	117	1.315		
	Total	169.332	119			
Repair	Between Groups	1.549	2	.775	.567	.569
	Within Groups	159.783	117	1.366		
	Total	161.332	119			
Remanufacturing	Between Groups	5.383	2	2.692	1.399	.251
	Within Groups	225.108	117	1.924		
	Total	230.492	119			
Recycling	Between Groups	40.921	2	20.461	14.039	.000*
	Within Groups	170.522	117	1.457		
	Total	211.444	119			
Disposal	Between Groups	2.020	2	1.010	.863	.425

	Within Groups	136.910	117	1.170		
	Total	138.930	119			
Economic	Between Groups	5.452	2	2.726	5.875	.004*
	Within Groups	54.285	117	.464		
	Total	59.737	119			
Environmental	Between Groups	.416	2	.208	.514	.600
	Within Groups	47.384	117	.405		
	Total	47.799	119			
Social	Between Groups	1.932	2	.966	2.487	.088
	Within Groups	45.438	117	.388		
	Total	47.369	119			

The p-values for reuse and recycling are less than 0.05 (Highlighted in red colour), so the size of companies can have a statistically significant effect on the adoption of reuse and recycling. Similar to the company's age, companies with different sizes view the impact of RL on economic sustainability performance differently. As can be seen in Table 4.36, the p-value for the economic variable is less than 0.05 (Highlighted in red colour).

As mentioned before, the size of companies was categorised into three groups (small (1), medium (2) and large (3)). Before running the Post Hoc Test, the Levene's Test was conducted which confirmed the group variances are equal. The result of Post Hoc Test is reported in Table 4.35. There are significant means differences in the adoption of reuse between large companies and those small and medium sized companies (The p-values are less than 0.05 - Highlighted in red colour). Regarding recycling, it is similar to reuse. Large companies differ from small and medium size companies in the adoption of recycling. Also, the results of Post Hoc Test show that large companies view the impact of RL on economic sustainability performance differently compared to small and medium size companies (Table 4.37).

Table 4.37: Post Hoc Test (Multiple comparisons)

Dependent Variable		(I) Company Size	(J) Company Size	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Reuse	Tukey HSD	1.00	2.00	-.31401	.37177	.676	-1.1966	.5685
			3.00	-.94444*	.36171	.027*	-1.8031	-.0858
		2.00	1.00	.31401	.37177	.676	-.5685	1.1966
			3.00	-.63043*	.22319	.015*	-1.1603	-.1006
		3.00	1.00	.94444*	.36171	.027*	.0858	1.8031
			2.00	.63043*	.22319	.015*	.1006	1.1603
Recycling	Tukey HSD	1.00	2.00	-.85024	.39133	.080	-1.7792	.0787
			3.00	-1.74014*	.38074	.000*	-2.6440	-.8363
		2.00	1.00	.85024	.39133	.080	-.0787	1.7792
			3.00	-.88990*	.23493	.001*	-1.4476	-.3322
		3.00	1.00	1.74014*	.38074	.000*	.8363	2.6440
			2.00	.88990*	.23493	.001*	.3322	1.4476
Economic	Tukey HSD	1.00	2.00	-.13986	.22080	.802	-.6640	.3843
			3.00	-.53011*	.21482	.040*	-1.0401	-.0201
		2.00	1.00	.13986	.22080	.802	-.3843	.6640

			3.00	-.39025*	.13255	.011*	-.7049	-.0756
		3.00	1.00	.53011*	.21482	.040*	.0201	1.0401
			2.00	.39025*	.13255	.011*	.0756	.7049
*. The mean difference is significant at the 0.05 level.								

The impact of manufacturing sectors on the adoption of RL disposition options and the perception of sustainability performance was examined (Table 4.38). The results show that between three manufacturing sectors, there are no significant differences among the means of RL disposition options adoption. Also, the results of One-Way ANOVA test reveal that there are no significant differences related to the perception of sustainability performance among the companies which operate in different manufacturing sectors (The p-values are larger than 0.05).

Table 4.38: One-Way ANOVA (The adoption of RL disposition options and the perception of three dimensions of sustainability by the manufacturing sector)

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Reuse	Between Groups	1.161	3	.387	.267	.849
	Within Groups	168.171	116	1.450		
	Total	169.332	119			
Repair	Between Groups	10.333	3	3.444	2.646	.052
	Within Groups	151.000	116	1.302		
	Total	161.332	119			
Remanufacturing	Between Groups	2.617	3	.872	.444	.722
	Within Groups	227.875	116	1.964		

	Total	230.492	119			
Recycling	Between Groups	9.995	3	3.332	1.919	.130
	Within Groups	201.448	116	1.737		
	Total	211.444	119			
Disposal	Between Groups	.451	3	.150	.126	.945
	Within Groups	138.479	116	1.194		
	Total	138.930	119			
Economic	Between Groups	3.890	3	1.297	2.693	.051
	Within Groups	55.847	116	.481		
	Total	59.737	119			
Environmental	Between Groups	.285	3	.095	.232	.874
	Within Groups	47.515	116	.410		
	Total	47.799	119			
Social	Between Groups	.975	3	.325	.813	.489
	Within Groups	46.394	116	.400		
	Total	47.369	119			

As mentioned before, the location of production has been classified into three groups (Australia, Overseas and both). The result of the ANOVA test (Table 4.39) reveals that the location of production does not have any significant effect on the adoption of RL disposition options and the perception of sustainability performance (All the p-values are larger than 0.05).

Table 4.39: One-Way ANOVA (The adoption of RL disposition options and the perception of three dimensions of sustainability by the location of production)

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Reuse	Between Groups	1.464	2	.732	.510	.602
	Within Groups	167.869	117	1.435		
	Total	169.332	119			
Repair	Between Groups	1.228	2	.614	.449	.640
	Within Groups	160.104	117	1.368		
	Total	161.332	119			
Remanufacturing	Between Groups	3.165	2	1.582	.814	.445
	Within Groups	227.327	117	1.943		
	Total	230.492	119			
Recycling	Between Groups	.960	2	.480	.267	.766
	Within Groups	210.483	117	1.799		
	Total	211.444	119			
Disposal	Between Groups	2.165	2	1.082	.926	.399
	Within Groups	136.765	117	1.169		
	Total	138.930	119			
Economic	Between Groups	.316	2	.158	.311	.733

	Within Groups	59.421	117	.508		
	Total	59.737	119			
Environmental	Between Groups	.040	2	.020	.049	.952
	Within Groups	47.759	117	.408		
	Total	47.799	119			
Social	Between Groups	.277	2	.138	.343	.710
	Within Groups	47.093	117	.403		
	Total	47.369	119			

To assess the impact of environmental certification on the adoption of RL disposition options and the perception of sustainability performance, the one-way ANOVA test was applied. Since some companies selected more than one option, it needs to group the companies into five categories (ISO14000 or ISO 14001 (1), EMS (2), ISO 14000,14001 and EMS (3), no adoption (4), other certifications (5)). It should be noted that the companies that adopt ISO 14000 or ISO 14001 were grouped into one category because of the low number of companies that adopt ISO 14000 (only two companies). The output of analysis indicates that the adoption of recycling was impacted by environmental certifications (The p-value is .010 < 0.05, Highlighted in red color, Table 4.40). The output of the One-Way ANOVA test confirms that the perception of economic and social performance can be affected by the adoption of environmental certifications (The p-values are .002 and .017 respectively which are less than 0.05 - Highlighted in red colour).

Table 4.40: One-Way ANOVA (The adoption of RL disposition options and the perception of three dimensions of sustainability by the adoption of environmental certifications)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Reuse	Between Groups	13.002	4	3.250	2.391	.055
	Within Groups	156.330	115	1.359		
	Total	169.332	119			
Repair	Between Groups	6.673	4	1.668	1.240	.298
	Within Groups	154.660	115	1.345		
	Total	161.332	119			
Remanufacturing	Between Groups	8.182	4	2.045	1.058	.381
	Within Groups	222.310	115	1.933		
	Total	230.492	119			
Recycling	Between Groups	22.900	4	5.725	3.492	.010*
	Within Groups	188.543	115	1.640		
	Total	211.444	119			
Disposal	Between Groups	2.608	4	.652	.550	.699
	Within Groups	136.321	115	1.185		
	Total	138.930	119			
Economic	Between Groups	8.027	4	2.007	4.463	.002*
	Within Groups	51.710	115	.450		
	Total	59.737	119			

Environmental	Between Groups	2.541	4	.635	1.614	.175
	Within Groups	45.258	115	.394		
	Total	47.799	119			
Social	Between Groups	4.687	4	1.172	3.157	.017*
	Within Groups	42.682	115	.371		
	Total	47.369	119			

To determine which groups differ in the sample, the Post Hoc Test was used. Also, the equality of variances was confirmed by the Levene's Test. The results reveal that among the companies which do not adopt any environmental certifications and those adopt three types of them (Group 3 and 4), there are significant mean differences in the adoption of recycling (Table 4.41). The result of Post Hoc Test shows that there are significant means differences in the perception of economic performance between companies that adopt at least one environmental certification and the companies which do not adopt any environmental certifications (The p-values are less than 0.05 - Highlighted in red color). Regarding social performance, there are significant differences in the means of perception of social performance among companies that adopt EMS and who do not adopt any environmental certifications (The p-value is .019< 0.05 -Highlighted in red color). Overall, this result represents the key role of environmental certifications in the perception of sustainability performance.

Table 4.41: Post Hoc Test (Multiple comparisons)

Multiple Comparisons						
Dependent Variable	(I) En Certifications	(J) En Certifications		Std. Error	Sig.	95% Confidence Interval

				Mean Difference (I-J)			Lower Bound	Upper Bound
Recycling	Tukey HSD	1.00	2.00	-.08908	.37853	.999	-1.1382	.9600
			3.00	-.17143	.33530	.986	-1.1007	.7579
			4.00	.83065	.31317	.068	-.0373	1.6986
			5.00	.81645	.44259	.353	-.4102	2.0431
		2.00	1.00	.08908	.37853	.999	-.9600	1.1382
			3.00	-.08235	.40252	1.000	-1.1979	1.0332
			4.00	.91973	.38429	.125	-.1453	1.9848
			5.00	.90553	.49547	.363	-.4677	2.2787
		3.00	1.00	.17143	.33530	.986	-.7579	1.1007
			2.00	.08235	.40252	1.000	-1.0332	1.1979
			4.00	1.00208*	.34178	.033*	.0548	1.9493
			5.00	.98788	.46328	.214	-.2961	2.2719
		4.00	1.00	-.83065	.31317	.068	-1.6986	.0373
			2.00	-.91973	.38429	.125	-1.9848	.1453
			3.00	-1.00208*	.34178	.033*	-1.9493	-.0548
			5.00	-.01420	.44753	1.000	-1.2545	1.2261
		5.00	1.00	-.81645	.44259	.353	-2.0431	.4102
			2.00	-.90553	.49547	.363	-2.2787	.4677
			3.00	-.98788	.46328	.214	-2.2719	.2961
			4.00	.01420	.44753	1.000	-1.2261	1.2545
Economic	Tukey HSD	1.00	2.00	-.34297	.19824	.420	-.8924	.2064
			3.00	-.08571	.17559	.988	-.5724	.4010
			4.00	.43074	.16401	.042*	-.0238	.8853
			5.00	.20035	.23179	.909	-.4421	.8427
		2.00	1.00	.34297	.19824	.420	-.2064	.8924
			3.00	.25725	.21080	.740	-.3270	.8415
			4.00	.77371*	.20125	.002*	.2159	1.3315
			5.00	.54332	.25948	.230	-.1758	1.2625
		3.00	1.00	.08571	.17559	.988	-.4010	.5724
			2.00	-.25725	.21080	.740	-.8415	.3270
			4.00	.51646*	.17899	.037*	.0204	1.0125
			5.00	.28606	.24262	.763	-.3864	.9585
		4.00	1.00	-.43074	.16401	.042*	-.8853	.0238
			2.00	-.77371*	.20125	.002*	-1.3315	-.2159
			3.00	-.51646*	.17899	.037*	-1.0125	-.0204
			5.00	-.23040	.23437	.862	-.8800	.4192
		5.00	1.00	-.20035	.23179	.909	-.8427	.4421

			2.00	-.54332	.25948	.230	-1.2625	.1758
			3.00	-.28606	.24262	.763	-.9585	.3864
			4.00	.23040	.23437	.862	-.4192	.8800
Social	Tukey HSD	1.00	2.00	-.28263	.18010	.520	-.7818	.2165
			3.00	-.05714	.15953	.996	-.4993	.3850
			4.00	.28661	.14901	.311	-.1264	.6996
			5.00	.29134	.21058	.639	-.2923	.8750
		2.00	1.00	.28263	.18010	.520	-.2165	.7818
			3.00	.22549	.19152	.764	-.3053	.7563
			4.00	.56924*	.18284	.019*	.0625	1.0760
			5.00	.57398	.23574	.114	-.0794	1.2273
		3.00	1.00	.05714	.15953	.996	-.3850	.4993
			2.00	-.22549	.19152	.764	-.7563	.3053
			4.00	.34375	.16262	.221	-.1069	.7944
			5.00	.34848	.22042	.513	-.2624	.9594
		4.00	1.00	-.28661	.14901	.311	-.6996	.1264
			2.00	-.56924*	.18284	.019*	-1.0760	-.0625
			3.00	-.34375	.16262	.221	-.7944	.1069
			5.00	.00473	.21293	1.000	-.5854	.5949
		5.00	1.00	-.29134	.21058	.639	-.8750	.2923
			2.00	-.57398	.23574	.114	-1.2273	.0794
			3.00	-.34848	.22042	.513	-.9594	.2624
			4.00	-.00473	.21293	1.000	-.5949	.5854

*. The mean difference is significant at the 0.05 level.

4.10 Flow of hypotheses testing

When the validity and reliability of the measurement models are confirmed, it is possible to create structural models and test the hypotheses. Structural equation modelling (SEM) is a theory-driven analytical approach to evaluate a set of hypotheses about the causal relationships between latent variables (Hancock and Mueller, 2013). A theoretical model consists of two parts including measurement model and structural model (Jöreskog and Sörbom, 1993). The measurement part of a model examines the relations between observed items and latent variables as well as the relations between the latent variables and their construct while the structural part of a model investigates the causal relationship between latent variables (Loehlin, 1987). The measurement models were assessed by CFA. SEM was used to analyse the structural model, by using AMOS software. SEM helps researchers test the theoretical hypotheses to discover how the constructs are theoretically connected and examine the significance and the direction of their relationships. In the following sections, the relationship between variables is examined.

4.10.1 The relationship between RL and sustainability performance

Figure 4.8 shows the structural model consisting of the relationship between RL and sustainability performance construct. This structural model is used to investigate the effect of RL on sustainability performance.

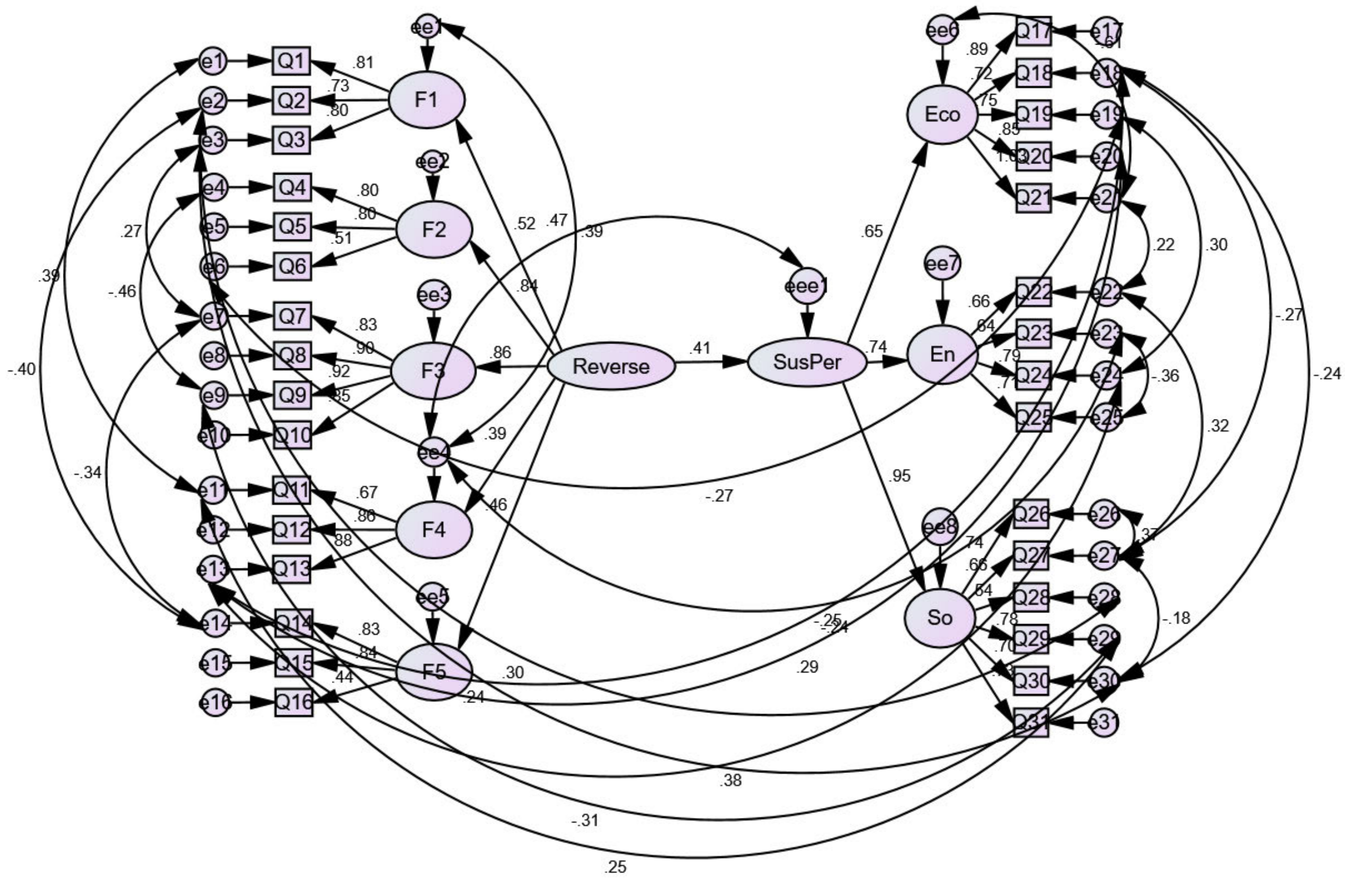

Figure 4.8: Structural model to test the relationship between RL and sustainability performance construct.

The same as measurement models, it is essential to examine the model fit indices for the structural model. Some covariances were considered between the errors to modify the model fit. The model fit indices are shown in Table 4.42. The CMIN/DF is 1.179, less than 3. The CFI, IFI and NFI are 0.96, 0.97 and 0.901 respectively which are higher than 0.9. The value of RMSEA is 0.039, less than 0.1. Accordingly, these values approve that the model fits the data properly.

Table 4.42: Model fit summary (the relationship between RL and sustainability performance)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	127	471.463	400	.008	1.179
Saturated model	527	.000	0		
Independence model	62	2524.082	465	.000	5.428

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.901	.783	.966	.960	.965
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.039	.021	.052	.911
Independence model	.193	.186	.200	.000

As can be seen in Table 4.43, the output of this analysis shows the relationship between RL and sustainability performance construct is significant. The p-value is less than 0.05 and the critical ratio (C.R.) is 2.880 which is outside the critical region (-1.96 and 1.96). The path coefficient obtained for the impact of RL on sustainability performance is 0.378, which confirms the positive effect of RL on sustainability performance.

Table 4.43: Regression weights- Default model

Construct		Construct	Estimate	C.R.	P
SusPer	<---	Reverse	.378	2.880	.004

4.10.2 The relationship between RL disposition options and sustainability performance dimensions

To examine the relationship between RL disposition options (reuse, repair, remanufacturing, recycling and disposal) and three dimensions of sustainability performance (economic, environmental and social), three is a need to develop another structural model. This structural model is used to test the following hypotheses:

H1. The adoption of reuse option affects the perceived sustainability performance of firms:

- H1a. Economic performance
- H1b. Environmental performance
- H1c. Social performance

H2. The adoption of repair option affects the perceived sustainability performance of firms:

- H2a. Economic performance
- H2b. Environmental performance
- H2c. Social performance

H3. The adoption of remanufacturing option affects the perceived sustainability performance of firms:

- H3a. Economic performance
- H3b. Environmental performance
- H3c. Social performance

H4. The adoption of recycling option affects the perceived sustainability performance of firms:

- H4a. Economic performance
- H4b. Environmental performance
- H4c. Social performance

H5. The adoption of disposal option affects the perceived sustainability performance of firms:

- H5a. Economic performance
- H5b. Environmental performance
- H5c. Social performance

The structural model comprises the relationships between eight latent variables, shown in Figure 4.9. AMOS software was used to analyse the structural model of the relationships.

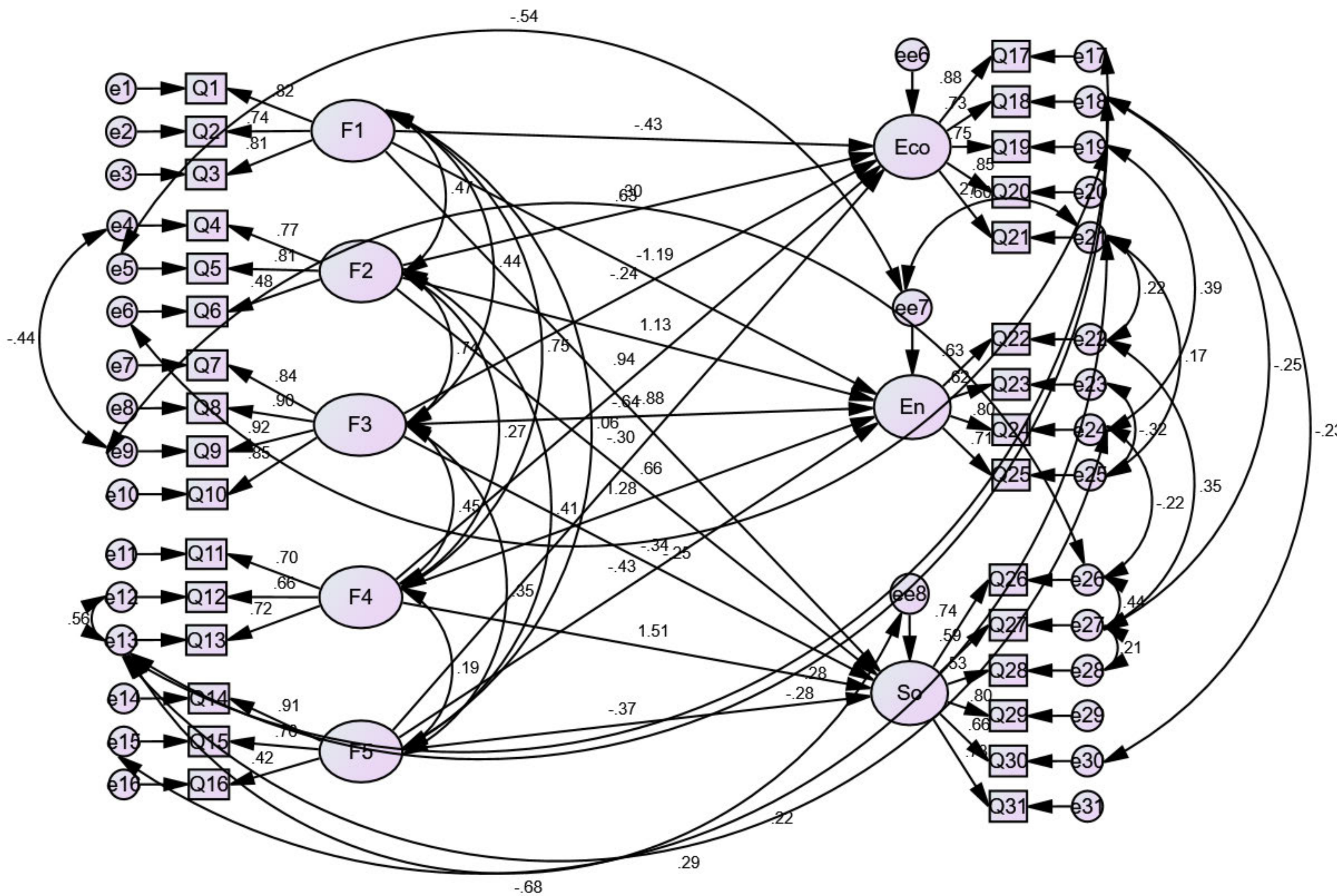

Figure 4.9: Structural model to test the relationship between disposition options of RL and sustainability performance dimensions

The model fit indices are summarised in Table 4.44. The CMIN/DF is 1.258, less than 3. The CFI, IFI and NFI are 0.95, 0.95 and 0.902 respectively which are higher than 0.9. The value of RMSEA is 0.047, which is less than 0.1. It is obvious how well the model fits the data. It should be mentioned that some modifications were applied to modify the model fit.

Table 4.44: Model fit summary (the relationship between disposition options of RL and sustainability performance dimensions)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	139	488.187	388	.000	1.258
Saturated model	527	.000	0		
Independence model	62	2524.082	465	.000	5.428

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.902	.768	.953	.942	.951
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.047	.032	.059	.661
Independence model	.193	.186	.200	.000

The significance and direction of relationships and the path coefficients are reported in Table 4.45. Reuse has a significant negative effect on three dimensions of sustainability performance. Since all the P-values are less than 0.05 and the values of C.R. are outside of the critical region, H1a, H1b and H1c are supported. According to the results, repair has a significant positive impact on the three dimensions of sustainability performance. H2a, H2b and H2c are supported because of the p-values (less than 0.05) and C.R. values (larger than 1.96). Regarding remanufacturing, only the relationship between remanufacturing and environmental performance is significant, so H3b is supported. Since the path coefficient is -.254, remanufacturing impacts environmental performance negatively. The p-values for the impact of remanufacturing on economic and social performance are .212 and .149 respectively (larger than 0.05) and the C.R. values are -1.249 and -1.445 respectively (inside the critical region), so H3a and H3c are not supported.

The impact of recycling on the three dimensions of sustainability performance is significant, so H4a, H4b and H4c are supported. Since the path coefficients are positive values, the positive effect of recycling on the triple-bottom-line sustainability is approved. The p-values and C.R. values related to the impact of disposal on the three dimensions of sustainability performance confirm the existence of significant relations (H5a, H5b and H5c are supported). The path coefficients show the negative effect of disposal on the triple-bottom-line sustainability.

Table 4.45: Regression weights- Default model

Factors		Factors	Estimate	C.R.	P
Eco	<---	F1	-.301	-2.050	.040
En	<---	F1	-.559	-3.667	***
So	<---	F1	-.498	-3.146	.002
Eco	<---	F2	.768	2.574	.010
En	<---	F2	.939	2.875	.004
So	<---	F2	.659	2.291	.022
Eco	<---	F3	-.141	-1.249	.212
En	<---	F3	-.254	-2.281	.023
So	<---	F3	-.161	-1.445	.149

Eco	<---	F4	.763	4.293	***
En	<---	F4	.702	3.949	***
So	<---	F4	.989	4.792	***
Eco	<---	F5	-.405	-2.063	.039
En	<---	F5	-.388	-2.116	.034
So	<---	F5	-.402	-2.053	.040

Three asterisks (***) indicates significance smaller than .001

4.10.3 The relationship between institutional pressures and the adoption of RL and sustainability performance

A structural model was developed to examine the effect of institutional pressures as external factors on the adoption of RL and sustainability performance. Figure 4.10 illustrates the structure model includes the relationship between institutional pressures and the adoption of RL and sustainability performance. This model was developed to test the following hypotheses:

H6. Institutional pressures affect the adoption of RL.

H7. Institutional pressures affect the perceived sustainability performance of a business.

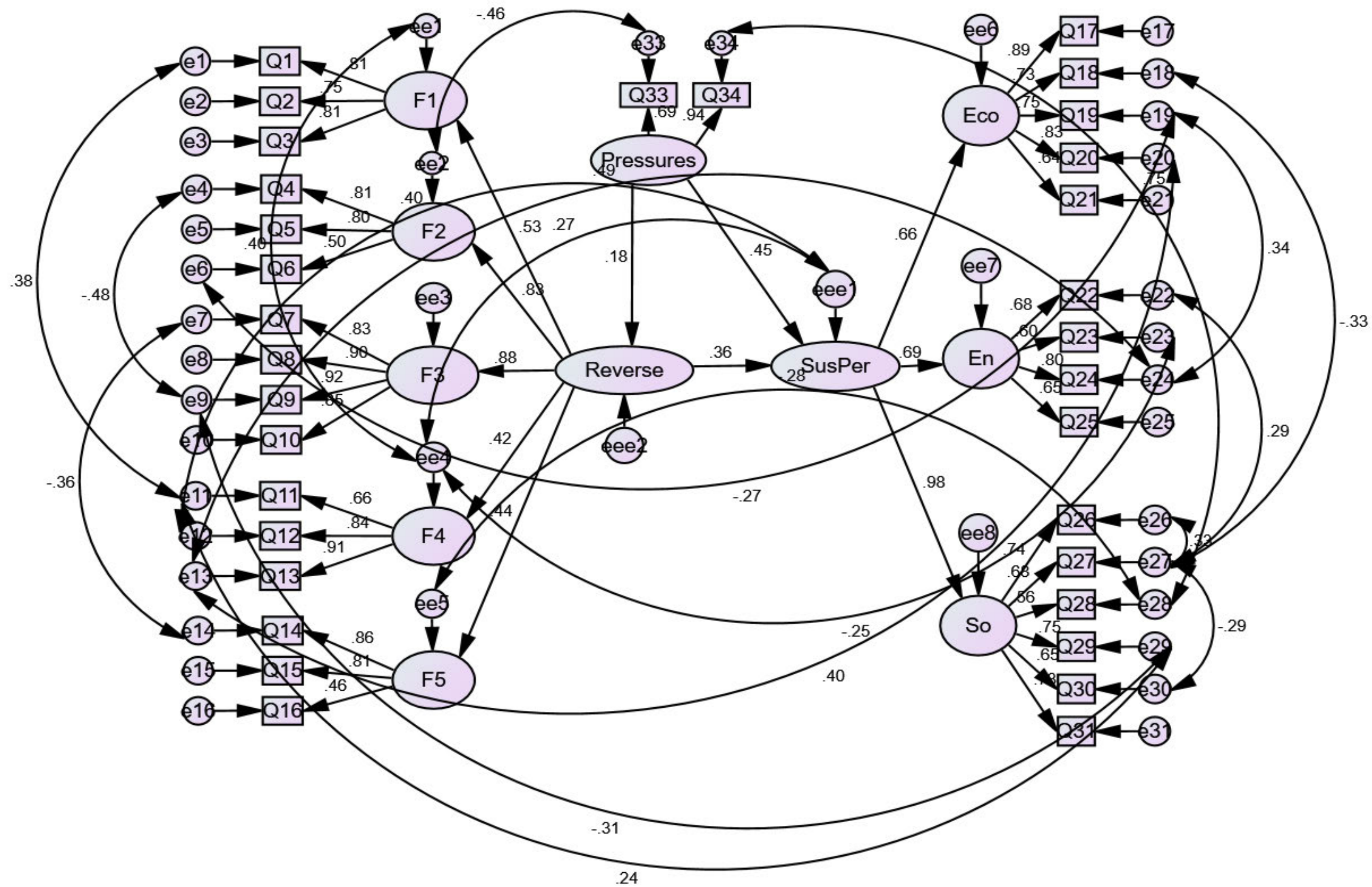

Figure 4.10: Structural model to test the relationship between institutional pressures and the adoption of RL, sustainability performance.

As discussed before, the model fit indices should be examined. Some covariances were considered to improve the model fit. Table 4.46 shows the model fit indices for the structural model which verifies the suitability of the model for the data. (CMIN/DF=1.324, less than 3. CFI, IFI and NFI = 0.93, 0.93 and 0.905 respectively, higher than 0.9 and RMSEA = 0.052, less than 0.1).

Table 4.46: Model fit summary (the relationships between institutional pressures and the adoption of RL, sustainability performance)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	97	614.513	464	.000	1.324
Saturated model	561	.000	0		
Independence model	33	2734.924	528	.000	5.180

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.905	.744	.934	.922	.932
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.052	.040	.063	.366
Independence model	.187	.180	.194	.000

The output of this analysis is presented in Table 4.47. The p-value and C.R. for the impact of institutional pressures on the adoption of RL reveal that the relationship between them is not significant, so H6 is not supported. Conversely, the relation between institutional pressures and sustainability performance is significant and positive. As the p-value is 0.003, less than 0.05 and the C.R. is 3.741, outside of the critical region (-1.96 and 1.96), H7 is supported.

Table 4.47: Regression weights- Default model

Construct		Variable	Estimate	C.R.	P
Reverse	<---	Pressures	.176	1.589	.112
SusPer	<---	Pressures	.454	3.741	***

Three asterisks (***) indicates significance smaller than .001

4.10.4 The relationship between resource commitment and the adoption of RL and sustainability performance

In the following section, the impact of resource commitment as internal factors on the adoption of RL and sustainability performance was assessed through developing a structural model. Figure 4.11 illustrates the structural model involves the relationship between resource commitment and the adoption of RL and sustainability performance. This model was developed to test the following hypotheses:

H8. Resource commitment affects the adoption of RL.

H9. Resource commitment affects the perceived sustainability performance of a business.

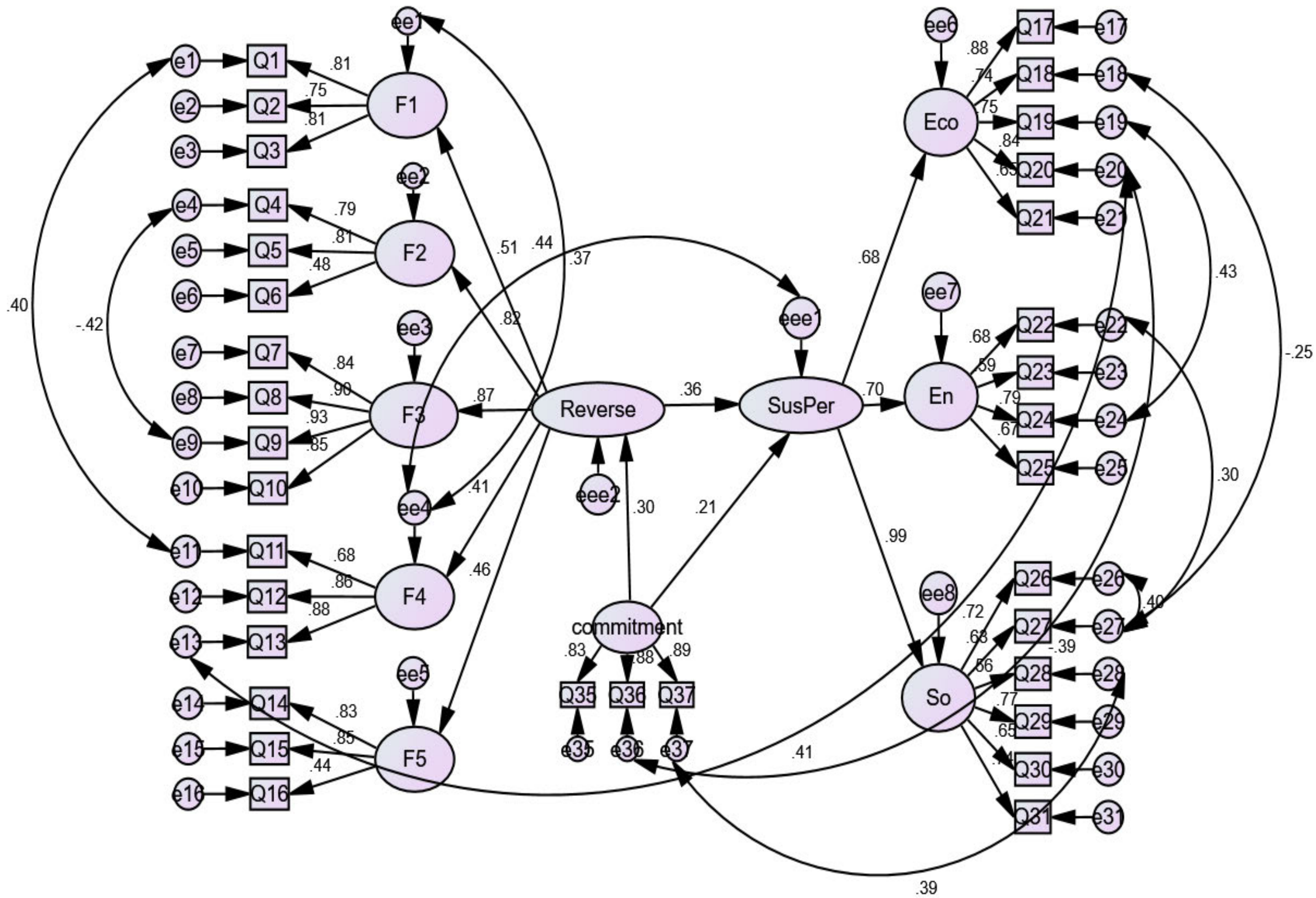

Figure 4.11: Structural model to test the relationship between resource commitment and the adoption of RL, sustainability performance.

The model fit indices are summarised in Table 4.48 which confirms the model fits the data properly. Some covariances were considered to modify the model fit.

Table 4.48: Model fit summary (the relationship between resource commitment and the adoption of RL, sustainability performance)

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	90	706.605	505	.000	1.399
Saturated model	595	.000	0		
Independence model	34	2890.801	561	.000	5.153

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.911	.728	.915	.904	.913
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.058	.047	.068	.102
Independence model	.187	.180	.194	.000

The output of the analysis is reported in Table 4.49. Resource commitment has a significant effect on the adoption of RL. Since the p-value is 0.011, less than 0.05 and the C.R. is 2.533 which is outside of the critical region, so H8 is supported. The path coefficient for the impact of resource commitment on the adoption of RL is 0.304 which confirms the positive relationship between them. Also, the relationship between resource commitment and sustainability performance is significant. The p-value is less than 0.05 and the C.R. is outside the critical region, so H9 is supported. The path coefficient obtained for the impact of resource commitment on the sustainability performance is 0.210 showing a positive relationship exists.

Table 4.49: Regression weights- Default model

Construct		Variable	Estimate	C.R.	P
Reverse	<---	Commitment	.304	2.533	.011
SusPer	<---	Commitment	.210	2.159	.031

To have a better understanding of the research results, a summary of hypotheses testing results are provided in Table 4.50.

Table 4.50: Summary of hypotheses testing results

Hypothesis	Relationship			Estimate	C.R.	P	Result
H1a	Reuse	→	Economic performance	-.301	-2.050	.040	(✓)
H1b	Reuse	→	Environmental performance	-.559	-3.667	***	(✓)
H1c	Reuse	→	Social performance	-.498	-3.146	.002	(✓)
H2a	Repair	→	Economic performance	.768	2.574	.010	✓
H2b	Repair	→	Environmental performance	.939	2.875	.004	✓
H2c	Repair	→	Social performance	.659	2.291	.022	✓
H3a	Remanufacturing	→	Economic performance	-.141	-1.249	.212	×
H3b	Remanufacturing	→	Environmental performance	-.254	-2.281	.023	(✓)
H3c	Remanufacturing	→	Social performance	-.161	-1.445	.149	×
H4a	Recycling	→	Economic performance	.763	4.293	***	✓
H4b	Recycling	→	Environmental performance	.702	3.949	***	✓
H4c	Recycling	→	Social performance	.989	4.792	***	✓
H5a	Disposal	→	Economic performance	-.405	-2.063	.039	(✓)
H5b	Disposal	→	Environmental performance	-.388	-2.116	.034	(✓)
H5c	Disposal	→	Social performance	-.402	-2.053	.040	(✓)
H6	Institutional pressures	→	Adoption of RL	.176	1.589	.112	×
H7	Institutional pressures	→	Sustainability performance	.454	3.741	***	✓
H8	Resource commitment	→	Adoption of RL	.304	2.533	.011	✓
H9	Resource commitment	→	Sustainability performance	.210	2.159	.031	✓

Note: ✓ means that the relationship is significant, and the hypothesis is supported at positive direction; (✓) means that the relationship is significant, and the hypothesis is supported at negative direction; × means that the relationship is not significant, and the hypothesis is not supported.

4.11 Summary

The chapter started with the selection of statistical techniques. The data analysis process consisted of descriptive analysis, confirmatory factor analysis (CFA) and structural equation modelling (SEM) to find out the relationship between RL disposition options and the three dimensions of sustainability performance. Prior to data analysis, data coding and data screening were conducted in SPSS to ensure the data is suitable for further statistical analysis. The demographic information was analysed to provide background data about the participants. The analysis of demographic information confirmed that the respondents were a representative sample of the target population. In addition, the demographic variables were considered as independent variables to investigate how these variables may affect the adoption of RL disposition options and the sustainability performance of firms by using analysis of variance (ANOVA). Among demographic variables, only the size of companies and the environmental certifications adopted by companies affect the adoption of RL disposition options. Regarding the perception of the sustainability performance, the age and size of companies as well as the adoption of environmental certifications impact on firm's sustainability performance.

Before performing CFA, the adequacy of the data sample was evaluated by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. CFA was conducted to ensure the unidimensionality and the construct validity of measures. CFA was carried out for RL and sustainability performance constructs separately. The validity and reliability of the constructs were assessed. The measurement models (first-order and second-order) for both constructs were evaluated to confirm how accurate the measured items reflect their factors as well as how well the latent factors measure their constructs. Also, CFA was carried out for institutional pressures and resource commitment as external and internal factors that affect the adoption of RL. The bivariate Pearson correlation was used to explore the possible relationships among the three dimensions of sustainability performance. The values of the correlation coefficient showed that the relationship between the three dimensions of sustainability performance was significant and positive. SEM was applied to discover the effect of RL disposition options on the triple-bottom-line sustainability performance and test the hypotheses. Finally, the effect of institutional pressures and resource commitment on the adoption of RL and sustainability performance were investigated by using SEM. Of the nineteen hypotheses, only three hypotheses were rejected, the relationship between remanufacturing and economic as well as social performance and the relationship between institutional pressures and the adoption of RL. In the next chapter, the results of quantitative analysis will be discussed in detail.

Chapter 5 Discussions of findings

5.1 Introduction

The previous chapter described the process of data analysis, presented the results and interpreted the outcomes. This chapter discusses the results and explains how the research questions have been answered. After restating the primary and subsidiary research questions, Section 5.2 discusses the implementation level of RL disposition options and explores how the three-dimension sustainability performance was affected by the implementation of RL disposition options in the Australian manufacturing industry. Section 5.3 evaluates the impact of internal and external factors on the adoption of RL and sustainability performance in the Australian manufacturing industry. Then, Section 5.4 examines the impact of the five disposition options of RL on perceived sustainability performance of firms.

5.2 Discussion of the findings with respect to the first and second subsidiary research questions

As noted before, the main aim of this study is to investigate the effect of RL disposition options on perceived sustainability performance, from the perspective of the triple-bottom-line, in the Australian manufacturing industry. The primary research question is as follows:

PRQ: How do RL disposition options affect the perceived sustainability performance of firms in the Australian manufacturing industry?

The following subsidiary research questions were developed to investigate the level of RL implementation and examine how the three dimensions of sustainability performance were perceived in the Australian manufacturing industry.

SRQ1: How are RL disposition options adopted in the Australian manufacturing industry?

To answer the first subsidiary research question, confirmatory factor analysis (CFA), descriptive analysis, and analysis of variance (ANOVA) were used.

SRQ2: How is sustainability performance perceived in the context of RL in the Australian manufacturing industry?

The second subsidiary research question was addressed via the result of CFA and analysis of variance.

5.2.1 SRQ1: The implementation level of RL disposition options in the Australian manufacturing industry

This section examines the extent to which the five RL disposition options—reuse, repair, remanufacturing, recycling and disposal—have been implemented in three selected sectors of the Australian manufacturing industry: namely, the “Machinery and Equipment Manufacturing”, the “Transport Equipment Manufacturing”, and the “Furniture Manufacturing” sectors. In the literature, these five RL disposition options are commonly discussed. However, they may not always contribute to RL in equal measure, meaning that in specific industries, some options will be used more than others. Based on the result of CFA in the Australia context, remanufacturing and repair contributed much more to RL than the other options (the regression weights are 0.89 and 0.83 respectively). Reuse, recycling, and disposal make a less significant contribution to RL, with regression weights between 0.4 and 0.5. The reason for this finding may be that, in Australia, it is very difficult to draw a boundary around the recycling sector. Recycling is frequently considered together with waste disposal as a waste management approach (Balance, 2017). Also, the reuse option requires minimal work, so it is perceived as contributing less to

RL. Due to the intensive operations that they involve, and hence the complexity they create in the selected manufacturing sectors, remanufacturing and repair are making strongest contribution to RL.

As mentioned in the previous chapter, the mean scores of the five RL disposition options are used to assess level of RL implementation. In Australia, most of the companies operating in manufacturing sectors outsource recycling and disposal activities to third-party service providers, because of the high cost of the required technologies; the scale of their individual operations not financially justifying internal recycling and disposal programs. By the same token, the overall level of RL implementation (Mean= 2.87) in the Australian manufacturing industry shows that RL is still an emerging business practice in Australia. Firms often tend to invest in and allocate resources for forward supply chains, mainly due to a lack of awareness of the potential benefits of RL (Phochanikorn et al., 2019, Mathiyazhagan et al., 2021). RL should not be assumed to be a cost centre for manufacturers, given that it can contribute to improving the sustainability performance of businesses (Geng et al., 2017). Another reason for the still-moderate level of RL implementation in Australia may be the absence of strict government regulations and a lack of public awareness about RL's contributions to environmental protection. Just as RL is considered as a core competency in developed countries (Laosirihongthong et al., 2013), the Australian Government should take a more proactive approach to encouraging manufacturers to improve their levels of RL implementation.

Most of the studies that have investigated levels of RL implementation were conducted in developing countries, especially in Malaysia. The result of Eltayeb et al. (2010)'s study revealed that the extent of RL adoption in the Malaysian manufacturing industry was lower than other green practices, and that RL was more commonly used for packaging rather than for the manufacture of original products. Similar results were reported in Azevedo et al. (2011)'s study, where the level of RL implementation was found to be low compared to other green practices in the Portuguese automotive industry. The level of RL implementation in Malaysian manufacturing is similar to the level of RL adoption in the Thai manufacturing industry (Laosirihongthong et al., 2013). Similarly, the level of RL implementation by manufacturing firms in the United Arab Emirates was medium (Younis et al., 2016).

Regarding levels of adoption of RL disposition options, the most commonly used option in the Australian manufacturing industry is disposal (Mean= 3.30), followed by repair (Mean= 3.16), recycling (Mean= 2.78), and remanufacturing (Mean= 2.60). Reuse is the least adopted disposition option (Mean= 2.50). This finding is in line with the level of reuse implementation in the Malaysian automotive industry (Amelia et al., 2009). It seems that Australian manufacturing companies are not eager to integrate reused components into the production of new products because of concerns about customer acceptance: customers often believe that the quality of reused products is low compared to new ones (Amelia et al., 2009). Furthermore, manufacturers may not have developed reuse capabilities for their products, such that the reuse option may apply only for after-market sales. Overall, the findings regarding levels of RL implementation are similar to those in the study that Khor and Udin (2013) conducted in Malaysian manufacturing industry, where disposal and repair are the most adopted practices while recycling and remanufacturing are the least used.

The current practices of RL in the Australian manufacturing industry were identified. To answer the first subsidiary research question, factors affecting companies' decisions regarding RL disposition options had to be investigated. This study followed previous research in considering several control variables, including companies' year of establishment, size, and sector, as well as the location of their production facilities and whether they had obtained environmental certifications (Ye et al., 2013, Huang and Yang, 2014, Huang et al., 2015, Khor et al., 2016). The results of the one-way ANOVA test showed that the size of companies and the acquisition of environmental certifications significantly influence companies' adoption of RL disposition options. In other words, larger organisations and firms with environmental certifications are more likely to implement RL. However, the other control variables, i.e., companies' age and sector, and the location of their production facilities, do not affect levels of RL implementation.

Firm size can be treated as a substantial control variable when it comes to examining a wide range of organisational issues, because size has a significant effect on organisations' behaviours in general (Hannan & Freeman, 1984). The size of a company is an indicator of the availability of resources for that company—resources that can be used to develop unique capabilities (Khor et al., 2016). Thus, large companies may have greater financial and managerial resources compared to small companies when it comes to the implementation of green practices such as RL (Wagner et al., 2012). The size of companies reflects the scale of their operations, and indicates whether they have access to networks capable of collecting and dealing with return products, including third-party providers and other companies in the same industry sectors. Small companies are less likely to have access to such networks. Also, since large companies generally face more public scrutiny than small companies, they are under greater pressure to adopt environmental practices to improve their sustainability performance (Zhu and Sarkis, 2007). Accordingly, in the Australian manufacturing context, large companies are more likely to adopt reuse and recycling options compared to small and medium companies.

Furthermore, companies that obtain environmental certifications are more likely to adopt recycling options compared to those that do not adopt any environmental certifications, because environmental certifications set out clear standards regarding how materials are to be recycled. Companies that acquired environmental certifications have the foundation for green initiatives, and have developed a high level of awareness regarding environment-related issues (Eng Ann et al., 2006). For example, Zhu et al. (2008a) found a positive relationship between adopting ISO 14001 certification and GSCM practices, since the process of adopting ISO 14001 certification led to high levels of experience and knowledge that helped motivate the adoption of GSCM practices.

5.2.2 SRQ 2: Perceptions of triple-bottom-line sustainability performance of adopting RL in the Australian manufacturing industry

This section investigates the participants' perceptions regarding sustainability performance, including economic, environmental, and social performance, in the context of RL. This study also examined the possible relationships between the three dimensions of sustainability performance. The result of a first-order measurement model of the sustainability performance construct indicated that the sustainability performance dimensions of RL are correlated to each other. This means that RL disposition options that have an impact on one dimension of sustainability performance are likely to have side impacts on other dimensions. The social dimension has the strongest relationship with the other two dimensions, because the indicators of the social dimension of sustainability cover a broad range of measures, including economic and environmental measures. When companies evaluate the social performance of their business, they also consider its environmental performance and how it contributes to the wider economy, including employment rates. The strongest relationship, however, is between social and environmental performance. The environment is a central part of people's lives, and any improvement in environmental performance will be reflected in the larger society.

To answer SRQ2, the results of the CFA of the sustainability performance construct are used. Based on the regression weights of the three dimensions of sustainability performance, adopting RL affects the social performance the most; it has a regression weight of 0.97, followed by environmental performance, with a regression weight of 0.71. It seems that the first thing that comes to people's mind with respect to sustainability, in the Australian context, is its positive impact on society and the environment. Economic performance of adopting RL, with a regression weight of 0.66, is perceived as contributing less to sustainability performance. A reason for this finding could be that businesses are often unwilling to consider sustainability as part of their business strategy, because they believe that its cost outweighs profits, even though academic research has actually revealed the opposite. In any case, adopting RL contributes more to social and environmental performance, less on economic.

Several indicators were used to measure sustainability performance of adopting RL. Based on the result of the CFA, the regression weights of the economic performance indicators are similar. Among economic indicators, "reduced costs", which includes six elements, is the most important measure when it comes to gauging the impact of RL implementation on the economic performance of a business. The weakest indicator is the one related to increased sales growth. As with the economic indicators, the regression weights of the environmental performance indicators are very similar. Of the environmental indicators, "reduction in pollution" and "exceeding environmental regulations" are the most significant indicators with respect to environmental outcomes. From a social perspective, RL implementation makes the most significant contribution to improving firms' corporate image. Creating more job opportunities had the lowest regression weight relative to the other social indicators.

To answer the second subsidiary research question, the participants' demographic information was used to examine whether there are any differences in the participants' perceptions of the three dimensions of sustainability performance of adopting RL. The results of the one-way ANOVA test showed that the age and size of companies as well as their adoption of environmental certifications have a significant impact on the firms' triple-bottom-line sustainability performance. In the Australian context, of the three dimensions of sustainability, economic performance of adopting RL was perceived differently by the companies that had been in their business for a long time and among the larger businesses. Larger companies encounter more environmental pressures, meaning that firm size can have a significant impact on the performance results of green supply chain practices (Zhu and Sarkis, 2007). In addition, the findings showed that economic and social performance are considered differently by the companies that gained at least one environmental certification compared to those that did not adopt any certifications. However, other variables, including job position, the industry sector, and the location of production, do not significantly affect perceptions of sustainability performance.

5.3 Discussion of the findings with respect to the third and fourth subsidiary research questions

Based on the reviewed literature, this study considered institutional pressures as an external factor and resource commitment as an internal factor that may impact the implementation of RL as well as perceived sustainability performance of firms. Two subsidiary research questions were developed as follows:

SRQ3: How do institutional pressures affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

SRQ4: How does resource commitment affect the adoption of RL and the perceived sustainability performance of firms in the Australian manufacturing industry?

5.3.1 The relationship between institutional pressures and the adoption of RL and sustainability performance

The result of CFA revealed that the factor loading for government regulations was lower the cut-off value of 0.4. As a result, the item was removed. In the context of Australian manufacturing industry, government regulations are not a good measurement of institutional pressures. It seems that in Australia, as compared to other countries, there are less strict government regulations to force companies to adopt RL.

As suggested by Balance (2017), the Australian Government's lack of encouragement and incentives for recycling, the standards it imposes on recycled products, and the uncertainty of its overall regulatory environment are the main barriers to implementing recycling. For example, in 2009, the National Waste Policy was launched by the Australian Government. The aim of the policy was to strengthen firms' commitment to reducing the consumption of resources, minimising the impact of waste disposal on the environment, and enhancing the management of hazardous wastes (Lee, 2012). However, although the government established some environmental protection regulations in support of the policy, enforcement of these regulations remains weak. A study conducted by Lee (2012) revealed that government regulations have had no significant impact on remanufacturing activities in Australia thus far.

Regulations in Australia are not as stringent as they are in other countries like China and EU nations, since both the business environment and natural environment are quite different across these contexts. As discussed in previous chapters, most Australian manufacturing companies outsource their manufacturing activities to overseas firms (more than 55 per cent of the participating companies). Some studies show that strict regulatory constraints can create barriers for exporting second-hand electrical and electronic equipment to countries with strict regulations (Shinkuma and Huong, 2009, Tengku-Hamzah and Adeline, 2011). For example, China plays a leading role in the manufacturing industry, so international trade and export are key motivations for Chinese manufacturers to adopt environmental practices like RL. In many cases, Chinese manufacturers are forced to comply with environmental laws before their products are permitted entry into foreign markets, such as the European Waste Electrical and Electronic Equipment (WEEE) Directive that obliges manufacturers to take back products (Lai et al., 2013). At the same time, since manufacturing is very resource-extensive and manufacturing activities can have a direct impact on the environment, the Chinese government has developed strict environmental regulations of its own, such as the Chinese version of the Restriction of Hazardous Substances (RoHS), and Chinese manufacturers have to comply with these internal environmental regulations (Ye et al., 2013).

The output of the SEM revealed that there is no significant relationship between institutional pressures and the adoption of RL, although institutional pressures can affect the sustainability performance of businesses positively. Previous studies have examined the relationship between institutional pressures and the adoption of environmental practices, including RL practices as well as sustainability performance. For instance, the study conducted by Ye et al. (2013) in the Chinese manufacturing industry revealed that institutional pressures had a significant positive effect on top managers' attitudes towards the implementation of RL and also on sustainability performance. Also, the findings of Gobbi (2011), Krikke et al. (1998) show that environmental regulations force organisations to recover products. In a similar way, Zhu and Sarkis (2007) investigated the moderating effect of institutional pressures on the adoption of green supply chain practices and organisational performance in the Chinese manufacturing industry. Their results revealed that stronger institutional pressures cause Chinese manufacturers to adopt green supply chain practices. Regarding organisational performance, they confirmed the significant influence of institutional pressures on environmental and economic performance. The result of the present study regarding the effect of institutional pressures on the adoption of RL is in conflict with previous studies (Gobbi, 2011, Ye et al., 2013, Zhu and Sarkis, 2007). Because most of the surveyed companies outsource manufacturing activities overseas, and do not have actual, physical manufacturing activities in Australia, institutional pressures may not play a key role in the adoption of RL domestically.

Regarding the impact of institutional pressures on perceived sustainability performance of firms, this study's results are in line with research conducted by Huang and Yang (2014) and Khor et al. (2016), which found a significant positive relationship in this connection. Khor et al. (2016) demonstrated that institutional pressures are significant predictors of performance. They showed that in the presence of institutional pressures, the adoption of RL disposition options can lead to improvements in performance outcomes. For example, strong institutional pressures improve organisations' environmental performance as a result of carrying repair, reconditioning, and remanufacturing activities, whereas in the absence of these pressures, organisations do not experience any environmental improvement. In contrast, recycling and disposal do not necessarily result in performance improvement under the influence of institutional pressures.

Because of the high cost of recycling and disposal activities in Malaysia, companies prefer to outsource these activities to third-party service providers. Meanwhile, the extension of strict regulations can bring negative impacts on the sales growth of recyclable and disposable products because of export restrictions (Khor et al., 2016). As discussed before, among the five RL disposition options considered in the present research, only repair and recycling can improve the economic performance of businesses, a finding that is in line with Khor et al. (2016)'s study. The reason may be a lack of strict government regulations in Australia. Without regulation pressures, only repair and recycling can improve the profitability of businesses and lead to stronger economic performance.

5.3.2 The relationship between resource commitment and the adoption of RL and sustainability performance

The results of the SEM confirm that resource commitment including managerial, technological, and financial resources positively and significantly influences the adoption of RL and perceived sustainability performance of firms, a finding that is consistent with previous studies (Daugherty et al., 2001, Richey et al., 2004, Jack et al., 2010, Huang et al., 2012, Piyachat, 2017, Morgan et al., 2018, Khor and Udin, 2013, Skinner et al., 2008). The present study shows that resource commitment plays a key role in firms' development of RL programs to recover assets, paralleling Khor and Udin (2013) findings. Conversely, the lack of resource commitment is a major barrier to RL implementation (Waqas et al., 2018). Moreover, analysing the participants' demographic information reveals that firm size affects the degree of the influence that resource commitment has on the adoption of RL and sustainability performance. The size of companies indicates how many resources, including financial, managerial, and technological resources, that firms have. Since large companies can commit more resources to green practices, they are more likely to adopt RL, and achieve superior performance compared to small companies. Thus, the results confirmed that the size of companies can have a positive impact on the adoption of RL and also on sustainability performance.

Since RL programs require intensive resources for their implementation and maintenance, commitment to various resources can play a key role in RL implementation and in achieving RL goals (Daugherty et al., 2001). Unwillingness to allocate technological, financial, and managerial resources is a major barrier to developing an effective and efficient RL program (Daugherty et al., 2001). The more resources a firm commits for this purpose, the higher the level of sustainability performance that it can achieve (Isobe et al., 2000, Sweeney and Szwejczewski, 1996). Daugherty et al. (2001) found that managerial resource commitment had a significant effect on achieving the aims of RL implementation, whereas the association between financial resource commitment and RL performance was not strong. Overall, however, there is no doubt that resource commitment is vital for companies to be successful in improving their performance through RL implementation (Daugherty et al., 2001).

The results of the SEM confirm that companies that commit more resources to RL processes are more successful in improving RL performance compared to firms that engage in less resource commitment. The commitment of resources can significantly influence management of the operational activities associated with RL, and also enhance RL capabilities in ways that improve sustainability performance (Richey et al., 2004, Genchev, 2007, Jack et al., 2010). In Skinner et al. (2008)'s study, resource commitment was considered as a variable that can moderate the relationship between RL disposition options and performance. When insufficient resources are devoted to RL programs, companies tend to dispose of products, because other RL disposition options require substantial resources if firms are to recapture value from returned products.

Without appropriate resource commitment, the RL performance outcomes may remain inferior. Similarly, Huang et al. (2012) confirmed the significant positive influence of resource commitment on the environmental and economic performance of RL in the Taiwanese high-tech sector.

5.4 PRQ: The impact of RL disposition options on the perceived sustainability performance of RL in the Australian manufacturing industry

As discussed in the literature review, most previous studies have considered the effect of RL on sustainability performance in general without considering different RL disposition options. When the relationship between RL and sustainability is considered as a whole, the result is very general and not accurate, because some companies may implement only one or a few RL practices. For some companies, RL means recycling. For others, it means disposal. In this study, the result of SEM confirms (with a path coefficient of 0.378) that the implementation of RL can significantly improve the sustainability performance of Australian manufacturing companies.

Further, since little attention has been given to how individual disposition options in RL affect sustainability performance, this study investigated the effect of five disposition options on all three dimensions of sustainability performance. SEM was used to explore the relationship between the five independent variables and three dependent variables. The results of the SEM indicate that all the RL disposition options except for remanufacturing can influence the performance outcomes of RL. This means that, in the Australian manufacturing context, adopting remanufacturing practices does not improve the economic and social performance of a business, and may even hurt its environmental performance. Repair and recycling can have a significant positive effect on all three sustainability performance dimensions. Of the five disposition options, repair has the strongest positive impact on environmental and economic performance. Repair generates less waste and consumes less energy in comparison with other practices, and it also requires little capital investment and only a small amount of disassembly. In addition, repair can improve social performance by providing job opportunities for low- and medium-skilled labour due to the simplicity of the processes involved. Indeed, many companies offer warranty services for damaged products and recalls. Hence the acceptance of returned products for repair is the best recovery option, which can result, in turn, in customer loyalty.

The result of the SEM analysis with respect to repair is in line with those of previous studies conducted on the electrical and electronics manufacturing industry (Jindal and Sangwan, 2016, Khor et al., 2016). Jindal and Sangwan (2016) indicated that repair is the best option because of the low costs involved, high value-added recovery, high technical/operational feasibility, and positive impact on environmental performance. Meanwhile, Khor et al. (2016) demonstrated that only repair and recycling can contribute to increasing profitability, whereas disposal does not have any significant impact on firms' sustainability performance. In similar way, Stahel (1994) found that repair is the best option in terms of profitability and low energy consumption.

Regarding recycling, the result is consistent with the argument of Ahmed et al. (2016), which holds that recycling is the best option in terms of sustainability benefits. Recycling is broadly known as an environmentally-friendly approach that effectively manages waste to decrease negative impacts on the environment (Oguchi et al., 2013). It is a cost-effective strategy for companies, because it reduces the costs of handling and managing waste (Mulliner et al., 2013). Recycling can bring economic, environmental, and social benefits by limiting the number of landfills and reducing the amount of waste being dumped in those landfills—with such dumping being is a typical approach to waste treatment (Mulliner et al., 2013). In Australia, recycling can yield significant economic benefits, by providing resources to a range of industries (e.g., the mining industry) without using additional natural resources (Balance, 2017). The conservation of resources through recycling can lead to environmental and social advantages for future generations, which cannot be measured simply by the economic indicators (Balance, 2017) that distinguish the costs of recycling from the costs of landfill disposal.

From a social perspective, recycling can create more job opportunities, especially for less skilled workers, in comparison with landfill services (Balance, 2017). Also, participating in recycling creates a strong sense of satisfaction among individuals (Balance, 2017). A life cycle assessment (LCA) was conducted in Australia (2008-2009) to evaluate the environmental benefits of recycling. The results show that recycling significantly reduces the environmental impacts of two main phases of business operations: virgin materials extraction and the disposal of waste in landfills (Balance, 2017). In comparison with disposal, recycling can bring a wide range of benefits to the environment through energy and water savings as well as a significant reduction of green gas emissions, natural resources consumption, and solid waste generation (Balance, 2017). Recycling in Australia reduces risks related to human health and leads to social well-being by improving air quality and reducing airborne pollutants (Balance, 2017). Conversely, waste disposal can cause severe health risks for populations living near waste landfills and also for waste disposal workers. Disposal can have a negative impact on sustainability performance, suggesting that disposal should be considered as the last option in the RL process.

In the past, manufacturers were not motivated to recover returned products. Instead, they simply disposed of them as cheaply as possible by sending them to a local landfill (Lai et al., 2013). The development of environmental restrictions regarding what can be placed in landfills led to a high cost for disposal, to which the significant negative impact of disposal on business performance can be attributed (Lai et al., 2013). For example, in many states in Australia, in cases where the products can be recycled, the government has applied landfill levies to reduce the amount of waste disposed of in landfills (Balance, 2017). Also, the rate of the production of obsolete products has increased, and manufacturers now have more unsalable products, meaning that sending the products to landfills and disposing of them as waste is a costly and unacceptable option. Accordingly, manufacturers have needed to develop procedures for recovering those products and reducing waste, in order to improve economic performance (Lai et al., 2013).

The existing literature reveals conflicting findings with respect to the relationship between RL disposition options and sustainability performance. Since previous studies considered different industries across multiple countries, the results may not be comparable. As discussed in Section 5.2.1, reuse is the least commonly adopted RL disposition option in the Australian manufacturing industry; incorporating reused components and parts into newly manufactured products is rare in Australia because of strict quality requirements and safety concerns. The result of the SEM confirms that the adoption of reuse may hurt the sustainability performance of a business, in conflict with Lai et al. (2013) finding that the practice of reuse improves the triple-bottom-line sustainability performance of RL. It is possible that Australian manufacturers have not adequately developed reuse capabilities for their products. Alternatively, companies may not be willing to integrate reused parts or components into their new products because of strict quality requirements. Ahmed et al. (2016) found that reuse was the least preferred option in end-of-life vehicle management in the automotive industry in Malaysia. When reuse is implemented, it may lead to waste within a short period of time because of quality problems, while also negatively impacting the brand image of companies (Ahmed et al., 2016). That said, reused components and parts can meet quality requirements if they are purposely designed for reuse during the design and development of original products (Amelia et al., 2009).

Meanwhile, customers' perceptions regarding reused products may directly influence social sustainability performance while indirectly influencing the other two dimensions of sustainability (Amelia et al., 2009). Consumers often have the perception that reused products have lower quality compared to new ones (Amelia et al., 2009), resulting in a negative impact on the viability of the reuse process. In today's highly competitive market, increasing demand for high-quality products makes manufacturers unwilling to develop products for reuse (Amelia et al., 2009). At the same time, a lack of knowledge about reuse options may also come into play. For instance, even in developed countries like European nations, the US, and Japan, reuse is still a relatively new and not widely implemented practice in the automotive industry (Gerrard and Kandlikar, 2007). Amelia et al. (2009) examined the barriers related to reuse implementation. They found that the technical difficulty of disassembly, the demand for additional production processes, the high labour cost for disassembly processes, and the lower quality of reused products are the main the barriers to reuse. Another study conducted by Aitken and Harrison (2013) showed that a general lack of awareness of the benefits of reuse as well as consumers' concerns about the quality and safety of reused products affected performance outcomes. For their part, manufacturers often do not support the establishment of infrastructure necessary to reuse products because of their concerns about the risk of lost sales of new products (Kumar and Yamaoka, 2007, González-Torre et al., 2010).

As discussed before, results indicate that there is no strong relationship between remanufacturing and economic as well as social performance. Remanufacturing involves intensive operational processes, requiring advanced technologies and highly skilled labour. Therefore, it is less widely implemented, in some industries, than other RL practices. For example, Jindal and Sangwan (2016) found that remanufacturing is the least preferred RL practice in the electronics manufacturing sector because of the high operational costs it entails; this finding is in line with Agrawal et al. (2016a) study. Remanufacturing requires a high level of disassembly, potentially creating a negative impact due to issues of technical and operational feasibility (Jindal and Sangwan, 2016). In the Australian context, remanufacturing has been implemented in only a few industries, such as the automotive industry, computer-printer consumables, servo motors, and compressors for air-conditioners and refrigerators (Lee, 2012). Only a few large firms are involved in remanufacturing activities in Australia; most of the companies that have implemented remanufacturing are small and medium-sized firms (Lee, 2012). It may be that the high cost and complexities of remanufacturing operations account for the lack of any significant impact of remanufacturing on economic and social performance in the context of Australia. In addition, the intensive operations required for remanufacturing products may hurt environmental performance.

For their part, Khor and Udin (2013) claimed that remanufacturing improves sales growth, while Ijomah (2009) argued that remanufacturing in some industries like domestic appliances is not profitable, because of the high costs of labour and of testing products for adherence to safety standards. For example, in the European Union (EU), domestic appliances manufacturers tend to recycle products like fridges and cookers because the cost of processing these products for recycling is continuing to decrease, while the cost of remanufacturing continues to rise. Also, Ijomah (2009) noted that the implementation of remanufacturing may bring environmental disadvantages, though this finding is inconsistent with some other studies (Xiang and Ming, 2011, Topcu et al., 2013). In any case, the cost of running safety tests is indeed expensive. In the process of manufacturing new products, the cost of testing can be limited by testing products in batches. By contrast, in the remanufacturing process, each remanufactured product must be tested individually, leading to environmental, social, and economic disadvantages (Ijomah, 2009). Remanufacturing can also affect firms' carbon footprint because of the transportation of parts and components. Most of the time, the processing of parts is carried out in different locations; and even worse, parts are exported to countries with lower labour costs to be remanufactured, and then sent back to the source country for sale (Ijomah, 2009).

5.5 Summary

This chapter discussed in detail the findings of quantitative research conducted on RL disposition options and sustainability performance in the Australian manufacturing industry. RL is still only an emerging practice in Australia, and its current level of implementation remains medium. By the same token, the degree to which RL disposition options are implemented in the Australian manufacturing industry varies. Disposal and reuse are the most and the least adopted disposition option, respectively. The analysis of variance (ANOVA) confirms that the level of RL implementation is affected by firms' size and their adoption of environmental certifications, but not affected by companies' age or sector, nor by the location of their production facilities. Since larger companies may have more resources and face more challenges regarding environmental pressures, they are more likely to adopt RL. Also, companies that have obtained environmental certifications have a greater awareness of environmental issues and perceive better the benefits of complying with a higher level of environmental standards, so they, too, are more likely to adopt green practices like RL. Of the three dimensions of sustainability performance, the implementation of RL affects social and environmental performance more than the economic performance. This research also reveals that sustainability performance of adopting RL is viewed differently by different companies, depending on their age, their size, and whether they have adopted environmental certifications.

Regarding the impact of RL disposition options on perceived sustainability performance of firms, all RL disposition options except remanufacturing can influence a firm's economic, environmental, and social performance. Repair and recycling are the best RL disposition options when it comes to improving the outcomes of sustainability performance. The findings show that the reuse option negatively impacts perceived sustainability performance of firms. The reason could be that companies have not yet developed products with adequate reuse capabilities. Also, because of strict quality measures and issues of customer acceptance, companies are not eager to incorporate reused components and products into their production process. Remanufacturing, for its part, does not significantly affect economic and social performance because of its high cost—cost associated with the intensive operations and advanced technologies required for remanufacturing activities. Implementation of remanufacturing is limited to a few industries because it is not technologically feasible or commercially viable to remanufacture all the products of the various industries. Also, remanufacturing may hurt environmental performance due to the intensive operations it requires as well as the carbon that is emitted during the transportation of parts and components.

Regarding institutional pressures, the results indicate there is no significant relationship between institutional pressures and the implementation of RL, especially in connection with government regulations. It seems that environmental regulations in Australia are quite different from those in other countries. Also, since most Australian companies outsource their manufacturing activities overseas, domestic institutional pressures do not play a key role in the adoption of RL. In contrast, the presence of institutional pressures contributes to improvements in sustainability performance. Finally, being able to commit financial, managerial, and technological resources can play a significant role in the implementation of RL, and also in achieving RL performance outcomes.

Chapter 6 Conclusion

6.1 Introduction

The previous chapter discussed the findings in reference to the research questions that the study was designed to answer. This chapter summarises the main findings and highlights the key research contributions made by the study, while noting the limitations of the present research and outlining directions for future research.

6.2 Summary of findings

Product disposition is a key component of the RL process. It consists of several options, including reuse, repair, remanufacturing, recycling, and disposal. In other words, disposition encompasses all the activities related to making a decision about what to do with returned or used products. RL, more broadly, is an emerging practice that supports the aims of achieving sustainable production and consumption. Currently, most companies tend to invest their resources in forward supply chains rather than RL practices because the benefits of RL implementation have not been made sufficiently clear. The present study sought to fill this gap, by providing empirical evidence on how adopting RL practices benefits firms' triple-bottom-line sustainability performance. Moreover, the study examined how resource commitment and institutional pressures affect the adoption of RL disposition options and perceived sustainability performance of firms. Based on the literature review, a conceptual framework was developed to examine the impacts of the five RL disposition options vis-à-vis economic, environmental, and social performance, and to study the roles of institutional pressures and resource commitment in the context of RL.

This research investigated which RL disposition options are most frequently chosen in the Australian manufacturing industry. The extent to which the various RL disposition options are implemented differs across different sectors in this industry. The results show that the most frequently adopted RL disposition options are disposal and repair, while reuse is the least frequently adopted option. Disposal and repair are traditional methods for dealing with faulty products, and both have been practiced for many years. Overall, the findings regarding levels of RL implementation are similar to those in the study that Khor and Udin (2013) conducted in Malaysian manufacturing industry, where disposal and repair are the most adopted practices while recycling and remanufacturing are the least used.

More generally, the analysis of variance (ANOVA) showed that there are differences among the respondents with respect to the adoption of RL disposition options. The implementation of RL is affected by the size of companies and the adoption of environmental certifications. Given that large companies have more resources and are often confronted with more pressures to achieve environmental sustainability, they are more likely to adopt RL practices. Further, companies that have obtained environmental certifications are more likely to have greater knowledge and awareness of environmental issues, making them more apt to adopt RL practices. RL practices are relatively new in the Australian manufacturing industry, and their overall level of implementation is moderate. The reasons behind this medium level of RL implementation in Australia may include a lack of awareness of RL benefits, the absence of strict government regulations, and insufficient public awareness of environmental protection. Most of the studies that have investigated levels of RL implementation were conducted in developing countries, especially in Malaysia. The result of Eltayeb et al. (2010)'s study revealed that the extent of RL adoption in the Malaysian manufacturing industry was lower than other green practices. The level of RL implementation in Thai manufacturing is similar to the level of RL adoption in the Malaysian manufacturing industry (Laosirihongthong et al., 2013).

This research also examined how sustainability performance of adopting RL is perceived in the context of the Australian manufacturing industry. Among the three dimensions of sustainability performance, social performance contributes most prominently to RL sustainability performance It seems that the first thing that comes to people's mind with respect to sustainability, in the Australian context, is its positive impact on society and the environment. Economic performance contributes least prominently. The reason for this pattern might be that businesses are reluctant to consider sustainability strategy due to a mistaken belief that the expenditures outweigh the benefits. Regarding economic performance indicators, the key indicator reflecting the impact of RL disposition options is cost reduction. RL can reduce the cost of raw material purchases, compliance and liability, energy consumption, waste treatment, logistics costs, and inventory investment. Reducing pollution and meeting or exceeding the limits imposed by environmental regulations are the most significant measures of how RL can contribute to environmental sustainability. With respect to social indicators, improvement in firms' corporate image is the way RL practices most contributed to improving organisations' social performance. The results of ANOVA showed that sustainability performance is perceived differently by long-established and larger companies than by newer and smaller companies. Also, companies that adopt environmental certifications have different perceptions of sustainability performance than firms that do not obtain certifications.

The main aim of this research is to investigate the effect of RL disposition options on perceived sustainability performance in the Australian manufacturing industry. Structural equation modelling (SEM) was used to explore the relationship between five RL disposition options and the three dimensions of sustainability performance. The result of SEM showed that all the RL disposition options except for remanufacturing affect the sustainability performance outcomes of RL. Remanufacturing has no significant impact on the economic and social performance in the Australian context, perhaps due to the complexity and high cost of remanufacturing operations. In Australia, remanufacturing is limited to a few industries, including the automotive industry, printer consumables, servo motors, and compressors for air-conditioners and refrigerators, because it is not technologically feasible or commercially viable for all products to be remanufactured. In similar way, Jindal and Sangwan (2016) found that remanufacturing is the least preferred RL practice in the electronics manufacturing sector because of the high operational costs it entails; this finding is in line with Agrawal et al. (2016a) study. In addition, Ijomah (2009) argued that remanufacturing in some industries like domestic appliances is not profitable, because of the high costs of labour and of testing products for adherence to safety standards. Also, the intensive operations required for remanufacturing together with the impact on carbon footprints caused by the transportation of parts and components can affect environmental performance negatively.

Repair and recycling have a significant positive impact on all three dimensions of sustainability, while disposal and reuse affect sustainability performance negatively. Disposal is considered as the last disposition option in the RL process because of its high cost and negative impacts on the environment and society. The implementation of strict regulations on waste treatment in landfills contributes to the high cost of disposing products; in turn, this cost negatively influences business performance. Similarly, reuse impacts sustainability performance outcomes negatively in the Australian manufacturing industry, which is in conflict with Lai et al. (2013) finding that the practice of reuse improves the triple-bottom-line sustainability performance of RL. Since reuse is the least frequently adopted disposition option in Australia, it is possible that Australian manufacturers have not adequately developed reuse capabilities for their products and tend to implement the reuse option only for after-market sales. It may also be the case that most of the products in the selected sectors are manufactured overseas, making the reuse option even more difficult to implement. Also, companies may not be willing to incorporate reused parts or components into the production of new products because of strict quality measures as well as issues of customer acceptance. Customers often perceive reused products as being lower in quality than new ones, and this perception may affect companies' brand image negatively (Amelia et al., 2009, Ahmed et al., 2016).

Of the five disposition options, repair has the strongest positive impact on environmental and economic performance. Repair generates less waste and consumes less energy in comparison with other practices, and it also requires little capital investment and only a small amount of disassembly. In addition, repair can improve social performance by providing job opportunities for low- and medium-skilled labour due to the simplicity of the processes involved. Indeed, many companies offer warranty services for damaged products and recalls. Hence the acceptance of returned products for repair is the best recovery option, which can result, in turn, in customer loyalty. The result of the SEM analysis with respect to repair is in line with those of previous studies conducted on the electrical and electronics manufacturing industry (Jindal and Sangwan, 2016, Khor et al., 2016).

Regarding recycling, the result is consistent with the argument of Ahmed et al. (2016), which holds that recycling is the best option in terms of sustainability benefits. Recycling is broadly known as an environmentally-friendly approach that effectively manages waste to decrease negative impacts on the environment (Oguchi et al., 2013). It is a cost-effective strategy for companies, because it reduces the costs of handling and managing waste (Mulliner et al., 2013).

This study also highlights the significant role played by resource commitment in the adoption of RL as well as in the sustainability outcomes of RL that is consistent with previous studies (Daugherty et al., 2001, Richey et al., 2004, Jack et al., 2010, Huang et al., 2012, Piyachat, 2017, Morgan et al., 2018, Khor and Udin, 2013, Skinner et al., 2008). The lack of resource commitment is a major barrier to RL implementation. Also, the result of analysis of variance confirmed the significant role of resource commitment in the adoption of RL and perceived sustainability performance for large firms. Moreover, analysing the participants' demographic information reveals that firm size affects the degree of the influence that resource commitment has on the adoption of RL and sustainability performance. The size of companies indicates how many resources, including financial, managerial, and technological resources, that firms have. Since large companies can commit more resources to green practices, they are more likely to adopt RL, and achieve superior performance compared to small companies.

This study further reveals that institutional pressures, especially government regulations, do not induce Australian companies to implement RL, although institutional pressures can affect the sustainability performance of businesses positively. It seems that in Australia, as compared to other countries, there are less strict government regulations to force companies to adopt RL. Although the government established some environmental protection regulations, enforcement of these regulations remains weak. A study conducted by Lee (2012) revealed that government regulations have had no significant impact on remanufacturing activities in Australia thus far. Regulations in Australia are not as stringent as they are in other countries like China and EU nations, since both the business environment and natural environment are quite different across these contexts.

6.3 Research contributions

This research makes several contributions to scholarship as well as practice. Despite the importance of RL implementation in the context of sustainability, only limited research has been conducted in this area, and there have been no studies of the impact of RL disposition options on the three dimensions of sustainability performance in the context of the Australian manufacturing industry. This study fills these gaps from both a theoretical and a practical perspective. The most significant contribution of this research which is the novelty of this research could be the confirmation (through SEM) of the conceptual framework which brings all RL elements and sustainability performance.

6.3.1 Theoretical contributions

This research has several important theoretical implications. The main theoretical contribution of the study is the development and validation of a conceptual framework to evaluate the performance outcomes of RL disposition options in each of the three sustainability performance dimensions and to investigate the impact of institutional pressures and resource commitment on the adoption of RL disposition options and sustainability performance. To this end, the study covers a broad range of activities related to the five RL disposition options in Australian manufacturing companies. The study shows that it is necessary to take sustainability into account when investigating RL issues, examining issues that have remained under-explored up to this point. Most of the previous work in the field has investigated only limited aspects of RL. Existing studies have mainly considered RL as a whole without examining the individual disposition options, and without offering an in-depth analysis of the relationships among disposition options and sustainability performance. Some previous studies have focused on only one practice in the RL process, such as recycling or remanufacturing. Those work cannot provide a comprehensive picture of RL practices—a picture that companies need in order to choose the most appropriate options with respect to sustainability benefits.

This study uses a list of sustainability indicators based on a triple-bottom-line perspective to evaluate the performance outcomes of RL disposition options. Most previous research has considered only one or two dimensions of sustainability performance; in particular, the social dimension of sustainability has remained under-explored. By integrating all three dimensions of sustainability performance, this study provides a holistic picture of the effects of RL implementation from a triple-bottom-line perspective. Moreover, by considering resource commitment and institutional factors, this research provides more insights into how internal as well as external factors affect the adoption of RL and sustainability performance of businesses. Finally, a majority of the previous studies have been carried out in developing countries like Malaysia and China, with less attention being paid to developed countries. Indeed, no studies have been conducted to explore the impact of RL disposition options on three dimensions of sustainability performance in the context of Australian manufacturing industry. The present research fills these theoretical gaps.

6.3.2 Practical contributions

Given its empirical nature, this study also has important practical implications. It provides a clear understanding of the current situation of RL implementation in the Australian manufacturing industry. Understanding this situation represents a starting point when it comes to companies' decisions about what they can or should do in this area. In addition, this study offers an instrument that companies can use to assess the sustainability benefits of RL implementation.

A major barrier to RL implementation is a lack of awareness concerning RL and its benefits (Dianne et al., 2013, Phochanikorn et al., 2019). When companies do not have enough knowledge about RL and its environmental, economic, and social benefits, they tend to resist RL implementation. This research sheds further light on RL and its sustainability performance outcomes, allowing companies to embrace RL practices with greater confidence. In short, increased awareness of RL and its benefits may affect people' attitudes, and thus their behaviour, in organisations.

The study provides Australian manufacturers with empirical evidence on the business value of RL implementation. It suggests how they can improve sustainability performance by adopting RL and choosing the appropriate disposition option(s). Since the RL process encompasses different disposition options, evaluating how each of those options may affect sustainability performance offers important insights to companies, enabling them to choose the option or options that most improve the sustainability performance of their businesses.

In addition, this study highlights the important role of resource commitment in the implementation of RL and achieving sustainability performance outcomes. It also clarifies the role of institutional pressures, suggesting that stricter environmental regulations may be required to incentivise companies to recapture value from returned or used products. Current institutional pressures, especially government regulations, do not have any impact on the adoption of RL in Australia. It seems that current environmental regulations in Australia are not as tough as those in other countries. The lack of strict government regulations may be one reason for the only moderate level of RL implementation in Australia. Further, given that pressures from customers and competitors currently do not affect the implementation of RL in Australia, it would be helpful to implement programs designed to increase public awareness of sustainability development and the benefits of RL implementation.

6.4 Research limitations and recommendations for future research

This research had some limitations, although attempts were made to mitigate them as much as possible. The target population of this study is manufacturing firms in Australia, selected because of the importance of RL for the manufacturing industry in general. Among different manufacturing sectors, three sectors were chosen due to their relevance for this research and their high consumption of materials. Because the study considered only three sectors rather than the whole manufacturing industry, the generalisability of the findings may be limited. Future research can be extended to other manufacturing sectors. Moreover, to afford different perspectives on the RL process, future research can be extended to include other service providers, such as transport and logistics services, in addition to the manufacturing sector.

Another limitation is related to the sample size. The sample size of this research was large enough for conducting factor analysis, and to ensure the validity and reliability of the research findings. This study considered three manufacturing sectors, so stratified random sampling was applied to select the sample of respondents. Due to the small size of the Australian manufacturing industry overall, the sub-samples were small when participants were separated into three groups. Consequently, the sample was not suitable for conducting factor analysis for individual groups and comparing the results across different sectors. Future research can apply the proposed conceptual framework in other countries with larger population sizes to compare the findings for different manufacturing sectors. By the same token, a single respondent was asked to complete the survey from each company, even though no one person would be responsible for all RL activities. Future research taking into account multiple respondents from each company is needed, so as to obtain a complete and accurate view of different aspects of RL implementation.

This study focuses on disposition options, the last step of the RL process. While disposition is a key component of RL and involves a broad range of activities, other parts of the RL process also influence the RL outcomes. Future research needs to consider other RL processes, including product acquisition, collection, inspection, and sorting to get a fuller picture of RL implementation and its impact on sustainability performance.

Further, with this study having been conducted in Australia, a similar study can be conducted in another developed country using the same conceptual framework, and the results can be compared. It would be interesting to compare these sets of results, in turn, with results deriving from an analysis based on the same framework but applied to a developing country. It should also be noted that this research is a cross-sectional study carried out once within a particular time frame because of time and cost constraints. Future researchers can conduct a longitudinal study to analyse how the perceived factors change over time, especially if there are changes to the regulatory environment.

Given that the data were collected through a survey questionnaire, future researchers can conduct interviews to supplement the quantitative data and further illuminate the results. Indeed, some of the results of this research are completely different from those obtained in previous studies, and they need to be investigated further. For example, the impacts of reuse and remanufacturing on the perceived sustainability performance of businesses in Australia are very different from those previously identified, and further research is warranted to explore the reasons for these discrepancies. Also, the impact of institutional pressures on the adoption of RL and sustainability performance needs to be investigated further. Although this study discussed possible factors at play in this connection, empirical evidence is needed to illuminate the institutional contexts by which RL practices are shaped.

This study considered control variables such as job position, size and age of companies, Australian manufacturing sectors, the location of production and adoption of environmental certifications as independent variables that can affect the adoption of RL and sustainability performance. Future research can consider some moderating variables such as size of firms, organisational culture etc. to investigate how these variables can affect the strength of relationship between RL and sustainability performance.

Appendices

Appendix A
Survey Questionnaire

Investigating the effect of disposition options of Reverse Logistics on sustainability performance in the Australian manufacturing industry

A. Company/Respondent profile

A.1. Please indicate your position in the company.

☐ President ☐ CEO ☐ Director/Managing Director ☐ General Manager ☐ Operations Manager

☐ Other, please specify __________________

A.2. Please indicate the numbers of years your company has been established.

☐ Less than 5 years ☐ 5-10 years ☐ 11-20 years ☐ More than 20 years

A.3. Please indicate the numbers of employees in your company.

☐ Less than 20 ☐ 20-199 ☐ More than 200

A.4. Please indicate the type of industry your company operates in.

☐ Machinery and Equipment Manufacturing

☐ Transport Equipment Manufacturing

☐ Furniture Manufacturing

☐ Other, please specify __________________

A.5. Please indicate where your products are made.

☐ Australia ☐ Overseas

A.6. Please indicate whether your company has adopted any relevant environmental certifications. Please tick any applicable.

☐ ISO 14000

☐ ISO 14001

☐ Environmental Management System (EMS)

☐ Others, please specify ____________________

☐ Do not adopt

B. Reverse Logistics disposition options

This section focuses on how Reverse Logistics disposition options are adopted in your company. These options include reuse, repair, remanufacturing, recycling and disposal.

B1: Reuse						
Do you implement reuse as a disposition option in your company?	☐ Yes		☐ No			
Reuse is carried out by	☐ Ourselves		☐ Third party			
Please indicate to what extent reuse option is implemented in your company where 5- Fully implemented | 4-Moderately implemented | 3- somewhat implemented | 2- slightly implemented | 1- Not implemented | 0- Not applicable.						
B1.1: We accept customer returns of unused or slightly used products.	☐5	☐4	☐3	☐2	☐1	☐0
B1.2: We return reusable products to retailers, or distributors, or any place in the forward or reverse supply chain as needed.	☐5	☐4	☐3	☐2	☐1	☐0
B1.3: We sell reusable products.	☐5	☐4	☐3	☐2	☐1	☐0
B2: Repair						
Do you implement repair as a disposition option in your company?	☐ Yes		☐ No			
Repair is carried out by	☐ Ourselves		☐ Third party			
Please indicate to what extent repair option is implemented in your company where 5- Fully implemented | 4-Moderately implemented | 3- somewhat implemented | 2- slightly implemented | 1- Not implemented | 0- Not applicable.						

B2.1: We accept faulty products from customers for repair.	☐5	☐4	☐3	☐2	☐1	☐0
B2.2: We fix or replace broken or damaged parts.	☐5	☐4	☐3	☐2	☐1	☐0
B2.3: We carry out only limited product disassembly and reassembly in the repair process.	☐5	☐4	☐3	☐2	☐1	☐0
B3: Remanufacturing						
Do you implement remanufacturing as a disposition option in your company?	☐ Yes		☐ No			
Remanufacturing is carried out by	☐ Ourselves		☐ Third party			
Please indicate to what extent remanufacturing option is implemented in your company where 5- Fully implemented | 4-Moderately implemented | 3- somewhat implemented | 2- slightly implemented | 1- Not implemented | 0- Not applicable.						
B3.1: We accept used products from customers for remanufacturing.	☐5	☐4	☐3	☐2	☐1	☐0
B3.2: We completely disassemble used products up to part level.	☐5	☐4	☐3	☐2	☐1	☐0
B3.3: We inspect all parts of used products and repair or rework repairable parts or components.	☐5	☐4	☐3	☐2	☐1	☐0
B3.4: We replace obsolete or defective parts or components with new or refurbished ones.	☐5	☐4	☐3	☐2	☐1	☐0
B4: Recycling						
Do you implement recycling as a disposition option in your company?	☐ Yes		☐ No			
Recycling is carried out by	☐ Ourselves		☐ Third party			
Please indicate to what extent recycling option is implemented in your company where 5- Fully implemented | 4-Moderately implemented | 3- somewhat implemented | 2- slightly implemented | 1- Not implemented | 0- Not applicable.						
B4.1: We accept used products from customers for recycling.	☐5	☐4	☐3	☐2	☐1	☐0

B4.2: We clean, sort and separate used products into different material categories.	☐5	☐4	☐3	☐2	☐1	☐0
B4.3: We extract and recover recyclable materials from used products.	☐5	☐4	☐3	☐2	☐1	☐0
B5: Disposal						
Do you implement disposal as a disposition option in your company?	☐ Yes		☐ No			
Disposal is carried out by	☐ Ourselves		☐ Third party			
Please indicate to what extent disposal option is implemented in your company where 5- Fully implemented | 4-Moderately implemented | 3- somewhat implemented | 2- slightly implemented | 1- Not implemented | 0- Not applicable.						
B5.1: We dispose of faulty parts as waste.	☐5	☐4	☐3	☐2	☐1	☐0
B5.2: We dispose of used parts as waste.	☐5	☐4	☐3	☐2	☐1	☐0
B5.3: We conduct appropriate treatment of waste.	☐5	☐4	☐3	☐2	☐1	☐0

C. Sustainability performance

This section assesses the sustainability performance outcomes of Reverse Logistics in your company.

C1: This section examines the economic performance outcomes derived from Reverse Logistics implementation in your company.

C1.1: Please indicate to what extent you agree or disagree that implementing Reverse Logistics improves the economic performance through the following: 5- Strongly agree | 4- Agree | 3- Neither agree nor disagree | 2- Disagree| 1- Strongly disagree.					
C1.1.1: Improving profitability	☐5	☐4	☐3	☐2	☐1
C1.1.2: Effective in recapturing value	☐5	☐4	☐3	☐2	☐1
C1.1.3: Increased sales growth	☐5	☐4	☐3	☐2	☐1
C1.1.4: Improving return on investment	☐5	☐4	☐3	☐2	☐1

C1.1.5: Others, please specify ___________________					
C1.2: Please indicate to what extent you agree or disagree that Reverse Logistics reduces the cost of the following: 5- Strongly agree | 4- Agree | 3- Neither agree nor disagree | 2- Disagree| 1- Strongly disagree.					
C1.2.1: Raw material purchasing	☐5	☐4	☐3	☐2	☐1
C1.2.2: Compliance and liability	☐5	☐4	☐3	☐2	☐1
C1.2.3: Energy consumption	☐5	☐4	☐3	☐2	☐1
C1.2.4: Waste treatment	☐5	☐4	☐3	☐2	☐1
C1.2.5: Logistics costs	☐5	☐4	☐3	☐2	☐1
C1.2.6: Inventory investment	☐5	☐4	☐3	☐2	☐1
C1.2.7: Others, please specify ___________________					

C2: This section examines the environmental performance outcomes derived from Reverse Logistics implementation in your company.

Please indicate to what extent you agree or disagree that implementing Reverse Logistics improves the environmental performance through the following: 5- Strongly agree | 4- Agree | 3- Neither agree nor disagree | 2- Disagree| 1- Strongly disagree.					
C2.1: Reducing overall energy and resource consumption	☐5	☐4	☐3	☐2	☐1
C2.2: Reducing the amount of waste generated	☐5	☐4	☐3	☐2	☐1
C2.3: Reducing pollution to water, air and land	☐5	☐4	☐3	☐2	☐1
C2.4: Exceeding environmental regulations	☐5	☐4	☐3	☐2	☐1
C2.5: Others, please specify ___________________					

C3: This section examines the social performance outcomes derived from Reverse Logistics implementation in your company.

Please indicate to what extent you agree or disagree that implementing Reverse Logistics improves the social performance through the following: 5- Strongly agree | 4- Agree | 3- Neither agree nor disagree | 2- Disagree| 1- Strongly disagree.					
C3.1: Improving customer satisfaction	☐5	☐4	☐3	☐2	☐1
C3.2: Improving customer loyalty	☐5	☐4	☐3	☐2	☐1
C3.3: Creating more job opportunities	☐5	☐4	☐3	☐2	☐1
C3.4: Improving firm's corporate image	☐5	☐4	☐3	☐2	☐1
C3.5: Improving health and safety of employees	☐5	☐4	☐3	☐2	☐1
C3.6: Improving employee job satisfaction	☐5	☐4	☐3	☐2	☐1
C3.7: Others, please specify ___________________					

D. Institutional pressures

This section assesses the drivers that encourage your company to adopt Reverse Logistics disposition options.

Please indicate to what extent you agree or disagree that the following drive your company for adopting Reverse Logistics disposition options: 5- Strongly agree | 4- Agree | 3- Neither agree nor disagree | 2- Disagree| 1- Strongly disagree.					
D1: Government regulations	☐5	☐4	☐3	☐2	☐1
D2: Customer pressures	☐5	☐4	☐3	☐2	☐1
D3: Competitor pressures	☐5	☐4	☐3	☐2	☐1
D4: Others, please specify ___________________					

E. Resource commitment

This section assesses the level of resource commitment in the adoption of Reverse Logistics disposition options in your company.

Please show the level of following resource commitment in adopting Reverse Logistics disposition options in your company: 5- Very high | 4- High | 3- Moderate |2-Slight | 1-Not at all.					
E1: Technological resource	☐5	☐4	☐3	☐2	☐1
E2: Managerial resource	☐5	☐4	☐3	☐2	☐1
E3: Financial resource	☐5	☐4	☐3	☐2	☐1
E4: Others, please specify ___________________					

Thank you so much for your time and participation.

Submitting this survey confirms your consent for the information you have provided to be used in this research.

Appendix B
Ethics Approval – Web-Survey

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

28 August 2018

Dr Jiangang Fei
Maritime and Logistics Management
Private Bag 1397

Dear Dr Fei

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: H0017580 - Investigating the effect of disposition options of Reverse Logistics on sustainability performance in the Australian manufacturing industry

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 28 August 2018.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Ailin Ding
Administration Officer
Tasmania Social Sciences HREC

Appendix C
Information sheet – Web-Survey

PARTICIPANT INFORMATION SHEET

Investigating the effect of disposition options of reverse logistics on sustainability performance in the Australian manufacturing industry

1. Invitation

You are invited to participate in a research study investigating the effect of disposition options of reverse logistics (RL) on sustainability performance in the Australian manufacturing industry. The study is being conducted in partial fulfilment of the PhD degree by Taknaz Banihashemi under the supervision of Dr. Jiangang Fei and Dr Shu-Ling(Peggy) Chen from the Department of Maritime and Logistics Management, Australian Maritime College, University of Tasmania.

2. What is the purpose of this study?

The main purpose of this research is to investigate the impact of disposition options of RL on the triple-bottom-line sustainability performance in the Australian manufacturing industry. This research examines the level of RL implementation in the Australian manufacturing industry. In addition, this research investigates the importance level of triple-bottom-line sustainability performance in the context of RL for Australian companies in the manufacturing industry.

3. Why have I been invited to participate?

As a senior manager, your valuable knowledge, experience and views about RL process will make a great contribution toward a better understanding of RL process and its effect on the sustainability performance in the Australian manufacturing industry.

4. What will I be asked to do?

You will be asked to spend **less than 15 minutes** to complete an online survey. The online questionnaire has been designed to provide maximum convenience to you. You only need to click in relevant boxes to provide the answers. Please note that receiving your completed questionnaire implies your consent for participating in this survey.

5. Are there any possible benefits from participation in this study?

Since this research aims to investigate the impact of disposition options of RL on the triple-bottom-line sustainability performance in the Australian manufacturing industry, the findings may help managers to evaluate their current RL practices and improve their RL performance by re-considering disposition options that can make the most contribution to achieving sustainable development. A summary of this research will be made available to you upon request.

6. Are there any possible risks from participation in this study?

There are no risks anticipated with participation in this study.

7. What if I change my mind during or after the study?

Your participation in this study is **entirely voluntary**. You can withdraw your participation from this study at any time during you completing the online survey without providing any explanation. Since the survey will be carried anonymously, it may not be possible to remove your data from the study after your submission.

8. What will happen to the information when this study is over?

All the electronic files will be kept secure in the University/AMC password-protected computer of the student investigator. In addition, all electronic data will be backed up to a UTAS server space accessible only by the research team as required by the UTAS data management policy. The electronic files will be deleted from the computer device and server after 5 years from the date of the PhD completion. All individual responses collected through the survey will be treated in a confidential manner.

9. How will the results of the study be published?

The results from this study will be published in the form of a PhD thesis. The findings may also be published at conferences or academic journals. A summary of the results will be provided upon request to any participant in this study.

10. What if I have questions about this study?

If you have any questions about this study or if you would like to discuss any aspects of this study, please do not hesitate to contact the following people:

Student Investigator:
Taknaz Banihashemi
PhD Candidate
Department of Maritime and Logistics Management
National Centre for Ports and Shipping
Australian Maritime College
University of Tasmania
Ph: +61 3 6324 9537
Email:Taknazalsadat.banihashemi@utas.edu.au

Chief Investigator:
Dr Jiangang Fei
Senior Lecturer
Department of Maritime and Logistics Management
National Centre for Ports and Shipping
Australian Maritime College
University of Tasmania
Ph: +61 3 6324 9877
Email: Jiangang.fei@utas.edu.au

Co-Chief Investigator:

Dr Shu-Ling(Peggy) Chen
Senior Lecturer
Head of Maritime and Logistics Management
National Centre for Ports and Shipping
Australian Maritime College
University of Tasmania
Ph: +61 3 6324 9694
Email: P.Chen@utas.edu.au

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number (H0017560).

Thank you for taking the time to consider this study.

This information sheet is for you to keep.

Appendix D
Invitation e-mail – Web-Survey

Invitation to participate in the survey about reverse logistics and its impact on the sustainability performance of the business

Dear Sir/Madam

My name is Taknaz Banihashemi, a PhD candidate at the Australian Maritime College, University of Tasmania. I would like to invite you to participate in an online survey that is the major part of my PhD research **investigating the effect of disposition options of reverse logistics (RL) including reuse, repair, remanufacturing, recycling and disposal on sustainability performance in the Australian manufacturing industry.**

Your valuable knowledge, experience and views about RL process will make a great contribution toward a better understanding of the RL process and its effect on the sustainability performance in the Australian manufacturing industry.

You will be asked to answer questions regarding **the level of RL implementation in your company**, **the sustainability performance outcomes of RL**, and **the main drivers to adopt RL** and **the level of resource commitment** your company has made in adopting RL. Please be assured that all individual responses collected through the survey will only be used for research purposes and treated in a **strictly confidential** manner.

The survey will take **less than 15 minutes** of your precious time to complete. Your participation in this study is **entirely voluntary** and you have the right to withdraw your participation from this study at any time without any consequences. If you have any questions about this study or if you would like to discuss any aspects of this study, please do not hesitate to email me at Taknazalsadat.banihashemi@utas.edu.au.

If you agree to participate in this survey, please click on the following link:

(Survey link)

Thank you in advance for your time and valuable contribution.

Yours sincerely,

Taknaz Banihashemi

PhD. Student in Supply Chain and Logistics Management
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UNIVERSITY of TASMANIA | AMC Australian Maritime College

Appendix E
Cover letter – Web-Survey

Investigating the effect of disposition options of Reverse Logistics on sustainability performance in the Australian manufacturing industry

Dear Sir/Madam

You are invited to participate in a survey which is a major part of a PhD research investigating the effect of disposition options of Reverse Logistics (RL) on sustainability performance in the Australian manufacturing industry. The main aims of this research are to:

1. Examine the level of RL implementation in the Australian manufacturing industry.
2. Investigate the importance level of triple-bottom-line sustainability performance in the context of RL in the Australian manufacturing industry.
3. Evaluate the impact of disposition options of RL on the triple-bottom-line sustainability performance in the Australian manufacturing industry.

Your valuable knowledge, experience and views about RL process will make a great contribution toward a better understanding of the RL process and its effect on the sustainability performance in the Australian manufacturing industry.

You will be asked to answer questions regarding the level of RL implementation in your company, the sustainability performance outcomes of RL, and the main drivers to adopt RL and the level of resource commitment your company has made in adopting RL. Please be assured that all individual responses collected through the survey will only be used for research purposes and treated in a strictly confidential manner.

For further information on this study, a participant information sheet is provided for your perusal. Please click on the following link:

(Information sheet link)

The survey will take less than 15 minutes of your precious time to complete. Your participation in this study is entirely voluntary and you have the right to withdraw your participation from this study at any time without any consequences. If you have any questions about this study or if you would like to discuss any aspects of this study, please do not hesitate to email me at Taknazalsadat.banihashemi@utas.edu.au.

If you agree to participate, please click on the following link:

(Survey link)

Thank you in advance for your time and valuable contribution.

Yours sincerely,

Taknaz Banihashemi

PhD. Student in Supply Chain and Logistics Management
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Appendix F
Reminder e-mail – Web-Survey

Gentle Reminder to be sent to the sample population

RE: Study on reverse logistics and its impact on the sustainability performance of the business

Dear Sir/Madam,

One week ago, I sent you an email inviting you to participate in an online survey aims to **investigate the effect of disposition options of reverse logistics (RL) including reuse, repair, remanufacturing, recycling and disposal on sustainability performance in the Australian manufacturing industry.** It examines **the level of RL implementation in your company**, **the sustainability performance outcomes of RL**, and **the main drivers to adopt RL** and **the level of resource commitment** your company has made in adopting RL. The survey is a major part of my PhD research.

This message has gone to everyone in the selected sample population. Since the survey is being carried out anonymously, we are unable to identify whether or not you have already completed the survey. If you have already completed the survey, please accept our thanks for your contribution. If you would still like to participate, **please click on the following link:**

(Survey link)

Your input is highly valuable to this study. Your valuable knowledge, experience and views about RL process will make a great contribution toward a better understanding of the RL process and its effect on the sustainability performance in the Australian manufacturing industry. Please be assured that all individual responses collected through the survey will only be used for research purposes and treated in a **strictly confidential** manner.

The survey will take **less than 15 minutes** of your precious time to complete. Your participation in this study is **entirely voluntary** and you have the right to withdraw your participation from this study at any time without any consequences. If you have any queries, please do not hesitate to email me at Taknazalsadat.banihashemi@utas.edu.au.

Thank you in advance for your time and valuable contribution.

Yours sincerely,

Taknaz Banihashemi

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