Integration and Efficiency in Port-Oriented Supply Chains: The Dynamics of the Automotive Import Chains Through the Port of Melbourne.

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Abstract

Australia has one of the most open and competitive automotive markets in the world. Whilst the closure of domestic car manufacturing in Australia by the end of 2017 has put pressure on the existing logistic infrastructure to handle excessive volumes of imported vehicles, the intense competition in the automotive market has created challenges for the different participants in this chain to save value. Within this competitive context, an efficient and integrated automotive chain is important to avoid the erosion of value within the chain by linking producer and consumer.

However, the challenge of creating an integrated supply chain has not been well conceptualised in the maritime context. This research was concerned with finding examples of integrated and efficient port-oriented chains and to investigate their related shipping linkages and the landside modal networks and operations that link suppliers and customers in these chains. It raises the question of what an efficient chain is and, in this competitive market, how do we capture a competitive advantage that will benefit all chain players including car manufacturers, shipping companies, ports and terminals, and landside operations.

A qualitative research methodology was applied to test the integration and efficiency of the auto chain against the conceptualisation that was extracted from the successful case studies of integrating coal export chains in eastern Australia, and a comprehensive literature review about chain integration in production based chains as well as maritime-related chains.

The outcome from testing the auto chain against the conceptual framework illustrated that, in recent years, the auto chain represents a partially integrated chain, and that the principles recognised in the integration of the coal chain are to some extent applicable to the auto chain.

The result of the research also confirmed the positive relation between integration and efficiency in the auto chain, a correlation that has been supported by many other researchers in the supply chain integration context. In addition, five types of integrating mechanisms were recognised as being attractive for participants in the auto chain, as well as those in the coal chain.

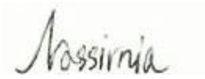
The findings of the research provide suggestions about the efficient utilisation of available infrastructure to cope with the increasing volume of imported vehicles to Australia, and Melbourne in particular. In addition, it highlights the need to recognise the dynamics, principles and drivers that impact on the integration, efficiency and behaviour of the participants in different port-oriented chains.

In a broader framework, it is expected that the results of this research will help in the understanding and development of the concept of chain integration and efficiency relationships with deeper insight, and to provide more applicable solutions to achieve supply chain integration in other contexts.

Declaration

I, Parisima Nassirnia, declare that PhD thesis entitled "Integration and efficiency in port-oriented supply chains: the dynamics of the automotive import chains through the Port of Melbourne", is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Signature Date



14/11/2017

Dedication

In memory of my former Principal Supervisor

Professor Ross Robinson

Acknowledgment

The endless marathon of effort and hardship that I went through during the years of this PhD has finally reached its conclusion. I was challenged to my limits in many aspects, experiencing several highs and lows, and memories sweet and sad. But I survived, and I don’t regret it because this journey has changed me into a better version of myself, and for that I am grateful.

Of course, this achievement could not have been possible without the contribution of great people who helped me at different stages, in many ways, big and small, directly and indirectly, and I wish I could thank them all in this short notice.

I started this journey with the gift of great company, my former Principal Supervisor Professor Ross Robinson. He was a constant source of knowledge, wisdom, inspiration and encouragement for me and my research. Having a different background to his field of research, I was eager to learn from him. Ross was a great teacher, willing to respond to all my questions patiently, and enlightening me with his deep research insights. Sadly, near the end of my third year of study, Ross was diagnosed with cancer and passed away within a year. I am forever grateful for his significant contribution towards helping me frame this research, and the remarkable enjoyment of working with him.

The second great contributor to this research is undoubtedly my current Principal Supervisor and former co-supervisor Professor Sophia Everett. I would like to express my biggest thanks and appreciation for her efforts throughout my research journey, and for providing me with guidance during the writing of my dissertation. She gave valuable advice, direction, supervision and motivation, as well as critical feedback, making this final product as good as it could possibly be.

My appreciation also goes to Professor Anne-Marie Hede, the current Dean of the Graduate Research Centre (GRC) and former research coordinator of the College of Business (CoB). In addition to her administrative role in helping all research students, I had the pleasure of working as her research assistant. I am very grateful for her endless professional support and the faith she placed in me, especially during those difficult moments of my research life.

I would like to acknowledge the scholarship provided to me by Victoria University (VU). I deeply appreciate the support and assistance I received from the wonderful staff at the VU GRC, CoB, scholarship team, International Student Support Centre, and Institute for Supply Chain and Logistics, especially Professor Colin Clark, the Dean of CoB, Dr Jo Vu, Ms Tina Jeggo and Ms Andrea Roggeri for their professional advice, encouragement and administrative support.

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Last but not least, I must thank my family. Continuing this research without the endless support, love and understanding of my mom, dad and in-laws would not have been possible. I am truly blessed to have had you all on my side during this research. I would especially like to thank my husband Chris, who stood by my side and supported me through all those difficult moments with constant love, patience, advice and understanding.

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3PLs	Third-party Logistics Providers
AAT	Australian Amalgamated Terminals
ABS	Australian Bureau of Statistics
ACBPS	Australian Customs and Border Protection Service
ACCC	Australian Competition and Consumer Commission
ACIS	Automotive Competitiveness and Investment Scheme
AD	Appleton Dock
AQIS	Australian Quarantine and Inspection Service
ATS	Automotive Transformation Scheme
BAPS	Bulk and Automotive Port Services
BHP/BMA	BHP Billiton Mitsubishi Alliance (BMA)
BMC	British Motor Corporation
BMW	Bavarian Motor Works
BTO	Build to Order
BTS	Build to Stock
CBU	Completely Built Up
CDS	Capacity Distribution System
CEU	Car Equivalent Units
DBCT	Dalrymple Bay Coal Terminal
DFAT	Department of Foreign Affairs and Trade
EDI	Electronic Data Interchange
FCAI	Federal Chamber of Automotive Industries
FOB	Free On Board
FPR	First Place to Rest
FTP	File Transport Protocol
GM	General Motors
GMH	General Motors-Holden
HVCC	Hunter Valley Coal Chain
MIRRAT	Melbourne International RoRo and Auto Terminal Pty Ltd
MOL	Mitsui O.S.K. Lines

MPC	Melbourne Port Corporation
NYK	Nippon Yusen Kabushiki Kaisha
OEM	Original Equipment Manufacturer
OICA	Organisation Internationale des Constructeurs d'Automobiles
PCC	Pure Car Carriers
PDI	Pre-Delivery Inspection
PMA	Port of Melbourne Authority
POAGS	P&O Automotive & General Stevedoring Pty Ltd
PoM	Port of Melbourne
PoMC	Port of Melbourne Corporations
PTCC	Pure Truck/Car Carriers
RoRo	Roll-on/Roll-off
SCI	Supply Chain Integration
SCM	Supply Chain Management
SCN	Supply Chain Network
SUV	Sport Utility Vehicles
VFACTS	Vehicle retail sales statistics provided by FCAI
VIN	Vehicle Identification Number
VW	Volkswagen
WDE	Webb Dock East
WDW	Webb Dock West
WWL	Wallenius Wilhelmsen Logistics

Chapter 1 Introduction

The automobile industry has changed significantly in the last 50 years to a point where the competitive forces have caused the overcapacity, the regionalisation of global production, and fragmentation of its automotive market (Holweg 2008).

These drastic changes have pushed car manufacturers to achieve the optimal balance between the economies of scale which results in a lower per unit cost, and product diversity which favours market penetration and better profit margin (Maxton & Wormald 2004, p. 257).

For many years, car producers relied on the static ‘supply-push’ model with overly optimistic forecasts, but this approach is no longer viable and has resulted in an excess of supply over demand (Holweg 2008). Car manufacturers, consequently, adapted to the new conditions of the highly competitive market, paying increasing attention to the downstream part of the automotive chain, namely the distribution of the finished vehicle (Carbone, Valentina & Martino 2003a).

In this highly competitive automobile market associated with high cost infrastructure, efficiency in the supply chain is critical. This is particularly the case in Australia where more than 12 percent of the country's total imports are automobiles (Trading Economics 2016). This figure will increase as local automobile production ceases altogether by 2017, making Australia totally dependent on vehicle importation from oversees. Within this competitive context, not only is an efficient production process critical but it also demands an efficient and integrated supply chain, linking producer and consumer.

Inefficient and fragmented supply chains erode value. In today’s production markets, car manufacturers can no longer rely simply on improving their products or reducing operating costs in order to maximise value. A seamless transition from place of manufacture to place of consumption is critical to achieving and/or maintaining competitive advantage. Indeed, Robinson (2013) has argued that paradigmatic changes demand a whole-of-chain perspective in order to capture or maintain competitive advantage.

Firms in other industries that understand this issue are restructuring their business processes to integrate the whole-of-chain activities with other chain members including suppliers, service providers and customers. The bulk export chains such as iron ore and coal exports from Australia, for example, are among the leaders in adopting a whole-of-chain perspective. Many researchers have argued that the level of supply chain integration (SCI) and performance are inextricably linked and that companies which are broadly integrated and embedded in chains tend to be more competitive (Alfalla-Luque, Medina-Lopez & Schrage 2012; Childerhouse & Towill 2011; Robinson 2009, 2010). Furthermore, Robinson points out that 'value is created not only by integrating infrastructure and the internal operations of the firm' (Robinson 2013) but by 'integrating systems and supply chain operations across the full range of component functions' (Poirier 1999, p.2).

Apart from some bulk export chains such as iron ore, this paradigmatic change is relatively recent in other markets, with earlier views tending to focus on infrastructure provision per se rather than on the effective use of that infrastructure. The emergence of ship queues, for example, was frequently associated with and led to port and terminal expansion, while in some instances a more effective use of existing infrastructure resolved congestion problems (Everett 2003, 2007; Everett & Pettitt 2006; Everett & Robinson 1998, 2006; Everett & Weston 2011; Robinson 2010; Robinson, Weston & Everett 2012).

By the late 1990s and early 2000s leading researchers such as Poirier (1999), Robinson (2002) and others had recognised and promoted the emerging dynamic of integration in supply chains. Leading firms were forming networks 'for sourcing raw materials, manufacturing products or creating services, storing and distributing the goods, and ultimately delivering the products and services to customers and consumers' (Poirier 1999, p.2), effectively creating supply networks with significant competitive advantage.

Now, more than a decade later, the mainstream supply chain literature notes that many companies, 'despite the awareness that integration is important, are failing in their attempts at internal and external integration' (Jayaram and Tan cited in Robinson 2015, p.194), and that there is a need 'for a wider cross-functional and inter organisational integration' (Sweeney cited in Nassirnia & Robinson 2013, p.5) and for a comprehensive and more holistic approach to chain integration. Undoubtedly, in some supply chains an end-to-end model is being applied. For example, in the iron ore chains from Western Australia's Pilbara region to overseas customers, and similarly, in coal export chains from Australia's east coast. Integration in these instances has either been initiated by the mining companies, or imposed by state based legislation or regulatory control. In other instances, integration of export and import chains may be driven by third-party logistics providers (3PLs).

In many instances, however, chain integration remains exceptional rather than routine. Against this background, this thesis critically examines the conceptualisation of what it calls the integration/efficiency construct in port-dependent chains. Particularly, it suggests that there is a compelling case for rethinking the integration paradigm, and that a whole-of-chain framework must revisit the definition of chain systems, the drivers of chain efficiency and performance, and the imperative of chain design in achieving efficient chain outcome (Robinson 2013).

1.1 Research problem

The finished vehicle import chain through the Port of Melbourne (PoM) is one of the most important chains, and has been handling more than 30 percent of all imported vehicles to Australia since 2007(Department of Foreign Affairs and Trade 2016).

This figure will inevitably increase as local automobile production ceases altogether by 2017, making Australia completely dependent on overseas imports. This growth in imported vehicles (Figure 1.1) will put pressure on existing supply chain infrastructure. In particular, the role of ports and automotive Roll-on/Roll-off (RoRo) terminals will come under significant pressure as they provide a strategic point between water and land transportation. In addition, they provide a ‘logistic support platform’ for processing and operating pre-delivery value-added activities in close proximity to the automotive consuming markets (Carbone, Valentina & Martino 2003a; Dias, Calado & Mendonça 2010; Mendonça & Dias 2007).

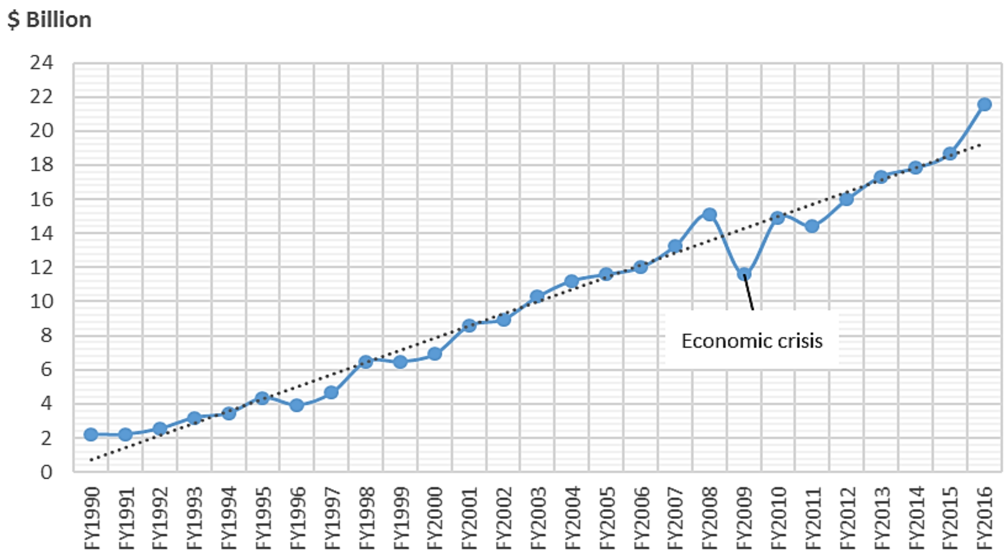

Figure 1.1. Imports of passenger motor vehicles to Australia between financial years 1990 to 2016.
Note: Based on data from Australian Bureau of Statistics (2016a).

This research focuses on those issues which an intensive literature review has revealed are areas of neglect or absence of an adequate conceptual framework within which to understand chain integration and efficiency relationships. Furthermore, it does so against a conceptual framework which has emerged from recent detailed studies of globally oriented bulk coal export chains in Australia (Robinson 2008; Robinson, Weston & Everett 2012). The thesis seeks to test this conceptual framework and apply its findings to a quite different product chain - in particular imported automotive products between global manufacturers through the PoM to retail customers.

It will raise a number of key issues including -

- The problem of chain definition - a whole-of-chain perspective. Preliminary research has suggested the importance of considering the integration/efficiency relationships within a comprehensive whole-of-chain framework. Figure 1.2 provides a first-step, working definition of the chain elements, and suggests the system focus and complexities of the research involved in understanding the dynamics of system operations.

- The problem of defining the integration/efficiency relationships in the chain. The thesis is not concerned with efficiency as such but the efficiency or otherwise which derives from integrative and disintegrative mechanisms, for example, contractual, policy, strategic alignment and information related issues.

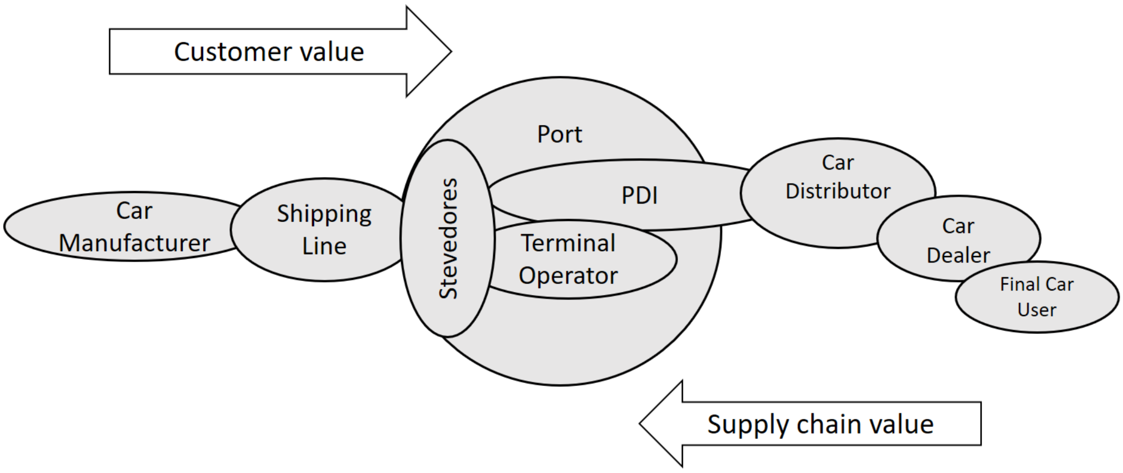

Figure 1.2. Functional structure of the Port of Melbourne automotive supply chains.
Source: Modified from Robinson (2001).

SCI and efficiency is one of the issues that has received much attention over the last decade from academic researchers and managers. Researchers in operations management, logistics research, production planning and control, production economics and other related journals, have focused almost exclusively on manufacturing firms as focal firms in supply chains. They describe, measure and understand the integration/chain efficiency relationships from the focal firm's perspective. However, not all chains are associated with manufacturing firms. There are many types of chain systems which are involved with other production firms such as mining operations, extractive industries, agricultural industries and 'finished goods' for which the issues of SCI and efficiency have the same importance as manufacturing chain systems.

This thesis focuses on integration and chain efficiency relationships, but within the framework of maritime-related chain and supply chain systems. This is particularly relevant for Australia for, as noted above, all vehicles will be imported after 2017. It is specifically concerned, therefore, with chain integration and efficiency in freight flows passing through ports and their related shipping linkages, and the landside modal networks and operations that link suppliers and customers.

There are obvious differences between these maritime-related chains and the chains of manufacturing firms in terms of chain structure, the types of firms involved, the products moved and the primary emphasis on the downstream and distribution linkages from supplier firms to customers. The key research question, however, focuses on the factors that drive integration and efficiency in these chains. Do differences in functional structure, the way the chain operates and expected outcomes require a different set of concepts and a new way of thinking about integration and chain efficiency as it has emerged in the 'mainstream' logistics and supply chain literature for manufacturing chains?

The mainstream literature offers insights into integration and supply chain efficiency, and there is broad agreement about the meaning of the concept of integration; though there are differences in emphasis and in detail. However, despite a large body of research, strong reservations have emerged within the most recent literature. As noted above, 'despite the awareness that integration is important, many companies are failing in their attempts at internal and external integration' (Jayaram & Tan 2010, p.262). Sweeney (2011) has called for a focus on 'wider cross-functional and inter-organisational integration' and a 'more holistic' approach to SCI. Similarly, Alfalla-Luque, Medina-Lopez and Dey (2012, p.1) have called for more empirical research, claiming that despite 'extensive research in the area of SCI, a comprehensive and integrated approach is missing’.

This mainstream literature provides an essential background to supply chain issues but the focus of this research is on the applicability of those backgrounds on maritime chains, in particular, on automobile import chains through the PoM where a level of integration has been implemented in some automotive import chains since the late 1970s.

Recent empirical and detailed case study research into nationally significant export coal chains through east coast Australian ports has underlined the critical need for a whole-of-chain approach and a more effective conceptualisation of the integration/chain efficiency relationships (Robinson 2007b; Robinson, Weston & Everett 2012). The new conceptualisation argues the need for more precise definition of the structure, dynamics and objective function of the port-oriented chain, the mechanisms of integration, the nature of integrative efficiency in the long and short term, and the key elements of chain design and control. It proposes a number of specific and interrelated conceptual building blocks (Robinson 2013).

However, as noted above, supply chains and chain systems differ quite significantly in structure, in dynamics, in business processes and procedures, and in many other ways. A conceptual framework that makes claims for a special class of port-oriented chains poses the problems of applicability and generality for other port-dependent chains. To what extent, then, does this proposed conceptualisation offer insights into other and all port-focused chains? Do the concepts and the conceptual framework have generic as well as specific applicability? Is the framework internally consistent? And does it offer real-world, problem-solving relevance?

This research identifies the critical need to test this new conceptualisation. It does so within a detailed, rigorous, analytical case study framework of the current nationally significant global 'finished auto' import chains through the PoM.

It will examine these developments within the context of two recent case studies of bulk coal export chains in Australia - the Goonyella coal chain in Queensland and the Hunter Valley Coal Chain (HVCC) in New South Wales. These chains will arguably provide an effective model if applied to the automotive import chains. These coal chains, furthermore, illustrate not only the benefits of chain integration but also efficiency gained from having a single point of control (Robinson 2007b). This single point of control can be imposed externally by a regulator in the Goonyella chain, for example. Alternately it can be implemented internally by adopting cooperative strategies among all chain members in order to maximise total benefits.

1.2 Thesis objective

A detailed review of the relevant literature in supply chain and logistics, including maritime and port-related chains, has revealed some important gaps. Generally, there has been a lack of focus on whole-of-chain integration and efficiency. In addition, until recently there has been little attention paid to the importance of chain design in integrating functions. With some notable exceptions, in the resources sector for example, there have been relatively few case studies with a focus on a whole-of-chain approach on real-world chain operations with the objective of understanding the chain integration/efficiency relationships.

Recent papers (Everett 2005; Everett & Pettitt 2006; Everett & Weston 2011; Nassirnia & Robinson 2013; Robinson 2002, 2010, 2013, 2015; Robinson, Weston & Everett 2012) focusing on maritime and port-related bulk export chains have called for the application of an adequate and appropriate conceptual framework within which to examine the chain integration/efficiency relationships. The papers have called for a more precise definition of chain structure, dynamics and function; a more adequate basis for understanding integrating mechanisms; a cohesive statement of chain efficiency and its drivers; and a framework for defining, implementing and evaluating cooperative equilibrium as a design strategy for chains and supply chains.

This research will test the concepts and principles of the coal export chains to the auto import chains. The emphasis in this thesis is not on infrastructure efficiency per se but on a whole-of-chain perspective and on the interdependencies between and among businesses and chain partners. This research is based on a sound conceptual framework but also involves detailed empirical work including discussions with chain firms and key players.

1.3 Thesis outline

Following this introductory chapter, the second chapter provides a detailed multi-disciplinary literature review. This chapter will conclude with a conceptual framework which will be applied to the auto import chain.

Chapter three presents the methodological approach including a number of research problems and questions that will be addressed in the thesis. The steps of conducting the research analysis and the empirical research approach will also be discussed.

Chapter four provides a detailed background to the automotive industry and car manufacturers.

Shipping lines and ocean car carriers are examined in chapter five, with a particular focus on importing vehicles through the PoM.

Chapter six discusses port operations and procedures. It includes the role of the PoM, the port corporation, stevedores and the automotive terminals. This will discuss changes in port and terminal operations over time and strategies to cater for a larger influx of imported vehicles.

In chapter seven, the landside operation of the chain will be explored and the role of pre-delivery inspection (PDI) companies, distributers and retailers will be discussed.

Chapter eight provides the analysis and examines the empirical findings against the principles of the conceptual framework.

Final comments and areas for further research are discussed in chapter nine.

Chapter 2 Literature Review and Conceptual Framework

This chapter provides a selective literature review focusing on the notion of ‘integration’ both in the ‘production related supply chain’ journals and in maritime literature. This is followed by discussion of coal export chains in Australia - a model which will be tested and applied to automotive chains through the PoM.

2.1 Supply chain integration and chain efficiency in production industry

The definition and the dimensions of integration as it relates to chain efficiency have been the subject of study in ‘production related supply chains’ for many years. As such, the literature review begins with the definition and clarification of integration and is followed by the 'production-related supply chain' literature and port-oriented chains.

2.1.1 Typology of integration in relation to a firm

There exists non-agreement with regards to the clarification and meaning of integration in relation to a firm, and some discussion of this is helpful. Integration can be internal and limited to the inside boundary of a firm structure (intra-firm integration), or can be external with any entity outside the boundaries of a firm (inter-firm integration). Internal integration refers to any collaborative strategies, coordination operations and synchronised processes that occur inside the boundary of a firm’s structures to improve its business effectiveness, efficiency or performance. However, Romano (2003,p.123) has argued that ‘intra-companies integration is a pre-requisite for inter-companies integration’.

The focus of this research is on inter-firm integration and coordination within a chain. External integration or ‘inter-firm integration’ refers to any collaborative and coordination efforts that occur between a firm and other entities outside its boundaries. The development of inter-firm relationships is most advanced in SCI compared with intra-firm integration (Mellat-Parast & E. Spillan 2014). Most integration concepts discussed in the literature relate to the firms’ dyadic relationships. In this sense, depending on the position of the other entity or firm, we can define different drivers and aspects for external integration. A firm can be defined in three different axes or dimensions (Figure 2.1).

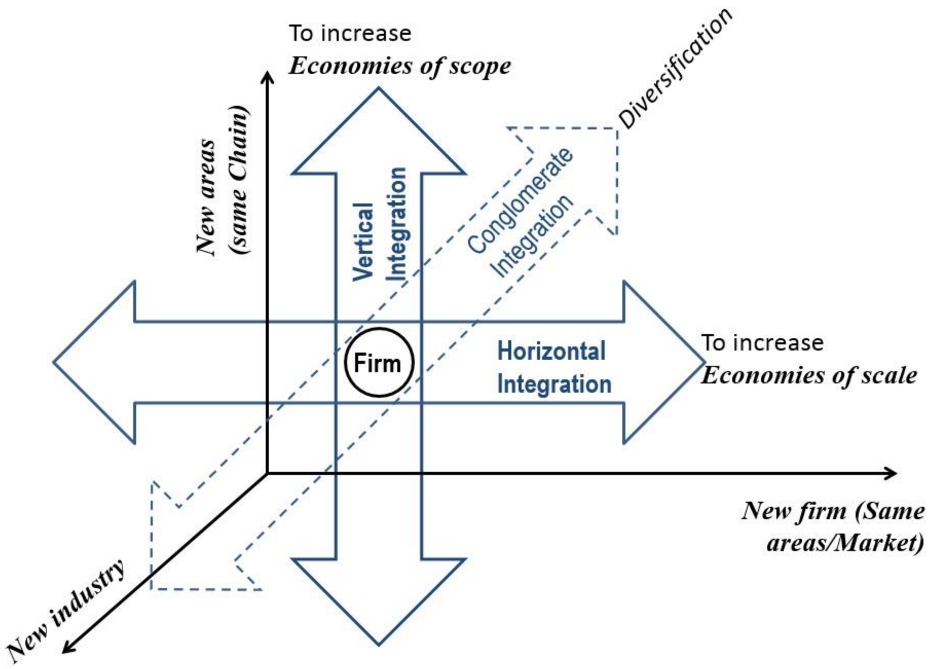

Figure 2.1. Aspects of external integration of two firms.

A firm either tries to be integrated with other firms in the same market to increase its economies of scale (horizontal integration) (Maggi & Mariotti 2010; Reve 1990, p.323), or takes advantage of economies of scope by being integrated with either its customers or suppliers, or a service provider in its supply chain (vertical integration). In some cases, companies may merge and integrate with a firm in a very different industry and context (conglomerate integration) and can expand both economies of scope and scale of a firm (Maggi & Mariotti 2010).

At its lowest level, integration between two separate firms can be a form of cooperation or collaboration to achieve better business results for both parties. Collaboration between two companies in the same market can be set to reach mutually acceptable outcomes such as fixing prices or sharing the market. Integration of two companies in a chain, on the other hand, seeks to smooth the operations between two firms increasing efficiency.

In the higher level of integration, two firms may build up a partnership which sets up a transaction between the two firms whilst retaining the independent essence or quiddity of each firm.

At its highest level, integration between two firms may occur when an acquisition takes place either in the form of merging and creating a new firm, or in the form of being acquired by another firm and going under the umbrella of the acquirer firm. In total, a higher level of dyadic integration occurs when alliances are formed between two firms either in the form of a partnership or in the form of an acquisition.

2.1.2 Supply chain network concept

Robinson (2009) has argued that in order to understand chain and supply chain efficiency it is critical to understand the way in which individual firms do business and operate (Figure 2.2). He argues that firms are embedded not only in chains but also in the markets. In addition, he suggests that 'firms may be under pressure to compete both within their chain and within the wider industry market in which they exist' (Robinson 2013, p.14). Figure 2.2 'effectively underlines the likely complexity involved in explaining a firm's behaviour in a chain - a critical aspect in whole-of-chain analysis' (Robinson 2013, p.14).

Berger and Gattorna (2001) predicted the emergence of a 'new e-Keirets' style of value chain competition that involves horizontally and vertically linked grouping of companies working cooperatively. Huang, Yen and Liu (2014) expanded the SCI concept from a dyadic perspective to a cohesive supply network perspective. In recent research about the development of supply chain management (SCM), Stevens, GC and Johnson (2016, p.29) argued that the SCI concept and practice has developed since the 1980s from an intra-firm integration to inter-firm integration 'as there was a limited amount of performance improvement that could be achieved without involving suppliers and customers'. Later this 'inter-firm integration' was extended to network based integration as 'firms understood that supply chains were non-linear networks'. The authors claim that, in recent times, due to the increased complexity, risk and costs borne by focal firms who are attempting to manage large networks, more firms are undergoing a transition to collaborative supply chain clusters which are smaller networks that are more easily managed.

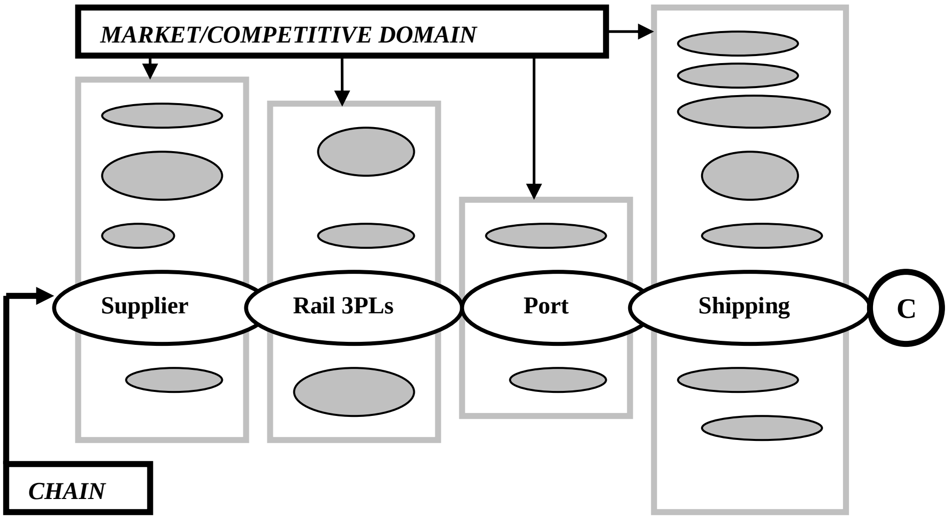

Figure 2.2. A schematic model of supply chain network.
Source: Modified from Robinson (2009, p.24).

2.1.3 Integration, efficiency and performance

SCI literature as part of SCM suffers from a lack of clarity and consistency in definitions (Chen, Paulraj & Lado 2004; Huang, Yen & Liu 2014; Van der Vaart & Van Donk 2008). Relatively few authors have tried to provide a formal definition for SCI (Flynn, Huo & Zhao 2010; Narasimhan & Das 2001; O'Leary-Kelly & Flores 2002; Pagell 2004; Palomero & Chalmeta 2014 ; Romano 2003; Wang et al. 2016). Some researchers (Narasimhan & Das 2001; Wang et al. 2016) have referred to 'integration' as a 'strategy' that companies may choose for improving their business performance. Others (Flynn, Huo & Zhao 2010; O'Leary-Kelly & Flores 2002; Zhao et al. 2008) draw attention to the optimality of the integration concept and the fact that there are different levels and scopes for 'integration' in supply chains. For example, Flynn, Huo and Zhao (2010) and Zhao et al. (2008) provide a similar definition for 'integration' and describe it as the level of collaboration of a firm with its supply chain network to improve the efficiency and effectiveness of operational interactions as well as material, information and money flow within the chain, with the purpose of gaining further value from the chain.

While older definitions of integration emphasise the intra-firm integration concept and limited scope for integration (Pagell 2004), more recent definitions refer to a wider scope of integration across a supply chain network (SCN) and describe it 'as a process of interaction and collaboration' across firms in a supply network (Huang, Yen & Liu 2014) or as

> the alignment, linkage and coordination of people, processes, information, knowledge, and strategies across the supply chain between all points of contact and influence to facilitate the efficient and effective flows of material, money, information, and knowledge in response to customer needs (Stevens, GC & Johnson 2016, p.22).

Palomero and Chalmeta (2014, p.1) define it as 'a competitive business approach for enterprises', claiming that 'integration is a continuous process of improvement of the interactions and collaborations among supply chain network members to improve their ability to work together to reach mutually acceptable outcomes for their organisation' (Palomero & Chalmeta 2014, p.4). Some firms choose to cooperate to reduce cost and increase mutually acceptable outcomes rather than competing for a higher share of a fixed profit.

Frohlich and Westbrook (2001) explained the scope and level of integration of a focal firm with its suppliers and customers in supply chains as 'arcs of integration' and identified five distinct types of arcs based on the direction and degree of each arc (Figure 2.3). The results of their research strongly support the idea that companies with the most extensive arcs (scope) of integration with supplier and customer would have the highest rates of performance improvement. Ten years later, Childerhouse and Towill (2011) confirmed Frohlich and Westbrook's framework for arcs of integration after testing it through statistical analysis on 50 value streams of different industries.

Another study involving more than 600 manufacturing companies in China confirmed the significant link between SCI and firm performance (Flynn, Huo & Zhao 2010).

Yunus and Tadisina (2016, p.91) argue that:

> as firms integrate with their supply chain partners, they will share more information enabling them to reduce the bullwhip effect, work together with key suppliers and customers to reduce costs or solve inventory problems, and collaborate to improve product design and service levels.

Despite significant evidence in support of positive links between different levels of integration and a firm's performance (Alfalla-Luque, Medina-Lopez & Schrage 2012; Childerhouse & Towill 2011; Flynn, Huo & Zhao 2010; Frohlich & Westbrook 2001; M. Beheshti et al. 2014; Prajogo & Olhager 2012), some researchers doubt the positive link between a firm's performance and it's level of integration (Fabbe-Costes & Jahre

2008; Huang, Yen & Liu 2014). However, it would appear that the real question is not whether integration will increase a firm's performance but what is the right level and form of integration (Childerhouse et al. 2011; Das, Narasimhan & Talluri 2006; Jayaram & Tan 2010; Terjesen, Patel & Sanders 2012), and under what conditions integration benefits performance (Huo et al. 2014).

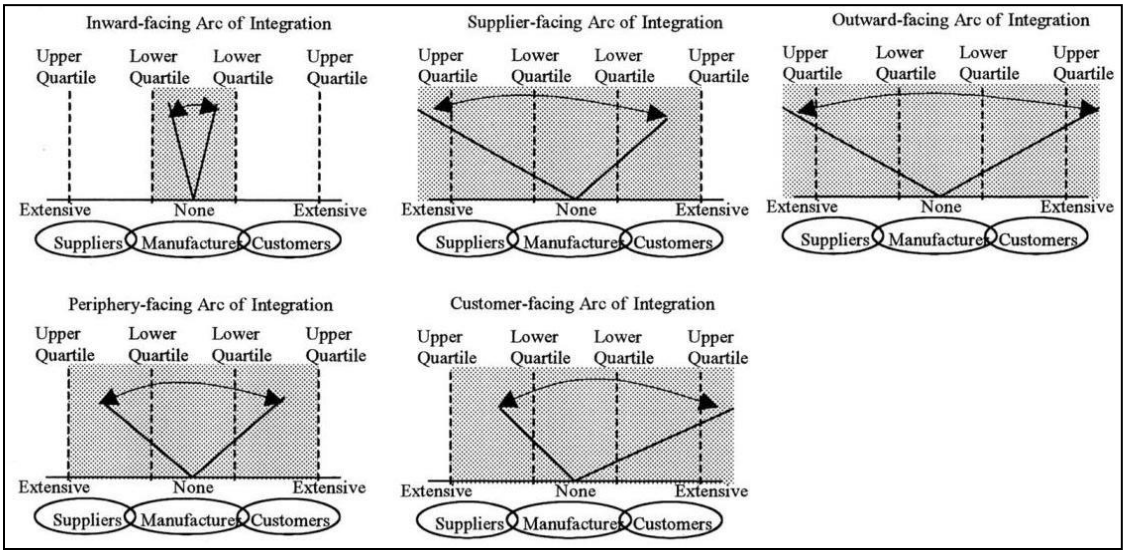

Figure 2.3. Five distinct arcs of integration representing integration of a focal firm with its suppliers and customers.
Source: Adopted from Frohlich and Westbrook (2001, p.191)

Fabbe-Costes and Jahre (2008) and Huang, Yen and Liu (2014) point to possible trade-offs that may exist between integration and the flexibility of a chain.

A further issue is whether 'there has been a clear preference for measuring the performance of the focal firm only, and this is by way of using subjective measures' (Van der Vaart & Van Donk 2008, p.42). Much of the literature has reported that integration of a focal firm with wider scope of suppliers or customers will benefit the focal firm by reducing waste and improving performance (Jayaram & Tan 2010).

> Seamless supply chain linkages improve an organisation's ability to evaluate the performance of upstream supply chain partners beyond the immediate first-tier suppliers. The gains in performance to the focal firm can be in the form of improved efficiencies and responsiveness (Jayaram, Tan & Nachiappan 2010, p.6841).

Chandra and Kumar (2001) argue that increased collaboration between supply chain partners can reduce waste and result in the overall efficiency of the supply chain, and the integration of whole chain is possible by coordination, alignment and control of business functions across the chain to eliminate potential bottlenecks.

As a supply chain becomes more integrated, coordination and effective use of assets will improve the output of the system by reducing waste (Ramdas & Spekman 2000), leading to efficient and effective utilisation of available chain resources, higher efficiency and productivity, and better service quality for the chain's customers (Jayaram, Tan & Nachiappan 2010).

In fact, the purpose of SCM is to manage firms and functional elements within a chain in order to increase the overall performance of the whole chain. According to this perspective every element in the chain should act in a way that maximises the total profit of the whole system and not just a part of it. Hosoda and Disney (2006, p.1308) indicate by way of quantitative research that 'a significant amount of benefit comes from each player in the supply chain doing what is best for itself and the supply chain, rather than doing what is best for its own selfish interests' or for local cost minimisation. Hence, whole-of-chain integration in order to improve the efficiency is an essential issue in the SCI context (Hosoda & Disney 2006, p.1301).

2.1.4 SCI dimensions, mechanisms, and level of integration

Much of the literature shows a 'lack of consent on factors driving and inhibiting SCI practices' (Mustafa Kamal & Irani 2014, p.535). Despite considerable research on the effect of a firm's performance, there is less research on how to achieve integration across a supply chain (Pagell 2004). Some research provides a list of integrative practices or mechanisms for SCI implementation that can help focal firms to increase their scope of integration with their upstream or downstream suppliers or customers in order to increase their operational performance (Alfalla-Luque, Medina-Lopez & Dey 2012; Flynn, Huo & Zhao 2010; Swink, Narasimhan & Wang 2007; Vijayasarathy 2010; Yu et al. 2013).

Alfalla-Luque, Medina-Lopez and Dey (2012) lists 22 variables extracted from earlier literature relating to the integration of a focal firm with its first-tier suppliers and customers within three dimensions of SCI including 'information integration', 'coordination and resource sharing' and 'organizational relationship linkages' (Alfalla-Luque, Medina-Lopez & Dey 2012). Some of these variables are SCI practices such as collaborative planning, process integration, and sharing of skills, ideas and institutional culture both externally (with customers and suppliers) or internally (within the boundary of the organisation) (Alfalla-Luque, Medina-Lopez & Dey 2012). Others list seven dimensions of operational, strategic, managerial, organisational, technological, financial and environmental SCI driving factors (Mustafa Kamal & Irani 2014). Factors such as ‘effective coordination and communication’, ‘facilitating information sharing’, ‘effective customer service and responsiveness’, and ‘improved product delivery’, and ‘supply chain visibility’ were among the most cited SCI factors for improving performance.

Considering the complexity and inconsistency in the literature about ‘integration’ and ‘SCI’, some researchers have tried to define different levels and scopes for integration of a local firm with its dyadic business partners (Figure 2.3 above) and with both dyadic and non-dyadic business partners in a SCN context (Figure 2.4). As noted above, Frohlich and Westbrook (2001) identified five different possible arcs of integration of a focal firm with its potential customers and suppliers after investigating a global sample of 322 companies to describe the extent, direction and degree these firms are integrated with their customers and suppliers.

In addition, wider scopes of integration such as ‘triadic’ (between three firms in a row in a supply chain), and ‘extended’ (between more than three firms in a supply chain including customers’ customers and suppliers’ suppliers) have been suggested in some literature, for example Fabbe-Costes and Jahre (2007).

The level of SCI in the form of ‘information sharing’ and the ‘interdependencies’ that exist among firms across a small section of the supply chain is noted in Figure 2.4. In this figure, the solid lines indicate ‘high level of knowledge sharing and interdependencies’ and dashed lines represent ‘low level of information sharing and interdependencies’. Based on the strength and number of these lines, the level of SCI can increase. As such, the lowest level of integration in this figure is described as arm’s length transaction supply chain in which there are weak connections between the central firm and its other business partners (suppliers A to D). In the low level of integration supply chain, these links are stronger but there are no links between the suppliers themselves. In the middle level of SCI, weak links in the form of ‘information sharing and interdependencies’ occur among suppliers A to D as well, and in the high level of integration of supply chain there are strong links between the central firm and its suppliers as well as among the suppliers A to D.

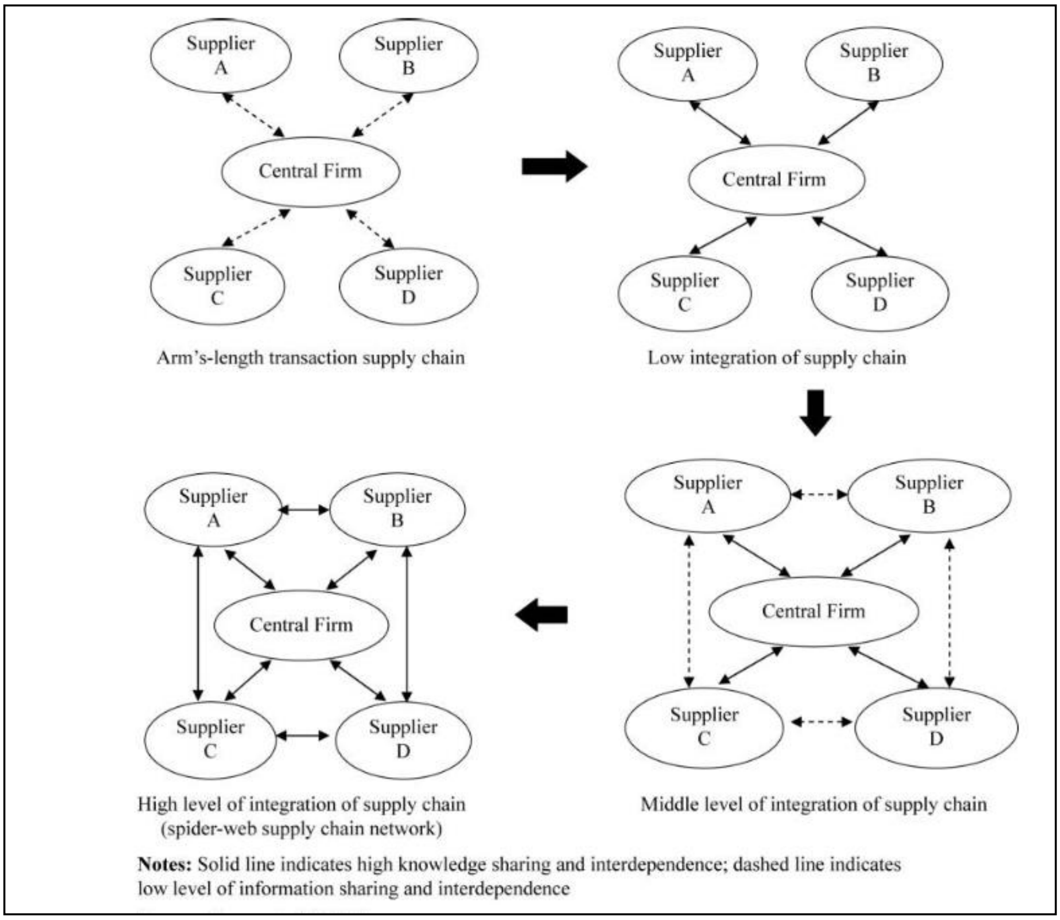

Figure 2.4. Evolution of different levels of SCI from arm's length transaction supply chain to high level of integrated SCN.
Source: Huang et al. cited in Huang, Yen and Liu (2014, p.66)

2.1.5 SCI and efficiency relationship with 3PLs

3PLs are generally firms that provide transportation, storage and warehouse services (Jayaram & Tan 2010). Much of the SCI literature in the past relating to manufacturing industries have neglected the role of 3PLs. In more recent times, however, the attention to the role of 3PLs has increased as researchers begin to understand that integration is important not only between the focal firms and its suppliers or customers but also with 3PLs (Maloni & Carter 2006; Marasco 2008).

In addition, 3PLs are no longer seen as providers of transportation service in SCM but have an extended role from movers of goods to strategic value-added entities such as global system integrators, supply chain solution companies, or managing the entire supply chain (Jayaram & Tan 2010).

Indeed, Lambert (2001) argues that if a company directly adds value to the chain, it should be considered a primary member of the chain. As such, in the integration of the whole chain, the role of 3PLs cannot be underestimated. Arguably, they need to be involved directly in any decision making for more effective integration of the whole chain.

The relationship between the levels of integration with 3PLs and chain performance was investigated by Jayaram and Tan (2010). Although the assumption that 'integration with 3PLs will improve the performance' was not supported by their research, they discovered that firms which integrate with 3PLs exert more effort on performance evaluation than firms which do not integrate with 3PLs. The researchers also found that developing trust among chain players is a prerequisite to developing inter-organisational integration. In these circumstances, the role of 3PLs as managers of entire supply chains is more important (Jayaram & Tan 2010).

Mortensen and Lemoine (2008, p.331) investigated the extent of the level of integration between manufacturers and 3PLs and found that the future of the 3PL 'industry is expected to be characterised by more standardised services, more segmented markets for the various services, and more intense competition'.

Lai, Ngai and Cheng (2004) compared the performance of 3PLs to other participants in the logistics sectors such as freight forwarder in both sea and air transport. Research from both cost and service perspectives revealed that 3PLs enjoyed a higher level of supply chain performance in transport logistics than other sectors in freight forwarding or in aviation and maritime transportation. It was concluded that 3PLs are more involved in chain operations and interactions with other chain members compared with other sectors (freight forwarding of air and sea transport) because of the nature of their business that covers a wide range of logistic services such as product transportation, processing, storage and other value-added activities (Lai, Ngai & Cheng 2004).

2.1.6 Summary of the gaps in production context

A detailed review of the relevant literature in supply chain and logistics has revealed some important gaps. In summary, there is confusion about the definition of integration, its scope and relationship with efficiency, role of companies in the market place and within chains, and the definition of chain and chain members. Some neglect to consider important issues such as a 'whole-of-chain integration perspective rather than partial integration' and 'coordinated long term planning and investment' in SCI. In addition, there have been methodological flaws in the analysis of the relationship between SCI and efficiency, and a 'lack of case study research and applicable solutions for SCI as a whole' is also apparent.

In addition, it seems that the concept of inter-firm integration in the majority of contemporary mainstream literature is linked to the notion of integration as 'collaborative attitude', 'communication', 'commitment', 'trust' and 'shared thinking and decision making' whilst in reality the story is different for a number of reasons (Robinson 2015).

Firstly, much of the literature in the SCI context has focused on the dyadic relationships or a limited scope of integration between focal firms and first or second tier suppliers and customers. In many instances, although integration of the whole chain was considered important in their discussion, very few measured SCI in an extended scope (Fabbe-Costes & Jahre 2007). It appears that the management of supply chains has been left to chance. What we can see from much of the literature in SCI are solutions and strategies to increase the integration of a focal firm in order to maximise its performance. Lack of applicable solutions for SCI as a whole is apparent in the literature and 'supply chain practice seldom resembles the theoretical ideal' (Fawcett & Magnan 2002, p.399). In fact 'most companies are currently engaged at the first level of SCM sophistication' (Fawcett & Magnan 2002, p.359).

Secondly, Lambert (2001, p.103) argues that a major weakness in the SCI literature relates to the weakness of whole literatures in the SCM context, with fewer efforts being made to recognise supply chain members because 'the authors appear to assume that everybody knows who is a member of the supply chain' (Lambert 2001, p.103). Consequently, in order to make a whole chain efficient, mapping the chain and its key members is required from the point of origin to the point of consumption. Following the analysis of the value propositions and core competencies within the chain, and the appropriate evaluation of existing and future supply chain relationships, a successfully integrated chain can be designed which will increase the overall benefits for the chain and chain members (Fawcett & Magnan 2002).

One common traditional assumption in the management of supply chains is to separate elements of a system and focus on each element separately in order to increase individual performance. However, performance maximisation of each element in a system does not necessarily maximise the performance of the whole system. Jayaram, Tan and Nachiappan (2010, p.6852) argue that ‘supply chain performance depends on how well supply chain partners work together and not on how well each partner performs individually’, ‘as firms pursue different goals’. The conflict in goals between firms is likely to lead to the creation of conflicts among members’ operational actions and cause the erosion of value within the chain.

A further problem arising from the separation of the elements of a system for analysis is through the elimination of chain members’ dependencies and interactions of the whole system. These eliminations can alter the understanding of the system and lead to wrong judgments and analysis of the whole system.

Therefore, it can be concluded that partial optimisation of a chain does not provide solutions to making the whole chain integrated and efficient. However, the findings of researchers for extending the scope of integration of a focal firm embedded in a chain can help us to achieve our goal for whole chain integration. For example, it was found in many papers that integration of material and information flow between two parties can increase their level of integration and can help to improve the operational performance of players (Alfalla-Luque, Medina-Lopez & Schrage 2012; Childerhouse, Disney & Towill 2004; Childerhouse & Towill 2011; Lam & van de Voorde 2011; Prajogo & Olhager 2012).

Nevertheless, what these studies have provided are some guidelines for whole-of-chain integration. For example, the need for system thinking and a holistic approach to SCI has been recognised by some researchers. Childerhouse and Towill (2011, p.7454) highlighted the idea that the wider scope of integration is ‘more likely to be aiming for a seamless supply chain where ‘all players think and act as one’ (Towill 1997)’. However, two decades later, Sweeney (2011, p.15 & p.20) still draws our attention to focus on ‘wider cross-functional and inter-organisational integration’ and a ‘more holistic approach to SCI’, and it was noted in another paper that ‘despite extensive research in the area of SCI, a comprehensive and integrated approach is missing’ (Alfalla-Luque, Medina-Lopez & Dey 2012, p.1).

2.2 Supply chain integration and efficiency in the maritime sector

By the year 2000 logistics and supply chain researchers and professionals expressed the need not only for the internal efficiency of firms but also efficiency in the product distribution chain from the producers or suppliers to buyers or customers. In 1999, for example, Poirier noted that ‘the new supply chain game is becoming a competition between effective supply network rather than individual cooperation’ (Poirier 1999, p.7).

By 2000 there were many changes taking place in freight transport, operations and the freight markets. Increased volumes of freight, extensive use of containerisation which had been underway since the late 1990s, changes were taking place in the shipping markets and networks, and extensive rationalisation and restructuring of the 3PLs to create new efficiencies in reliability, quality of services and time demanded by shippers.

Ports as ‘four-modal nodes where ocean ships, short-sea/river ships, and road and rail modes converge’ (Almotairi & Lumsden 2009, p.204) and which are, potentially at least, critical bottlenecks in chain infrastructure, came under particular scrutiny. Chain firms were, in fact, focusing on internal restructuring as well as on the critical issue of chain integration and efficiency. The maritime literature reflected the changing function of ports as elements in value-driven chains rather than as stand-alone service providers, and questioned issues related to their integration into supply chains (Robinson, Weston & Everett 2012). Subsequent research focused on related issues such as the key importance of chain structures and that ports are embedded in chains influencing shippers in choosing a port (Magala & Sammons 2008). Notteboom and Rodrigue (2005) stressed the need to consider logistics integration and inland freight distribution networks for port regionalisation, and Woo, Pettit and Beresford (2011) added logistics elements to value-added activities to the port’s performance evaluation framework.

In further research, a model consisting of six conceptualised parameters, including value-added services and the degree of inter-connectivity with inland modes of transport, were developed in order to evaluate the extent of port integration in supply chains (Song & Panayides 2008). Lam and van de Voorde (2011) extended the idea of integration to container shipping as an integrated chain, and suggested that integration 'can bind the partners in a cooperative relationship that enables the organisations to accomplish their goals collectively and efficiently' (Lam 2010, p.68). In a recent study on port SCI, the authors supported the idea that companies across the SCN should cooperate and take a holistic approach toward SCI and that 'cooperation between different organizations within the port is essential' (Stevens, LCE & Vis 2016, p.270). In this research, port SCI was defined as 'the extent to which a port authority plans, organizes, and coordinates activities, processes, and procedures related to physical, information, and financial flows beyond its own gates along the supply chain and monitors performance in such activities' (Stevens, LCE & Vis 2016, p.262).

Much of the research relating to integration and efficiency issues within a maritime context was undertaken by Robinson (2002, 2003, 2004, 2006, 2007a, 2007b, 2008, 2009, 2010, 2013, 2015; 2012) who argued that the level of SCI and performance are inextricably linked and that companies which are broadly integrated and embedded in chains tend to be more competitive.

Robinson notes Cox's findings that power regimes may have significant influence on integrating chain systems. Cox argued that supply chain networks tend to be disintegrated because of unfavourable power regimes that interrupt the flow of value from end-user to the raw material provider (Robinson 2007b).

Robinson, however, focused on improving the efficiency of maritime trade chains and sought practical solutions to disintegration in maritime chains. He later expanded on this and argued that beside power and power relationships as Cox et al. (2002) had noted, the business model of the chain network was also influential on the structure, architecture and integration level in the chain. Firms in supply chains are 'differentiated by the business model which they embrace and which underlies the strategies which they adopt' (Robinson 2007b, p.96).

A business model, he suggested, not only impacts on the behaviour and operation of a single firm within a chain, but will also impact on the architecture and dynamic of a chain and indicate integrative or disintegrative strategies of the chain (Robinson 2009, p.20). Furthermore, Robinson noted that some business models are inherently more integrated than others (Robinson 2010). 'A demand-pull customer oriented distribution model was likely to achieve significant efficiency by leveraging control through the chain' (Robinson 2009, p.246). Furthermore, he found that in the east coast Australian coal chains, having the ability to link coal on the stockpiles to coincide with ship arrival significantly improved chain efficiency by eliminating bottlenecks – a common occurrence at the terminal. Similarly, the differences in operating hours between warehouses and terminals in the container chains were the cause of congestion and bottlenecks. Ports are 24 hour a day operations whereas warehousing, where the containers are moved and unpacked, operate 10 hours per day, five days per week.

Robinson indicated the levels of integration occurring in recent decades (Figure 2.5) suggesting that

> as freight volumes increase, corporate structures on both the blue water (shipping) segment and the land-based segment of freight flows (from the port to the final customer) seek economies of scale (and, indeed, economies of scope and of density) and significant rationalisation and functional integration occur (Robinson 2002, p.249).

Figure 2.5 suggests that the underlying modifications and consolidation and rationalisation of activities taking place in port-oriented freight chains significantly reduces the occurrence of bottlenecks.

The initial conditions in Figure 2.5 indicate the pathway of many individual firms and third-party service providers in a highly disintegrated transport chain. Each function of the individual firm is discrete and performed in isolation of other chain participants. This segmented chain represents an inefficient chain in which individual firms work for their own profit and to maximise the value they capture from the chain as an independent element. Figure 2.5 indicates the evolution of the chain from an inefficient segmented chain to an efficient integrated chain with high levels of cross functional integration of business processes (Robinson 2002).

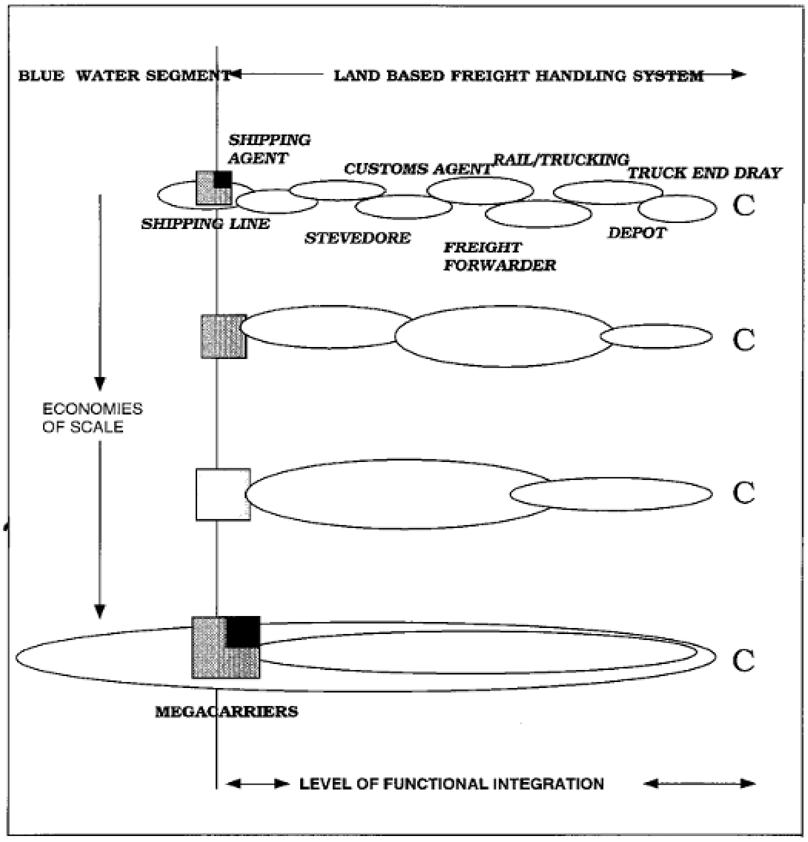

Figure 2.5. Level of integration in port-oriented supply chain.
Source: Robinson (2002, p.249)

Robinson (2015) applied this concept further to major export coal chains in Australia and argued that despite their differences in terms of supply chain dynamics and characteristics with the manufacturing supply chains, the firms in bulk freight chains are more likely to adopt integrative business strategies than firms in other supply chains. Robinson argued that the business strategy approach of Greenwald and Kahn (2005) and their 'single intelligence model of cooperation' resonates with particular real-world supply chains and has significant merit. Robinson (2015) adopted Greenwald and Kahn's framework to port-oriented bulk freight chains, arguing that these chains are likely to be more attracted to cooperative strategies, to behave rationally, and to produce optimal mutual outcomes. He noted three conditions: size of the firm; ability to capture economies of scale; and firms operating in an operating environment in which they can exert a level of monopoly control.

2.3 Conceptual framework

For the purpose of this research, integration is defined as ‘a continuous process of improvement of the interactions and collaboration among supply chain network members to improve their ability to work together to reach mutually acceptable outcomes for their organisation’ (Palomero & Chalmeta 2014, p.4). We consider integration as an optional strategy for individual firms participating in a supply chain network, and not as an absolute remedy for every supply chain network.

For a firm in a supply chain network, integration with other firms in any form, including collaboration, coordination, horizontal alliances, or vertical, is a ‘competitive business approach for enterprises’ (Palomero & Chalmeta 2014, p.4). Some firms choose to cooperate to reduce cost and increase mutually acceptable outcomes rather than competing for a higher share of a fixed profit (Palomero & Chalmeta 2014), while others may have cooperative strategies imposed on them by an external entity such as a regulator.

It was noted above that in both production based and maritime chains, there is a need for a more ‘holistic’ and ‘comprehensive and integrated’ approach to chain integration. It further called for the need to address and clarify the complexity of chain networks, strategies of firms in markets and in chains, identify the drivers of effective integration, and ‘to work collaboratively to generate mutual gains and savings’ (Lambert and Pohlen cited in Robinson 2015, p. 193).

Two recent case studies of bulk coal export chains in Australia, the Goonyella coal chain in Queensland and the HVCC in New South Wales, provide evidence of effective efforts to implement SCI, and suggest that this is likely an appropriate model to achieve SCI in auto chains. The events of both case studies occurred at the time of the recent resources boom which was associated with increasing demand for Australian coal Australia (Everett & Weston 2011). Each case study is explained briefly below:

2.3.1 Goonyella coal chain

The Goonyella coal chain comprises two terminals - the dedicated Hay Point terminal services BHP/BMA export coal and the common user Dalrymple Bay Coal Terminal

(DBCT). The coal from Goonyella region in Northern Queensland is transferred by a dedicated rail operation serving both DBCT and Hay Point.

DBCT was completed in 1983 with a 15 million tonne (mt) capacity, and was developed and operated by the government of Queensland. By 2001 the rapid growth of coal and the failure to upgrade the terminal put significant pressure on existing infrastructure, causing congestion at the port, long ship queues (up to 70 at any one time for an average of 20 days), and associated demurrage costs because much of the coal was exported under free on board (FOB) contracts of sale. The terminal, as noted above, had been developed and was operated by the Queensland Government, although it was privatised in 2001 when it was sold to Babcock and Brown. The situation between 2004 and 2005 reached an unacceptable level for all chain players, and triggered an inefficient chain with high demurrage costs and delays of coal delivery to the end-customer (Robinson 2007b).

Following increasing congestion and dysfunction of the chain over a period of five years, the Australian Competition and Consumer Commission (ACCC) intervened, granting authorisation to the terminal operator to act as channel master for three years from April 2005. Authorisation meant immunity from legal action under the Trade Practices Act 1974 and a queue management system was set in place, resulting in a change in the operating model from a supply-push to a demand-pull model. The new queueing system resulted in the change of the coal supply chain business model from supply-push to demand-pull, creating a more stable system. The authorisation process allowed the terminal operator of DBCT to act as a monopolist and grant immunity by the regulator under the Trade Practices Act 1974 on the basis that ‘the public interest may not always be served by the operation of unconstrained competitive markets’ (Robinson 2007b, p.89).

The mismatch between coal and ship arrival at the terminal was the major cause of congestion and bottlenecks at the port. The change to the demand-pull model linking coal and ship arrival was the enabler of chain integration. After the three-year period imposed by the regulator was lifted, the uncoordinated and random coal and ship arrival once again created bottlenecks and congestion.

2.3.2 Hunter Valley coal chain (HVCC)

From mid-2000 the pressure on chain infrastructure facilities in the HVCC in NSW also increased due to a growing demand. Long ship queues at the port of Newcastle (exporting in excess of 100 mt annually) on a railway network of limited capacity caused the bottleneck. Like the Goonyella coal chain, congestion led to authorisation and a Capacity Distribution System (CDS) was set in place. Unlike the Goonyella coal chain, there was not a single dedicated railway line serving the HVCC. Rather, a single railway carrying 100 mt of coal annually was shared with passenger trains (which have priority over freight trains), as well as the transporting of other commodities such as grain. Due to cost and environmental factors, it was not feasible to duplicate the track.

Similar to developments in the Goonyella chain, a demand-pull model was set in place in the Hunter Valley under the jurisdiction of the terminal operator, reducing congestion and ship queues to an acceptable level. Unlike the Goonyella coal chain, however, when the three-year period of authorisation expired, participants in the HVCC voluntarily continued the CDS. They cooperatively established an incorporated company - the Hunter Valley Coal Chain Coordinator Limited - in which chain participants were shareholders. The company replaced the terminal operator as the controlling body. Consequently, the chain was, and remains, integrated under a system of mutual interest to meet the demands of all participants. As a result, integrative chain efficiency was achieved in the HVCC through the mutual adjustment of all participants and implementation of operational efficiency along with investment efficiency (Robinson, Weston & Everett 2012).

The above two case studies provide valuable insights with regards to achieving and maintaining chain efficiency with a particular focus on port-oriented supply chains. In both case studies, SCI was achieved and was initially imposed externally by a regulator granting authorisation to the terminal operators to act as channel masters, imposing control and management over the whole chain (Robinson 2015). In the case of the HVCC, however, although integration was initially imposed by the regulator, it was subsequently adopted 'internally and voluntarily' through the cooperation of the members of the chain. A 'cooperative equilibrium' model was adopted to maintain chain efficiency through mutual adjustment and implementation of operational efficiency along with investment efficiency (Robinson, Weston & Everett 2012).

This thesis seeks to apply the principles of integration in the above coal chains to the automotive import chains. A conceptual framework is proposed which illustrates different levels of SCI amongst the members in a particular supply chain network (Figure 2.6) and also the possible models for achieving an integrated supply chain network (Figure 2.7).

Figure 2.6 shows the level of integration across SCNs and the factors that affect the position of a particular SCN in that line (scope) that is between a fully fragmented supply chain network (C1) and a fully integrated supply chain network (C4). According to this figure, the structure of a SCN, its underlining business model, and the dynamics of the chain, will influence the level of integration in that SCN. Figure 2.6 does not provide any scale or discrete level for integration in a SCN because, considering the complexity of SCNs, it is unrealistic to provide a quantitative measure for integration of a chain. As such, Figure 2.6 is an adaptation and alteration of Figure 2.5 in which the evolution of different levels of SCI was illustrated.

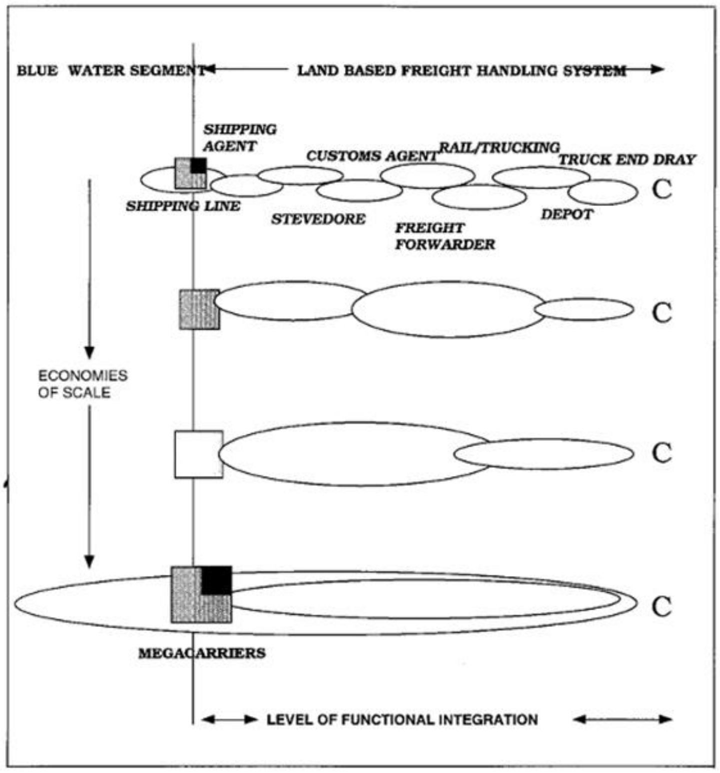

Figure 2.6. Level of integration in port-oriented supply chain.
Source: Robinson (2002, p.249)

As noted above, the integration of a whole chain is either imposed by a regulator as it occurred in both the coal export chains over a short period; or adopted voluntarily through the internal cooperation of all chain members as occurred in the HVCC. Arguably, Figure 2.7 illustrates possible models for achieving an integrated supply chain network and the integrative mechanisms that are used to make an integrated SCN. According to this figure, the 'Voluntary model' which was initially a direction by the regulator, was subsequently implemented voluntarily by the participants in the chain in order to maximise efficiency and increase value captured by the chain. The 'Voluntary model' resembles a 'cooperative equilibrium' model in which individual players cooperate to maximise the overall output of the chain rather than competing individually which is likely to lead to chain disintegration.

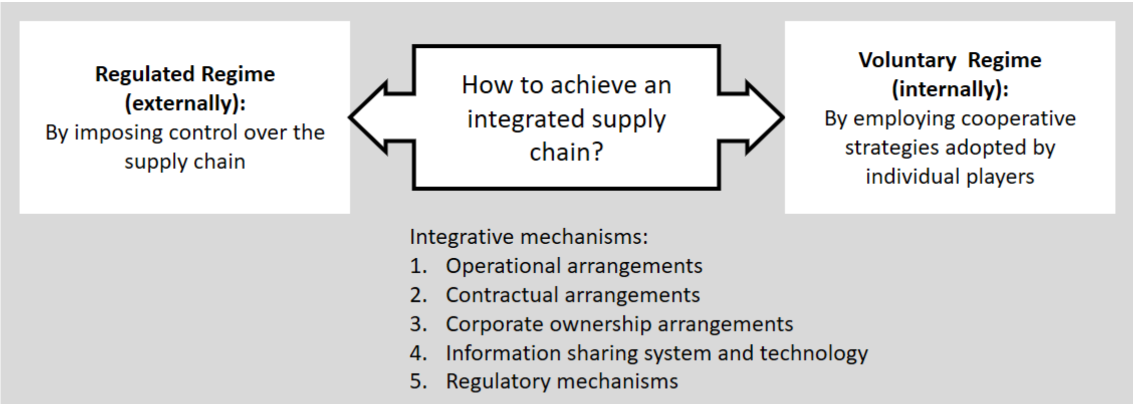

Figure 2.7.Possible models for achieving an integrated supply chain network and the integrative mechanisms that are used to make an integrated SCN.

This conceptual framework might suggest valuable insights into other and all port-focused chains. However, since supply chains and chain systems are significantly different in structure, in dynamics, in business models, and other aspects, a conceptual framework that makes claims for a 'special class' of port-dependent chains indicates the problem of applicability and generality for other port-oriented chains. It also raises other questions such as to what extent does this proposed conceptualisation apply to other port-oriented chains either in a generic or more specific way? Is this framework internally consistent? Or does it offer real-world, problem solving relevance?

Because chains are exceptionally complex and at times the impact of random events, uncertainty, complex inter-firm relationships, policy and regulatory constraints must be understood in terms of chain analysis. Further empirical studies to understand chain integration concepts and mechanisms is recommended.

This research is conducted to test this new conceptualisation within a detailed, rigorous, analytical case study framework in one of the current nationally significant port-dependent chains in Australia: the ‘finished vehicle’ import chain through the PoM. The detail of the research methodology and the case study will be discussed in the next chapter.

2.4 Conclusion

In this chapter, a conceptual framework was developed based on the two recent coal chain case studies in Australia as well as a comprehensive literature review with the subject of SCI and efficiency in two sectors of production industry and maritime research. This conceptual framework proposes possible models and integrative mechanisms for achieving an integrated supply chain network in port-oriented freight chains.

Chapter 3 Research Methodology

3.1 Introduction

The primary focus of this study is to identify and examine the relationship between chain integration and efficiency. It does so relying on two case studies in the bulk export sector and seeks to apply those concepts and principles to the automotive import chain. The methodology and justification for the use of case studies will be analysed and argued in this chapter.

This thesis focuses on chain integration and efficiency relationships. In particular, it focuses on those issues which an intensive literature review has revealed are areas of neglect or misunderstanding in the absence of an adequate framework within which to understand chain integration and efficiency relationships. Further, it does so against a conceptual framework which has emerged from recent research on Australian coal export chains by Robinson (2007a, 2007b, 2013) and Everett and Robinson (2007). The thesis seeks to test this conceptual framework developed for a coal export chain, and tests these concepts on automobile import chains from the manufacturers' plants through the PoM and ultimately to retail customers.

This thesis adopts a case study approach which is an increasingly popular form of research (Gerring 2006). Case studies are a form of qualitative research and 'are intensive analyses and descriptions of a single unit or system bounded by space and time' (Hancock & Algozzine 2006, p.9 & P.11). Case study analysis can be defined as 'an intensive study of a single unit or a small number of units with the aim to generalise across a larger set of units' (Gerring 2004, p. 341). In addition, it has been defined as a choice of a defined unit or item to be studied which has clear boundaries as opposed to a topic or focus such as a single community, group or persons (Merriam 2009). A single case study is suitable when that study presents a critical case to test a well-formulated theory (Ellram 1996, p.101), one in which

> the theory has specified a clear set of propositions as well as the circumstances within which the propositions are believed to be true. A single case, meeting all of the conditions for testing the theory, can confirm, challenge or extend the theory. The single case can then be used to determine whether the theory's propositions are correct or whether some alternative set of explanations might be more relevant (Yin 2009, p.47).

This research aims to test a theory that has emerged from two coal export chain case studies, with more insight added from a comprehensive literature review and the principles applied to another but quite different case study. Eisenhardt, Kathleen M (2002, p.544) argues that 'an essential feature of theory building is comparison of the emergent concepts, theory or hypotheses with the extant literature ...a key to this process is to consider a broad range of literature'. The literature, he argues, is important in discussing similar findings as it 'ties together underlying similarities in phenomena normally not associated with each other. The result is often a theory with stronger internal validity, wider generalisability, and higher conceptual level' (Eisenhardt, Kathleen M 2002, p.544).

Testing this developed conceptual framework on a port-oriented automotive import chain will create a more robust theory because 'the propositions are more deeply grounded in varied empirical evidence' (Eisenhardt, Kathleen M. & Graebner 2007, p.27). Consequently, conducting this research and adopting a single case study approach was selected as the most appropriate approach for this exploratory kind of research.

In addition, according to Yin (2009) and as noted above, a single case study may involve more than one unit of analysis. These incorporated subunits of analysis will require a more complex or embedded design and can often add significant opportunities for extensive analysis which enhances the insight and robustness of a single case study. For the purpose of this research, the whole automotive import supply chain network is considered as a single case study, one in which many firms are embedded.

Figure 3.1 shows a generic design of a port-oriented automotive import chain. This figure demonstrates the finished vehicle import chain through the port of Melbourne. It includes car manufacturers as the main suppliers of this chain and exporters of their manufactured vehicles to Australia; shipping lines transporting cargo to the discharge port; stevedores transferring imported vehicles from the vessels into the terminal yard; terminal operators managing the automotive terminals providing temporary storage and space for imported vehicles until the custom and inspection procedures are complete; PDI operators performing further processing and preparation on the imported vehicles; and finally to the dealerships to sell the imported vehicles to the final consumers.

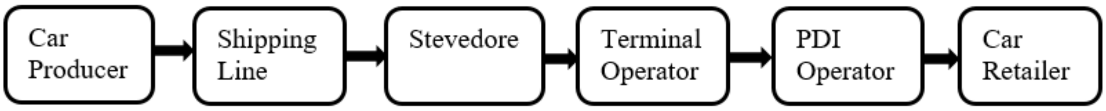

Figure 3.1. A generic port-oriented automotive import chain.

3.1.1 Why automotive import chain through the PoM was selected as the case study

This section provides the rationale and justification for the selection of automobile chains for the case study. This research seeks to test a conceptual framework developed from coal export chains while applying the principles to a quite different product (finished manufactured automobiles). Selecting an import port-oriented chain with a different business model and a different commodity than the coal chains provides more variation in this field of research in order to achieve a wider and broader view of port-oriented freight chains. In addition, it highlights the integrating mechanisms imposed and sought by chain members.

The finished automobiles compared with other commodities which are imported to Australia, in terms of size and value, are considered to be the preferred case study for this research, being a high value, voluminous luxury commodity and their only economical means of transport is by specially designed car carrying vessels. Note that some high value luxury vehicles are transported in containers but the numbers are relatively low and are not the focus of this study. The majority of imported vehicles are processed through separate RoRo facilities. In addition, with a few landside 3PLs, the mapping of the automotive import logistic network and its analysis was considered to be feasible within the limitation of this study.

In addition, the automotive industry has in the past been a pioneer in developing supply chain efficiency concepts, strategies and industrial engineering techniques that eliminate waste and increase productivity, as well as creating efficiency in the entire end-to-end supply chain. For many years automobile manufacturers have tended to focus on the optimisation of their supply chain network on the supply side, or upstream of their production process, but recently their approach has changed and they are now focusing on the downstream of the chain (Carbone, V & De Martino 2003b). As such, finding similar approaches in the distribution part of this study is more likely than with many other commodities.

Furthermore, a lack of research in the field of imported automotive chains in Australia has been another convincing reason to choose this case study material. Despite a number of studies of auto supply chains in Europe and the US (Carbone, V & De Martino 2003b; Hall & Olivier 2005) and despite the fact that the 'automobile trade is a major sector in the Australian economy' and 'motor vehicles are the largest non-containerized commodity handled at the ports' in Australia (Victoria Department of Transport 2011, p.9), no major study of the automobile import trade has been completed in Australia; and certainly few, if any, studies have examined the trade in terms of its integration and efficiency within a whole-of-chain context. This issue became increasingly relevant and important to the researcher when it was revealed that the 'Australian passenger car market is one of the most open and progressive automotive markets in the world' (Federal Chamber of Automotive Industries 2014b, p.5), making it one of the most competitive markets in the world - one which is small in size but very varied in terms of variety of brands and models.

Finally, at the time of conducting this research, of the four car manufacturers operating in Australia in the past, one had ceased production and the remaining three announced the closure of their production plants by the end of 2017. The cessation of domestic vehicle production in Australia means that the Australian automotive market, from the end of 2017 onwards, must rely completely on imported vehicles. Consequently, the existing port infrastructure will be required to provide appropriate capacity to not only replace the domestic vehicle consumption with the imported vehicles from overseas but also cope with the increasing demand for importing vehicles.

Selecting this case study can provide a useful contribution to the automotive industry in Australia, especially the state of Victoria. This case study will help identify the most effective integrating practices and policies for the efficient utilisation of available infrastructure and aid to enlighten the need for future development and planning for the importation of automobiles to Australia in general and particularly to Melbourne.

3.2 The research problem and questions

Past research into SCI shows that despite the awareness that integration creates value and avoids value erosion in the chain networks, the majority of supply chains are fragmented or disintegrated. As a result, value is eroded in inefficient fragmented chains because 'companies are failing in their attempts at internal and external integration' (Jayaram & Tan 2010, p.262) and 'most companies are currently engaged at the first level of SCM sophistication' (Fawcett & Magnan 2002, p.359). In addition, the relationship between efficiency and integration is neither well understood nor practiced by all players in the supply chain. Knowing these facts about the real-world, SCI practice creates a challenge regarding how to overcome value erosion and make a more efficient integrated chain.

In an endeavour to find a solution to this widespread problem we start by examining our current knowledge in the literature. Is our knowledge sufficiently well-presented to overcome this problem? An investigation in the current literature review shows that the fundamental cause of this problem may be found in some confusion associated with chain definition and theory building, for example, and some neglected issues in the literature, which has misled our understanding of the whole-of-chain picture.

The literature review indicates that many researchers found ambiguity about the concept of integration and its relationship with efficiency (Van der Vaart and Van Donk (2008) and Chen, Paulraj and Lado (2004)), definition of chain (Van der Vaart and Van Donk (2008); Chen, Paulraj and Lado (2004); and Huang, Yen and Liu (2014)) and chain members (Lambert 2001, p.103), and the simultaneous roles of firms within the chain and market context in the current literature which was pointed out by Robinson (2009, p.24). In addition, neglecting to focus on the whole-of-chain integration rather than just a single part of it has been mentioned by many authors (Towill (1997); Robinson (2009); Sweeney (2011); Childerhouse and Towill (2011); and (Nassirnia & Robinson 2013)). Furthermore, a lack of attention to long-term planning noted by Fawcett and Magnan (2002), Lam (2010) and Lam and van de Voorde (2011), and the role of other influential organisations such as regulators which was raised by Everett (2005, 2007), have made the current theoretical recommendations to achieve SCI ineffective and unrealistic at times. Indeed, as Fawcett and Magnan (2002, p.339) found out, 'supply chain practice seldom resembles the theoretical ideal'. This research tries to provide a more realistic and practical solution to whole-of-chain integration by investigating real-world case studies.

This research focuses on aforementioned issues which an intensive literature review has revealed are areas of neglect. As such, it will raise a number of key problems including:

- The problem of chain definition - a whole-of-chain perspective. Preliminary research has suggested the importance of considering the integration/efficiency relationships within a comprehensive whole-of-chain framework. Figure 3.2 provides a first-step, working definition of the chain elements, and suggests the system focus and complexities of the research involved in understanding the dynamics of system operations.

- The problem of defining the integration/efficiency relationships in the chain. The thesis is not concerned with efficiency as such but the efficiency or otherwise which derives from integrative and disintegrative mechanisms, for example, contractual, power-related, policy, strategic alignment and information-related issues.

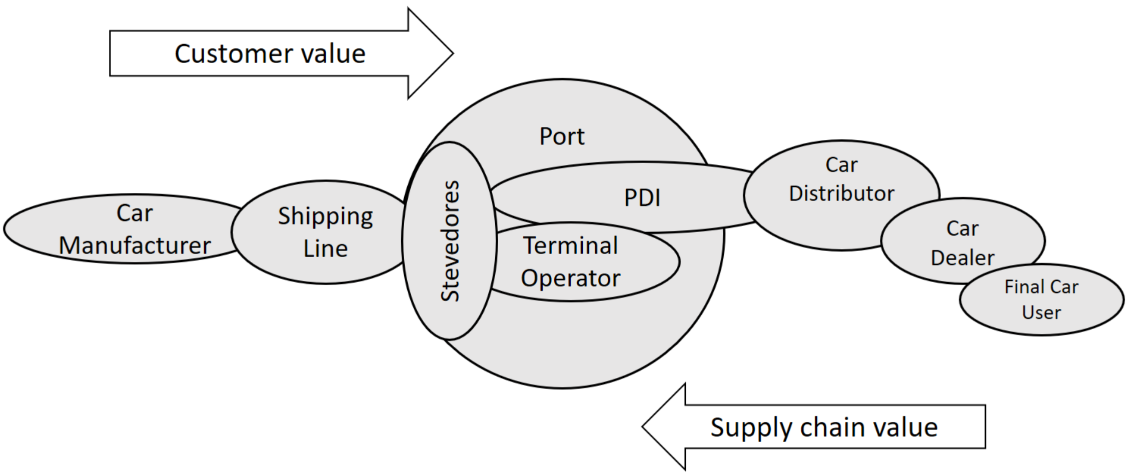

Figure 3.2. Different elements of automotive import chain through the Port of Melbourne.
Source: Modified from Robinson (2001)

- The problems relating to achieving integration across the whole chain, and the preferred strategies that different chain participants choose to increase integration and efficiency of the whole chain, and finding the possible factors that drive integration and efficiency in a chain.

- The problem relating to the lack of a practical and realistic solution for SCI, a new way of thinking and conceptual framework with a focus on the port-oriented freight chains, and particularly on the current nationally significant global 'finished auto' import chains through the PoM.

To find a solution to the above problems, this research aims to bring a new conceptual framework and new type of thinking based on the current evidence of the successful implementation of SCI in some real-world port-oriented chains in Australia to develop the concept of chain integration/efficiency relationships. Recent papers, focusing on maritime and port-related bulk chains for export coal, have in fact proposed what is arguably an adequate and appropriate conceptual framework within which to examine the chain integration/efficiency relationships (Everett 2007; Everett & Robinson 2007; Nassirnia & Robinson 2013; Robinson 2007b, 2009, 2010, 2013; Robinson, Weston & Everett 2012). The papers have called for: a more precise definition of chain structure, dynamics and function; a more adequate basis for understanding integrating mechanisms; a cohesive statement of chain efficiency and its drivers; and a framework for defining, implementing and evaluating cooperative equilibrium as a design strategy for chains and supply chains.

This thesis seeks to test the adequacy and effectiveness of the new conceptual framework by means of a detailed case study of real-world, nationally important, high value 'finished auto' import chains through the PoM.

We have adopted the conceptual framework that emerged from the coal export chain case studies in Australia (Robinson 2007b; Robinson, Weston & Everett 2012) and based on a comprehensive literature review in production-based chains as well as maritime-related chains. According to this conceptual framework, the integration of a whole-of-chain approach is either imposed by a regulator as occurred in both coal export chains over a short period, or adopted voluntarily through the internal cooperation of all chain members, as occurred in the HVCC. Based on this evidence, Figure 3.3 illustrates possible models for achieving an integrated supply chain network and the integrative mechanisms that are used to integrate the chain. According to this figure, the ‘Voluntary model’, which was initially a direction by the regulator, was subsequently implemented voluntarily by the participants in the chain in order to maximise efficiency and increase value captured by the chain. The ‘Voluntary model’ resembles a 'cooperative equilibrium' model in which individual players cooperate to maximise the overall output of the chain rather than compete individually which is likely to lead to chain disintegration.

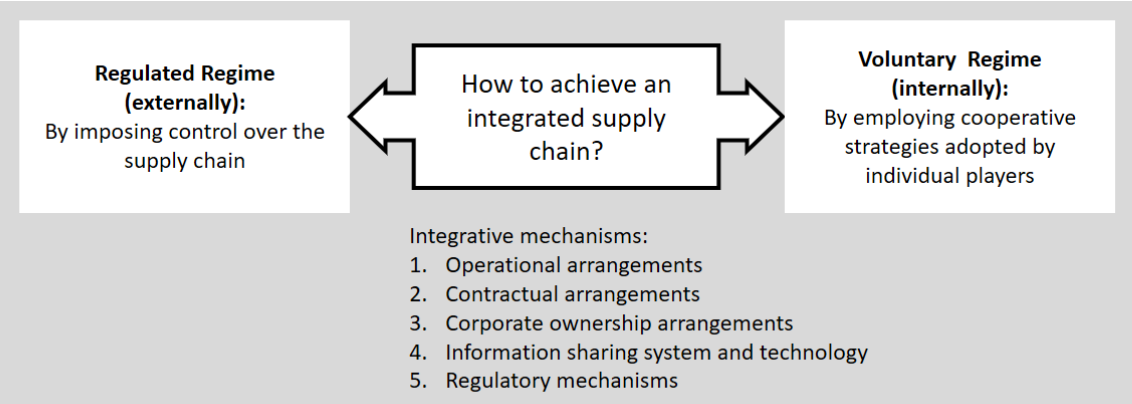

Figure 3.3. Possible models for achieving an integrated SCN and the integrative mechanisms used.

This conceptual framework is tested by applying it to the auto chain, and the following questions have been designed to test the proposed conceptual framework:

A To what extent is the new vehicle import chain through PoM integrated and efficient?

B Does it represent a voluntary regime or is it an externally regulated regime?

C How was integration achieved in this case study? Which particular integrating mechanisms were adopted and practiced by the members of this chain to enhance the integration and efficiency of the chain?

Question A of this study attempts to analyse the new vehicle importation chain network through the PoM in terms of efficiency and levels of integration. Although this research does not seek to provide a quantitative score for the level of chain integration, the qualitative analysis will identify and demonstrate the extent of integration.

Question B seeks to determine whether the strategy is cooperative and adopted voluntarily or whether it is imposed by the regulator or another external body.

Question C identifies integrating mechanisms in the case study. It also looks, albeit briefly, at the strategies adopted by different firms in an endeavour to seek increased control over the chain. These include mergers, acquisitions and alliances, and other efficiency seeking business strategies.

Although some theoretical ‘integrative mechanisms’ have been suggested in the literature review, the ‘integrative mechanisms’ that are recognised in the empirical case study of this research are practical mechanisms extracted from a real-world case study.

In addition, the answers to questions A, B and C will test the conceptual framework and apply the concepts to another port-oriented chain handling a different commodity and utilising a different business model.

Finally, it is expected that the results of this empirical case study will help to understand and develop the concept of chain integration/efficiency relationships with deeper insight and provide more applicable solutions to achieve SCI in other contexts.

3.3 Steps in conducting case study SCI analysis

This research is mainly focused on the recognition and evaluation of current integrative practices and mechanisms across the distribution chain network of the selected case study, and on testing and applying the conceptual framework developed based on export bulk chains.

The methodology for this research will adopt the whole-of-chain construct developed by Robinson (2009). He suggested three constructs (Figure 3.4) for the evaluation of the whole-of-chain, namely ‘chain structure’, ‘chain architecture and dynamic’ and ‘chain performance and efficiency’. These include -

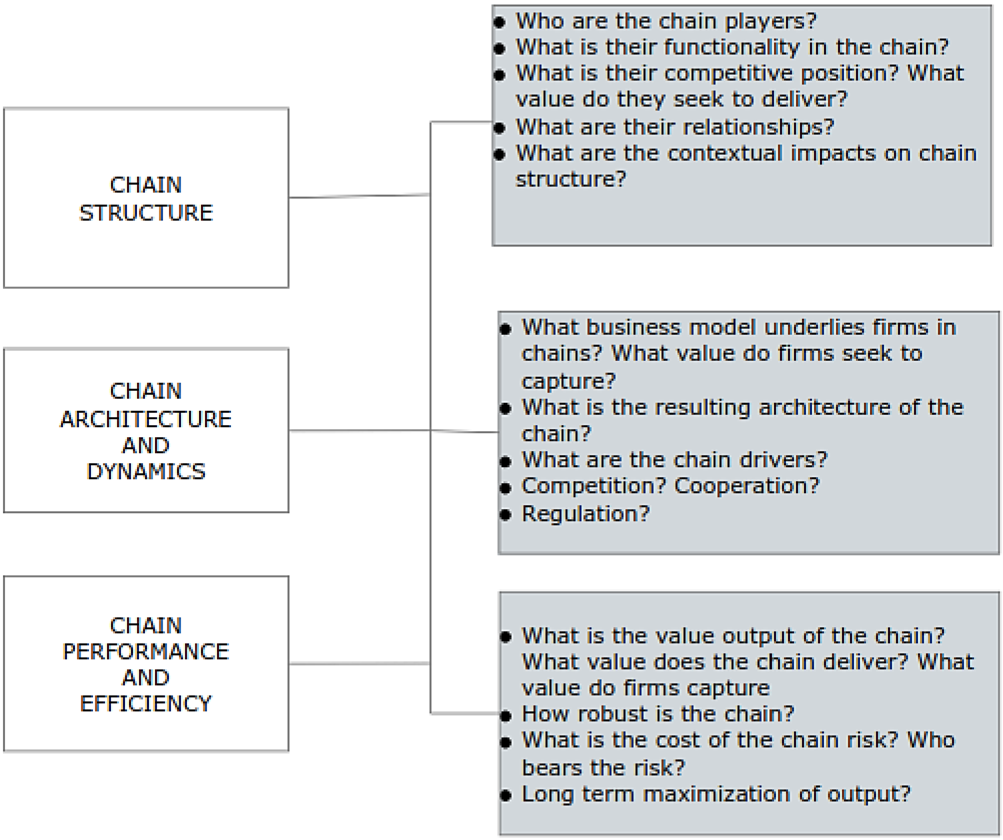

Figure 3.4. Supply chain construct.
Source: Robinson (2009, p.40)

3.3.1 Chain structure

The chain structure is the first step in the SCN analysis which identifies the different players in the chain, the existence of any relationship among them, and the type and different aspect of all linkages and relationships among these SCN members. This step involves detailed mapping of the sequential pattern of activities in the form of respective SCN functions and the contribution of each player in the chain, corporate structure and contractual arrangements and linkages.

Chain structure means mapping a generic chain through the PoM. The first step is to identify the SCN members. For the freight chain of vehicles through Melbourne, the initial step is to recognise these players and to draw a generic diagram of the flow of participants in the chain. This is the most basic diagram that can reveal the relationship amongst chain players in a freight chain. The next stage is to recognise the functionality of the chain, what operations are involved in the SCN, and what are the sequential patterns of key activities in the chain. The recognition of SCN functionality reveals the position, role and duties of each player of SCN. Furthermore, it helps to recognise the role of other influential players and entities such as statutory organisations that have jurisdictional regulatory oversight on the operations of the SCN. The contractual linkages of the chain members reveal the flow of money and value in the chain, and the type of transactions that might occur between dyadic or non-dyadic SCN members. The corporate interactions of chain members determine the long term trends of the SCN and value chain competition, and how well chain members manage their relationships (Robinson 2009).

3.3.2 Chain architecture and dynamics

This construct will underline the business model of the chain and its resulting architecture. In addition, the dynamics of the chain will be revealed by finding the influences and power regimes and their impact on the competitiveness of SCN chain members.

Robinson (2009, p.39) argued that chains often emerge and metamorphose without a previous plan. However, he notes that 'it is important to recognize that chain morphology is the artefact of a business model; and it is the effective implementation of the business model which causes chain efficiency' (Robinson 2009, p.41). In addition to the chain's underlying business model, some chain members are likely to be able to exert more influence than others which is also likely to drive and influence chain dynamic and architecture (Robinson 2009). The investigation of the chain architecture and dynamics may enlighten us about the chain efficiency and the drivers of chain efficiency in our case study.

3.3.2.1 Business model of the chain

A business model not only impacts on the behaviour and operation of a single firm within a chain, but will also impact on the architecture and dynamics of a chain and indicate integrative or disintegrative strategies of the chain (Robinson 2009, p.20).

The supply chain architecture is the function of the underlying business models of the chain, and supply chain efficiency depends on the efficiency and effectiveness of this business model (Everett & Weston 2011). Furthermore, as Robinson (2010) has argued, some business models are inherently more integrated or disintegrated than others.

In the supply-push or the market economy model, for example, Reddy and Reddy (2001) have argued that in a ‘market economy’ model, the product movement is triggered by the market forecast and not actual customer demand. Consequently, the chain is driven by the supplier to the end-customer. In this model the supplier, or manufacturer, coordinates and controls activities across the chain. The architecture of a chain with a market economy business model may be characterised by multiple stock locations across the chain because the supply of products is pushed by the supplier to the end customer. In the event that the demand at the end of the chain is lower that the coming supply, the stocks will be held at different points throughout the chain (Robinson 2010). The supply-push model is suitable for manufacturers (or the brand owners) when low cost production and low price product is important for the competitiveness of their business (Li, Zhang & Willamowska-Korsak 2014). However, as the coal chain case studies have demonstrated, inventory issues are likely to occur, creating congestion and a bottleneck at the terminal. A mismatch occurred because the product and ship arrival at the terminal was not coordinated, for example (Everett & Robinson 2007; Everett & Weston 2011; Robinson, Weston & Everett 2012).

In a demand-pull model, on the other hand, or ‘network economy’ model (Reddy & Reddy 2001), the specific demand from a firm or customer triggers action via a real time cyber network from downstream of the chain to upstream of the chain right to the suppliers. As such, there is no, or little, buffer stock across the chain and chain architecture is not characterised with multiple buffer stocks (Robinson 2009). This business model is suitable for the product markets that are under extreme competitive pressure, and product customisation is a strategic option to increase competitiveness. In a demand-pull business model, the firm’s resources are organised and mobilised to meet demand patterns of the customers. In this model, the firms or customers have significant competitive flexibility. Similar to the supply-push model, the product supplier or manufacturer is the major coordinator of the chain (Robinson 2010); however, unlike the supply-push model, the focus in a demand-pull model is on the enhancement of real time information flow across the chain and lower inventory costs, and is driven by the supplier but only in response to the customer's order. This business model represents both lean and agile characteristics (Christopher & Ryals 2014). As a result, demand-pull models are inherently more efficient compared with supply-push models (Robinson 2010).

3.3.3 Chain performance and efficiency

This construct focuses on the efficiency of the entire chain network by evaluating the macro settings such as inter-firm relationships and linkages, inter-firm capacity alignment, real time information exchange, and the regulatory and market policy environment of the chain network.

This is an acceptable axiom that 'efficient chains will deliver superior value to customers' (Robinson 2009, p.20). The effective integration and coordination among chain members, capacity alignment across the chain, and integrated on-time flow of information and set of integrative mechanisms will maximise chain throughput and the potential value available for chain players.

Conceptualisation of the chain efficiency is a difficult task as it is a multivariate function of exceptional complexity within the chain (Robinson 2009). Some efficiency factors are related to the individual firms' performances (micro chain efficiency factors), while other factors are related to the inter-firms' relationship and actions (macro level). Although micro factors can also affect the performance of a chain as a whole, we know that having a chain consisting of internally efficient firms will not guarantee an effective level of efficiency in the whole chain. As such, the effects of macro efficiency factors are stronger on the efficiency level of the whole chain. In this research, we focus on the macro efficiency factors of a chain.

Brooks, Schellinck and Pallis (2011) explains that chain efficiency is a critical determinant of market capture, market share and business success for chain players. The effective integration of business processes, consequential capacity matching in chain functions, and required or acceptable output value will maximise chain throughput and the potential value available to firms in the chain.

3.3.3.1 Capacity alignment

Appropriate capacity for a supply chain system, including adequate and effective infrastructure, transportation and storage facilities, in addition to proper coherent information nets that can sense and control moving signals and location of products across the chain, are necessary for efficient value driven chain systems.

In bulk freight systems, each individual firm has a specific operation capacity which is based on their business plan; however, for a whole chain the capacity needs to be seen from a system-wide perspective rather than an atomistic view of logistics and supply chain systems (Robinson 2009, p.46).

Robinson (2009) argued that in a supply chain system, each subsequent event depends upon the ones prior to it, and every supply chain system must have enough capacity to meet the target demand of the chain. For instance, an hour delay caused by the bottleneck is equal to one hour lost in the whole system. Based on this view, it is critical to know the bottleneck of each supply chain system, and to understand that a proper sustainable, robust system is one in which the capacity of one element in the system is matched with the capacity of other elements of the system and also with the system output (Robinson 2009, p.55).

Note that in this research, the micro-analysis of the chain capacity is not possible due to the limitation of the research. However, the macro-analysis of the chain capacity and its effect on the efficiency and performance of the whole chain is considered as part of the analysis of the whole chain. The important issues for this macro-analysis of the whole chain capacity, therefore, is to identify the bottleneck in the system.

3.3.3.2 Real time and integrated flow of information

There is no doubt that visibility and information exchange across the supply chain network will enhance the chain efficiency. Information technology is a powerful factor in the increase of visibility and transparency of information and improvement of business process integration across the supply chain network, enabling integration of elements in the supply chain network. The critical issue is the degree to which information technology systems might be used by different firms in a SCN to fully integrate the demand side of the chain with the supply of the chain to increase effectiveness and efficacy operations and business process across the chain network. This issue will be investigated particularly in chapter seven which deals with landside operation of the case study chain.

3.4 The empirical research approach

In this research context, an empirical case study approach provides an appropriate and necessary format for detailed investigation of complex chain processes and chain relationships. The case study approach is ‘an exploratory research technique that intensively investigates one or a few situations similar to the researcher’s problem situation’ (Zikmund 2003, p.115). Its aim is to obtain information from similar situations to the research problem being investigated (Zikmund 2003). The case study research approach is mostly suitable when questions such as ‘why’ and ‘how’ are to be answered (Yin 2009). These include questions such as ‘What is the level of integration in the auto chain?’, ‘What integrative strategies are attracted to auto chain members and why?’ and ‘How is integration and efficiency achieved in the auto chain?’

In addition, among different methodological approaches including, but not limited to, simulations and surveys, the case study approach is a feasible approach for performing relevant and intensive research to build theory (Eisenhardt, Kathleen M. & Graebner 2007; Näslund, Kale & Paulraj 2010).

The case study approach may not be suitable for every type of research situation; however, ‘case study research methodology’ has been recommended in many areas of logistics as an excellent tool for theory building, and providing detailed explanations of ‘best practices’ and a better understanding of the observations and data (Ellram 1996).

In addition, according to Näslund (2002, p.321), since ‘logistics problems are often ill-structured, even messy, real-world problems’ and ‘supply chain management is an applied field of research’ (Näslund, Kale & Paulraj 2010, p.331), case studies are especially suited for these types of issues as they attempt to advance both science and practice with a holistic and systemic thinking approach.

One of the significant benefits of this type of research method is the ability to investigate complex issues with extensive attention to detail. This allows the researcher to understand the actual procedures and events related to the case study under observation, and to identify the relationships among variables, business processes and business functions.

The results of the case study will confirm or deny the claims made from other case studies; but generalisation must be made with care, if at all. Insights gained will provide the basis for further exploratory research questions and hypotheses for further testing.

3.4.1 The quality of case study research design

According to Yin (1993), to evaluate a case study methodology in terms of its quality, the following four tests are used: (1) construct validity, (2) internal validity, (3) external validity, and (4) reliability (1).

Table 3.1. Case study tactics for four design tests.

Tests	Case Study Tactic	Phase of research in which tactics occurs
Construct validity	Use multiple source of evidence Establish chain of evidence Have key informant review draft case study report	Data collection Data collection Compositions
Internal validity	Do pattern matching Do explanation building Address rival explanations Use logic models	Data analysis Data analysis Data analysis Data analysis
External validity	Use theory in single-case studies Use replication logic in multiple case-studies	Research design Research Design
Reliability	Use case study protocol Develop case study database	Data Collection Data collection

Source: Yin (2009, p.41)

To conduct this research case study, careful research design was planned by applying the four tests presented by Yin as follows:

3.4.1.1 Construct validity

'Construct validity is a complex concept composed of several forms of supporting validity', addresses concerns at the entire study level, and represents the process of theory development and testing (Mentzer & Flint 1997, p.207).

To prevent a subjective judgment in a case study approach, the first tactic is the use of multiple sources of evidence. Creating a chain of evidence is recommended by Yin (2009) for data collection. For this case study, data was collected from a number of different sources including interview data, documentation, archival records such as government reports, company documents, catalogues, annual reports and websites, and direct observations. In addition, although the main part of the interview questions with each company representative is related to the role of that particular company in the SCN, there were some questions raised about the operational process, the output of the whole chain, and the performance of other members of the chain from the interviewee's perspective. The collection of these answers about the overall chain operational function and efficiency are effective to make sure that our judgment about the overall chain functions and efficiency are not subjective and are the outcome of all chain members and perspectives.

The second tactic recommended by Yin to avoid subjective judgments and increase the construct validity of the research is to establish a chain of evidence. The purpose of the chain of evidence is to help 'the reader of the case study to follow the derivation of any evidence from initial research questions to ultimate case study conclusion or in the inverse direction from the case study' conclusion to its initial case study evidence (Yin 2009, p.122). In this research, a chain of evidence is set up and maintained during the initial data recording and documentation process by providing enough citations to the relevant evidence in the collected data such as citing to the specific document, interview or observation, and recording the actual evidence and circumstances under which the data is collected. As a result, all the collected data and evidence related to the case study objectives are analysed, cited and catalogued.

The third tactic for construct validity of the case study is to ask the key informant to review the draft of the case study report. In this case study, for each firm participating in the case study, a completed summary of the case study was reviewed by the key company's representative. Asking multiple key informants to check the case study report helps to avoid misleading information and errors in the case study reports and ensures that information in the case study report is realistic and accurate, and excludes biased point of views (Yin 2009).

3.4.1.2 Internal validity

Internal validity refers to the causal relationships between variables and results and is mainly a concern for explanatory case studies. 'Here, the issue is whether the researcher provides a plausible causal argument, logical reasoning that is powerful and compelling enough to defend the research conclusions' (Gibbert, Ruigrok & Wicki 2008, p.1466).

Yin (2009) argues that internal validity is inapplicable to descriptive or exploratory studies. As this study is under the broad heading of 'exploratory case studies', the internal validity is, therefore, not applicable.

3.4.1.3 External validity

External validity of research is the extent to which the result of the research can be accurately generalised to the broader population (Mentzer & Flint 1997, p.211).

Lack of generalisability has been the major criticism of case studies (Ellram 1996, p.104). However, Yin (2009, p.43) responds to these critics by arguing that 'this analogy to sample and universe is incorrect when dealing with case studies'. In his view, survey research (in which a sample is intended to generalise to a larger universe) relies on statistical generalisation, whereas case studies (as with experience) rely on analytic generalisation rather than enumerate frequencies (i.e., statistical generalisation) (Yin 2009, p.43).

Theory, arguably, is the means by which case study research can be generalised. The case studies are not chosen for statistical reasons, but might be chosen to provide description, to test theory, or to generate a new theory (Eisenhardt, Kathleen M 2002; Eisenhardt, Kathleen M. & Graebner 2007).

According to Yin (2009, p.44):

> The generalization is not automatic; however, a theory must be tested by replicating the findings…, where the theory has specified that the same result should occur. Once, such direct replication has been made, the results must be accepted as providing strong support for the theory, even though further replication have not been performed.

For this study, the generalisability was enriched by such replication.

3.4.1.4 Reliability

Reliability is the extent to which the research can be replicated by other researchers and lead to the same insights and results. In order for a case study approach to be reliable, the main issues are transparency and replication (Gibbert, Ruigrok & Wicki 2008). To achieve these levels of replications and transparency, two tactics are suggested.

The first tactic is to establish a case study protocol which is 'a report that specifies how the entire case study has been conducted' and helped the transparency of the research (Gibbert, Ruigrok & Wicki 2008, p.1468). In conducting this research, the case study protocol was used which included the interview guide, details of types of evidence, and documents that might be relevant, as well as the procedures to be followed in using the research instruments.

The second tactic is to maintain a 'case study data base' which will help with the replicability of the case study (Gibbert, Ruigrok & Wicki 2008, p.1468; Yin 1993, p.40). The 'case study database is a way of differentiating the evidence from case study' which has been collected from different sources. These include documentations, archival records, interviews, direct observation, participant-observation and physical artefacts (Yin 1993, p.40), and recording and collecting them in the form of documents in a way 'to facilitate the replication of the case study' by another researcher (Gibbert, Ruigrok & Wicki 2008, p.1468). For this research, the case study database is the interview guide and interview questions for each type of firm including the shipping line, stevedore, terminal operator and PDI in the study, and a datasheet that was designed by the researcher to summarise the output of each interview and data collection in a standard format for all firms participating in the research to relate each unit of data collection for each firm to a wider picture about the whole chain network (refer to Appendix A). In addition, any printed material and additional notes or documents recorded outside of the interview guide, and any printed material provided to the researcher by the participating firms in the study such as copies of manuals, presentations, reports and other internal documentations, were also included in the study database.

3.4.2 Data collection procedures

In the conduct of this case study research, data was collected from a number of different sources including documentation, archival records, interviews and direct observation (Table 3.2). The opportunity to use multiple material sources of evidence for data collection in a case study approach is one of the strengths of this method over other research methods, and good case study research uses various sources of data which can be highly complementary (Yin 2009).

Table 3.2. Different sources of data and examples for each source of data were used in this research.

	Source of data	Example
1	Documentations	Written reports of events, formal studies or evaluation of similar case studies, news clippings and media articles available online or in hard copies in libraries and articles from trade magazines.
2	Archival records	Publicly available files such as those available in Australian governmental websites, Federal courts, private company websites, organisational records such as annual reports, maps and charts of geographical places, statistical and service records of different organisations such as Ports Australia, Australian Bureau of Statistics (ABS), and in some cases required particular confidential information and data has been obtained by making special request/permission or purchasing such information from official websites such as Department of Foreign Affairs and Trade, and the Federal Chamber of Automotive Industry.
3	Direct observation	Site visits of automotive terminals at PoM, site visit of two car production plants in Melbourne (Toyota and Ford), site visit of inside a car carrier RoRo vessel, and site visit of a PDI processing centre in Melbourne.
4	Interviews	Interviews with the general or operation manager of each participant company including shipping lines, stevedore, terminal operator, port authority, PDI company, distributor (vehicle importer) and dealerships.

Table 3.3 lists the kind of case study material collected from each subunit of the case study. This table suggests that in-depth interview discussions were one of the most valuable sources of information for this research. However, the only subunit of the case study in which face-to-face interviews were not conducted was the car manufacturers which, due to the limitation of this research and because traveling to overseas locations to carry out interviews was not practical or possible. As an alternative, the researcher used other sources of data such as documentations and archival records to understand the business strategies of the manufacturing companies. In addition, the researcher had

the opportunity to visit two car production plants in Melbourne during the period of this research which helped the researcher in gaining insights and a better understanding of the operation of the supply chain of an automotive industry.

Direct observation as well as site visits in the automotive terminals in the PoM, visits and inspection of the car carrier vessels particularly at the time of unloading vehicles, and the inspection of PDI processing and operation depots were highly informative and enhanced the researcher's understanding of the end-to-end supply chain.

Table 3.3. The type of data collected for each unit of analysis of the case study.

	Documentation	Archival records	Direct observation	Interviews
Car manufacturers	✓	✓	✓	---
Shipping lines	✓	✓	✓	✓
Stevedores	✓	✓	✓	✓
Terminal operator	✓	✓	✓	✓
Port authority	✓	✓	---	✓
PDI company	✓	✓	✓	✓
Car distributor (importer)	✓	✓	---	✓
Car dealership	✓	✓	✓	✓

Interviews were conducted using an identical interview structure and guides (as specified in Appendix B) after gaining a formal written consent letter from the participants for their contribution to the research under the specific condition to keep their identity anonymous. Interviewees were selected by using a number of different techniques. Some interviewees were nominated and invited to participate through the Victoria University industrial network connections. Others were nominated by their companies as the most appropriate company representatives. This was associated with and followed the sending of a formal invitation letter to their company explaining the research purpose and expected interview questions. In addition, some of the participants were contacted and recommended by other interviewees following a request to nominate someone in the other dyadic firms they were in relationship with (snowballing techniques). However, regardless of the recruiting techniques for participation in the research, all of the interviewees were key informants and decision makers of their companies in terms of operational procedures and management of logistics and supply chains, and were at senior and top management levels. They were completely aware and very familiar with the role of their firm and its contribution and interaction in the chain in which it was embedded.

Prior to each interview with a participating company, the researcher gathered and reviewed all publicly available information and documents related to the company such as materials available on the company's website, their annual reports, related presentations and catalogues. Collecting and perusing this information prior to the interview with each firm, helped the researcher to be well prepared to ask more specific questions relating to the participant firm and the phenomenon under investigation. Most of the interviews were audio recorded subject to permission and consent by the interviewee. Subsequently, the transcription of these audio records provided a large volume of extremely rich data. After each interview, a report was sent to the interviewee to ensure that the transcript was accurate, with a request for the material to be checked and to ensure that any misunderstanding or possible errors were avoided.

In addition, at the time of conducting the interviews, there was the opportunity for the researcher to receive some internal company documents and materials from the participants which were complementary and enabled a better understanding of their company procedures and policies.

3.4.3 Case study data analysis procedures

A content analysis approach was used to categorise and elaborate themes from collected data in each subunit of the case study. The content analysis method has been recommended by a number of researchers to analyse the type of data that is used in this research such as the company's documentations and relevant archival records, transcripts of interviews with the company's informants, and written records of the researcher's direct observations (Golicic & Mentzer 2005; Holsti 1969; Krippendorff 2004). As such, the themes and evidence related to each subunit of the case study were analysed at the first stage. These themes were related to the subject of each research question noted above.

In general, the analysis was undertaken in two separate though closely related stages. The first stage involved content analysis of each subunit of the case study including car manufacturers, shipping lines, stevedores, terminal operators, PDI companies, importers and dealerships. At this stage, the focus was to understand the role of each subunit in the chain, their dyadic relationship with other subunits, and the type of integrative strategies used by each subunit. This stage could help to partially answer questions A, B and C about the auto chain. The second stage was to look at the relationship between all subunits (the whole chain) and to sum up all the points and results taken from each subunit to be able to answer questions A to C about the auto chain, as well as the result of the test of the conceptual framework to identify the relationship of chain integration and efficiency and the model for achieving SCI across the whole chain.

3.5 Conclusion

This chapter builds upon the literature review and the conceptual framework outlined in chapter two. It has discussed the single case study approach as the most appropriate methodology for this research. Furthermore, it has presented the case study topic that was chosen for conducting this research and the rationale for this choice and research methodology. The detailed steps of conducting the case study analysis and the detailed empirical research approach and its validation were discussed in some detail. These sections provided further information about the data collection methods and steps in conducting data analysis of the case study, and provided an overall picture about how the data was collected and analysed to address the research questions.

Chapter 4 Automotive Manufacturers

4.1 Introduction to global automotive industry

The automotive industry has lasted more than 130 years since the invention of the combustion engine in 1880 and shows no sign of decline, with significant market growth each year. In 2015 more than 68 million units of passenger cars were produced worldwide (OICA 2016), and global vehicle production has increased rapidly since 2000 (Figure 4.1).

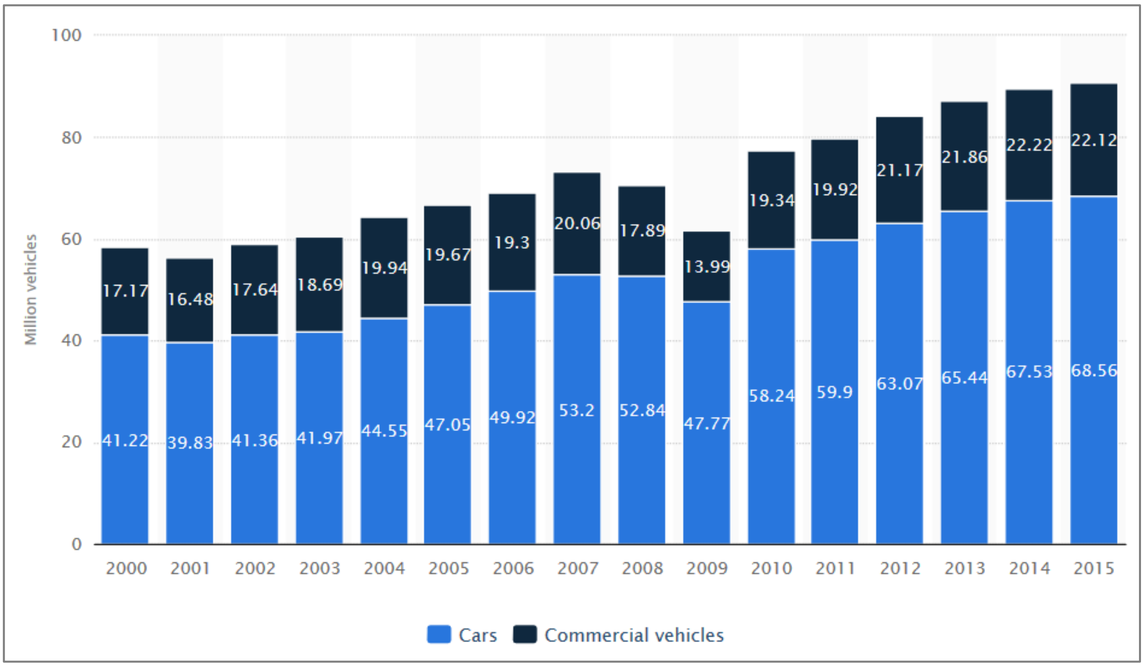

Figure 4.1. Global automobile production since 2000 in million vehicles.
Source: Statista (2016)

However, over the last 130 years of automotive innovation, the industry has transited dramatically from the early craft production of automobiles at the beginning of this period to the mass production of low unit cost cars after World War 2. This was followed by lean car manufacturing techniques for the mass production of quality cars which enabled large volumes of high quality vehicles to be produced with decreasing per unit production costs.

Although cars today are not very different in terms of their basic functions and external shape and design compared to those from a century ago, there are clear improvements in their functional features, their environmental protection and safety control level, and the amount of interactions and comfort that they provide for their users (Fujimoto 2014). Particularly in the last 30 years, there has been significant product development and improvement in the new automotive models in terms of digital/IT gadgets as well as fuel alternation and environmentally friendly cars.

In terms of the automotive market, the past 45 years can be characterised as a period of intense competition, product variations and increased customer expectations. The automotive industry since 1970 has changed significantly. These important changes include the regionalisation of production sites, the overcapacity of production, fragmentation of the market, and the change of the automotive supply chain model (Holweg 2008). These changes have led to the increase in horizontal integrative strategies across the automotive market to overcome these challenges. The business of car manufacturing went 'global' during this period, and there is a 'gradual shift toward a new business model' for the automotive supply chain from 'mass production under a supply-push model' to 'mass-customisation under a demand-pull model'. These changes will be discussed in the following sections.

4.1.1 Horizontal integrative mechanism in the automotive industry market

The high cost of vehicle production and an increasingly competitive market has meant there is a need to capture economies of scale for car manufacturers. Achieving economies of scale in today's market is a very challenging task because of high customer expectations and the fierce competition between car manufacturers. This pressure has forced today's car manufacturers to look for opportunities to increase the efficiency of their production lines and achieve efficiency in mass customisation by using horizontal integrative mechanisms such as different forms of partnerships (acquisitions, alliances or joint ventures) as well as operational interdependencies and contractual agreement for joint investment or product and technology development. Some horizontal integrative strategies are discussed in more detail below.

4.1.1.1 Platform sharing:

A major basis for car manufacturers to share and collaborate is the platform sharing strategy. A product platform consists of a combination of related parts that form the basic structure of that product, with everything else made around that structure (Güttner & Sommer-Dittrich 2008, p.65). A platform for a car is the unique underbody and wheelbase (Holweg & Pil 2004, p.163) of the body shell on which the other components are mounted. Significant sunk costs are generally associated with the design and development of a new platform (Holweg & Pil 2004, p.178).

Early in the industry's growth, each platform was designed for a certain model[1] and body style[2]. Later, with the growth of the automotive industry, another approach was the standardisation of those vehicle components that are hidden from the customers' eyes in the final product, such as the chassis, and sharing those components for two or more models of the same size class (Güttner & Sommer-Dittrich 2008, p.64). During that time industry growth and the number of produced vehicles for each platform was high and the expected life cycle of a certain car model was sufficient to return the initial investment of new product design and development while at the same time yielding a profit. However, in today's market where the competition among car manufacturers is fierce, the number of automobile manufacturers and the range of automotive models and products is greater than ever before, a certain car model may not have a long life and changes are introduced more rapidly which means that there may not be sufficient volume produced to make worthwhile profit for the investor (Holweg 2008). As a result, expensive platforms had to cease operation as the demand for the car declined close to the end of its short life cycle. To prevent such detriment and in order to reduce the risk of investment loss, at present platform sharing and the use of mutable body shells are strategies that car manufacturers from different brands use to share the initial investment for product development and car platform design and manufacturing.

The number of platforms in use is decreasing, which shows that car manufacturers are trying to increase the number of similar components across as many models as possible. At the same time, they are endeavouring to increase the variety and differentiations of their product's appearance (Holweg & Pil 2004, p.177). Consequently, the average number of car body types per platform increased from 190 in 1990 to 258 in 2002 in Europe (Table 2.3 in Holweg 2008, p.25). For example, 'Volkswagen's Jetta and Beetle and Audi's TT and A3 shared the VW Golf IV platform' (Holweg & Pil 2004, p.178).

Another example is General Motors (GM) and Fiat, as they formed an alliance in 2000 in order to share a platform and capture economies of scale in purchasing (Holweg &

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[1] *Model* means a vehicle that might share a platform with others but has significant differences in sheet metal (Holweg & Pil 2004, p.163).
[2] *Body styles* are variations within models such as two doors, four-doors, and so on… (Holweg & Pil 2004, p.163).

Pil 2004, p.70). Under this system, production costs are reduced because many other parts such as suspension, braking and exhausts are the same when platforms are shared (Holweg & Pil 2004, p.178).

4.1.1.2 Badge engineering:

Rebadging and relaunching a product under a new name is another strategy that car manufacturers use to increase sales in new markets. For instance, Peugeot 104, Citroen C 1 and Toyota Aygo have an identical car model which is produced under three different brand names (Güttner & Sommer-Dittrich 2008, p.377).

This strategy is more effective when a certain brand is more popular in certain markets. For instance, Renault and Nissan produced similar models under their global shared platforms. However, those models are sold under the name of Nissan in markets such as Japan or China where the Nissan brand is popular. Conversely, in Europe, those cars are sold under the Renault badge because of its popularity in Europe (Sehgal & Gorai 2012). Similarly, in Australia, Ford Telstar and Mazda 626 in 1983 were both based on the Mazda platform and powered by Ford motors following an agreement by both manufacturers to meet local content rules (Robinson cited in Fuller 2012).

4.1.1.3 Alliances:

In total, a higher level of dyadic integration occurs when alliances are formed between two firms, either in the form of a partnership or in the form of an acquisition. In the history of the automotive industry, different forms of alliances have occurred among many car manufacturers. These alliances not only help the manufacturers to capture economies of scale but also help with other forms of collaborations such as platform sharing or expanding to new markets and learning by doing so.

Alliances have given car manufacturers an opportunity to rationalise their production capacity and increase the efficiency of their production line whilst keeping costs down. Alliances have also been a strategy for some car manufacturers to minimise the risks of product development, and to develop within unfamiliar markets (Gannon, cited in Ding 2011).

A further reason behind the growth of consolidation and alliances in the automotive industry in the last three decades is the decline in brand loyalty among new car buyers. Since the 1970s, the gradual shifting of the power positions in the automotive market from the manufacturers in favour of final car customers, brand loyalty has decreased among new car buyers. As a result, decisions to buy cars are no longer only based on the quality and reputation of the car manufacturers but are also based on the other additional benefits such as the coverage of the warranty, choice of additional equipment or a cost benefit analysis (Güttner & Sommer-Dittrich 2008, p.61). For car manufacturers, the only way to keep their customers satisfied and loyal was to provide them with a variety of models across a wide market segment (passenger car, sport, hatchback, station wagon, etc) and one of the easier way to expand their model range was to acquire the individual brands or consolidate with their competitors (Güttner & Sommer-Dittrich 2008, p.62).

Many of these alliances have occurred in the form of acquisition of small brands by big Original Equipment Manufacturers (OEMs) such as GM, Ford, VW, BMW and Toyota to expand their model segments and strengthen their market position (Güttner & Sommer-Dittrich 2008, p.62). For example, the VW group was able to successfully acquire brands such as Audi, Seat, Skoda, Bentley, Bugatti, Lamborghini and Porsche along with commercial vehicle manufacturers Scania and MAN and the motorcycle brand Ducati into VW's manufacturing group (Güttner & Sommer-Dittrich 2008, p.62 ; Volkswagen 2015).

Other forms of alliances have been in the form of joint ventures or equal stake alliances of some car manufacturers. An example of this is the alliance between Renault and Nissan. The Renault car manufacturer from France and Nissan from Japan started a partnership in 1999 to jointly represent the fourth largest car manufacturers in the world in terms of the number of vehicles produced (Renault-Nissan Alliance Communications 2016). Figure 4.2 illustrates the ownership structure of this alliance. Since the start of their alliance, Renault and Nissan have shared platforms such as the B platform (Nissan Tiida/Versa and Renault Clio) and the C platform (Renault Mégane/Scénic and Nissan Qashqai). This alliance has provided both companies the opportunity to rebadge some identical models and sell them under the name of the most popular brand in the target market. Currently, the alliance is pursuing a new approach named Common Module Family to double the amount of shared parts and components among future Renault and Nissan products, which will increase the sharing of technical architecture among the models and increase the economies of scale and reduce costs in the product development section (Renault-Nissan Alliance Communications 2012).

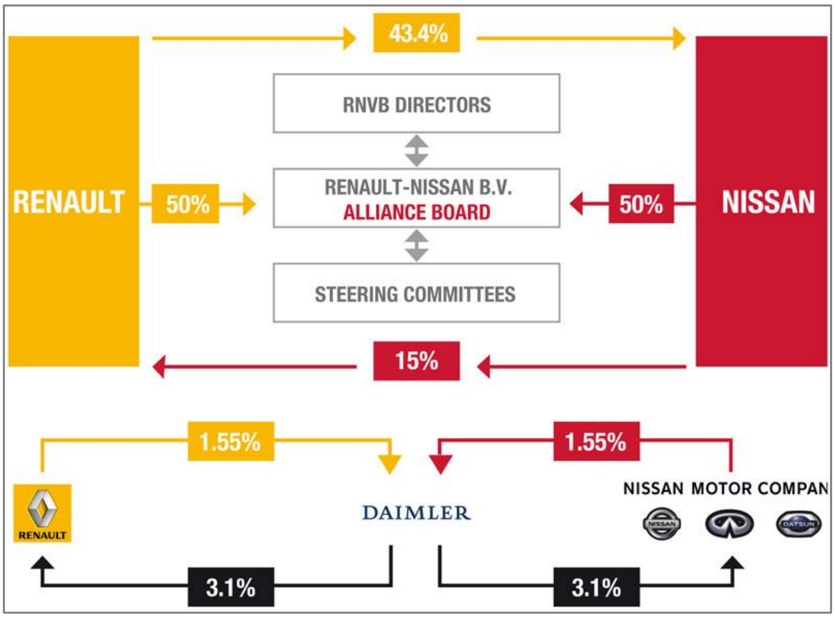

Figure 4.2. Ownership structure of Renault-Nissan alliance.
Source: (Renault Nissan Alliance Facts and Figures 2013, p.5)

4.1.2 The major changes in the car manufacturers supply chain

The supply chain of an automotive production assembly plant can be divided into two parts; one is the chain of components in the supply side and the second is the distribution chain of finished vehicles in the downstream of the chain. Since almost two-thirds of car production costs are related to the upstream section of the chain, traditionally the focus of car manufacturers has been on the improvement in the upstream of the auto chain to decrease costs (Kearny, cited in Carbone, Valentina & Martino 2003a, p.309). However, over the past 45 years, there have also been changes in the car manufacturing supply chain model, and the attention to the downstream side of the auto chain or the distribution of finished vehicle has increased.

4.1.2.1 Regionalisation of the car production and increase of finished vehicle movement across the continent

While more than 90 percent of the global passenger car production was from North America, Europe and Japan in the 1970s (Holweg 2008), Figure 4.3 notes that the share of these regions of total passenger car production has been reduced to 45.6 percent in 2013.

	VOLUME	% SHARE
EU*	14,616,202	22.3%
NAFTA	7,084,136	10.8%
Japan	8,189,323	12.5%
South Korea	4,122,604	6.3%
BRIC	25,886,146	39.6%
Others	5,534,876	8.5%
Total World	**65.433.287**	**100%**

Figure 4.3. The passenger car production of different world regions in 2013.
Source: The European Automobile Manufacturers' Association (2014, p.37)

Since 1990, the number of international free trade agreements has increased among different regions of the world and has led to the free movement of capital and the removal of many international trade barriers. This has had an important impact on the import and export of vehicles and free flow of commodities. As a result, the automotive manufacturing plants clusters have shifted from high labour cost regions such as the USA, West Europe and Japan to low labour cost areas like South America, South East Asia and South Africa. These changes have made the competition in the global automotive market more intense. It has led to price wars, with pressure on production to reduce costs as profit margins decrease. Weston and Robinson (2008) have argued, however, that in this intensely competitive market, efficiency in the supply has become increasingly important.

Consequently, the regionalisation of car production and changes in manufacturing locations have increased the role of the finished vehicle supply chain as increasing numbers of finished vehicles are transported across the continents.

4.1.2.2 Car manufacturing supply chain: shift from supply-push to demand-pull

A further important change in the auto supply chain over recent decades has been the shift of the automotive supply chain model from supply-push to demand-pull.

For many years, car producers relied on the static business model of supply-push but they realised the need to adapt to the new conditions of a saturated, highly competitive automotive market and the need to connect more with their demanding customers. They subsequently and consequently adopted the demand-pull model.

The supply-push approach, under overly optimistic forecasts in the automotive production market, resulted in an excess of supply over actual demand especially since the beginning of 2000. The economic crisis in 2008, however, triggered this problem further and slowed its recovery. According to Holweg (2008, p.25) the solution is to either 'produce into the growing inventories of unsold cars (around 1.5–2 months in most markets), and then employ sales incentives, such as discounts, high trade-in prices, free upgrades, and the like, to maintain their market share', or to change the business model and begin producing vehicles based on the customers' orders.

Theories of producing a customised car in five days have already been published (Parry & Graves 2008) and we have seen successful attempts by some car manufacturers such as Renault, Nissan and BMW to initiate Build to Order (BTO) models. The shift to the BTO model is not a simple task, however, impacting on economies of scale and production costs. There is also a waiting period for the customer and a minimum time for a customer to receive a car after placing an order (Holweg 2008). As such, most of the car manufacturers are using the strategy of delaying/postponement of customisation (Mendonça & Dias 2007) and production based on the combination demand forecast and the actual BTO demand. This is because local forecasts are less accurate than the global forecast for high volumes, and forecasting is easier at a generic level (pure models) than a level of detailed order (finished car) (Dias, Calado & Mendonça 2010). These models tend to be completed and customised close to the final market downstream of the chain and close to the dealerships and final consumers where the customers' requirements are more visible. Meyr (2004) has explained how automotive makers in the premium section of this business try to take advantage of economies of scale under a demand-pull model (mass-customisation) to avoid overcapacity and stock rising of finished cars.

Figure 4.4 shows different stages of order fulfilment in a production plant. Although the final customer's detailed orders might not be available at the earliest stages of car production, but in the premium segments of cars, car makers produce a car as long as there is an order available for it either by the final customer (detailed order) or a retailer/sale and/or sales department (pure forecast models). As cars go forward through the production line, the strategy is to increase the number of detailed orders by the final customers. The lack of information will be replaced by retailer forecast. These ordered cars are Build to Stock (BTS) from the perspective of a retailer as they still need to be sold to the final customers, but are BTO from the perspective of the car manufacturer as they are being prepared according to dealership orders (Meyr 2004).

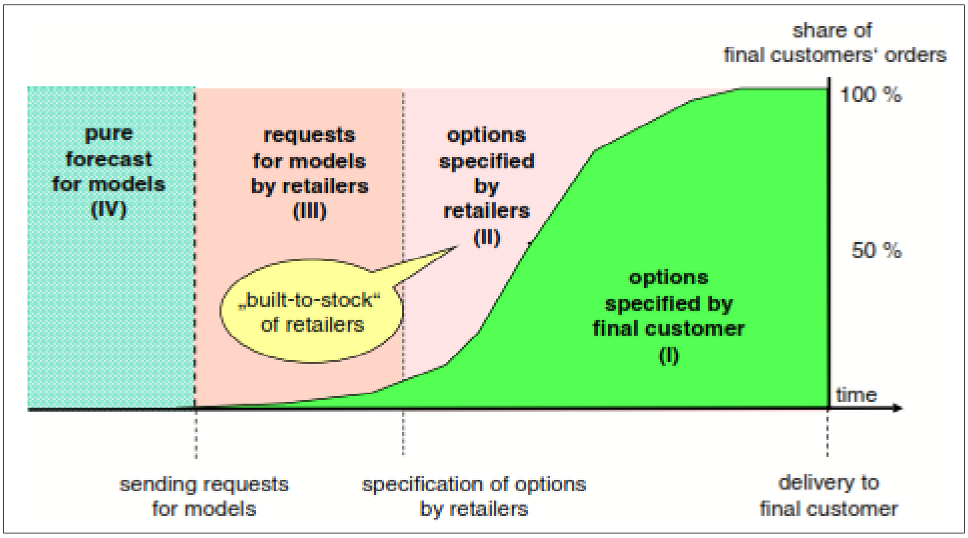

Figure 4.4. Order fulfilment process for car manufacturers in the premium section.
Source: Meyr (2004, p.451)

4.2 Australian automotive industry and the government protection policies

The first attempts to build an internal combustion engine vehicle in Australia started early in the 1890s[3]. The production of automobiles on a commercial scale, however, did not commence until 1949. This period can be divided into two periods from 1902 to 1936 and from 1937 to 1963. This was influenced to a large extent by the changes in the Australian government protection policies toward local car production.

The first period was the beginning of the twentieth century to 1936. During this period, most of the domestic requirements of the Australian automotive market were imported from overseas. The shipment of a complete automobile on general cargo ships was not economically viable at that time. As a result, the chassis[4] were imported in a semi

[3] In 1897 Harry A. Tarrant produced his first car and probably the first petrol-driven car manufactured in Australia, in a small workshop in Post Office Place, Melbourne, where Tarrant had been manufacturing stationary engines (Australian Science and Technology Heritage Centre 1988).
[4] The term chassis includes the chassis proper, engine, rear axle, drive line and running gear, together with front fenders, bonnet, instrument panel, instruments and glass windscreen.

knocked-down condition to Australia and local dealer-assemblers added a body[5] usually from a local designer and manufacturer on the chassis to sell it as a complete car.

In this period, the production of cars was mostly limited to car bodies, and most of the domestic requirements of the Australian automotive market were imported from overseas. The Australian government protection policy which started in 1902 by placing tariffs on imported car bodies was doubled during the 1920s. As a result of this policy, the local automotive component production expanded in Australia, and foreign investors such as Ford, General Motors, Chrysler and British Motor Corporation (BMC) started to invest in Australia. By 1936 the majority of vehicles on the Australian market were assembled locally from imported chassis (Table 4.1).

The next period was from 1937 to 1963, when the Australian government started to attract foreign car manufacturers to produce complete vehicles in Australia from locally produced components. It also increased duties on imported engines, imported chassis and a quota on the importation of chassis from North America. It later introduced tariff protection for domestically produced Passenger Motor Vehicles (PMVs) in exchange/repayment to increase the Australian content of their products. These Australian government protection policies were successful in achieving their goals by attracting major global car manufacturers such as Ford, GM and BMC to develop their production plant in Australia. By 1956 Australia was fourth on the list of most motorised countries in the world. However, the lifting of import licencing control and restrictions at the end of this period led to the increase in imported vehicles especially from Japan which created an increasingly competitive challenge for local producers (Smyrk 2000) (Table 4.1).

Table 4.1. The chronology of the Australian automotive industry 1897-1963.

Year	Event
1896	First attempts to make an automotive inside Australia (Hass 2013).
1900 - 1936: Start of Australian government support policy for local car producers (car body producers)	
1902	Australian government protection policy for local car production started (Smyrk 2000).
1920	Tariff protection on car bodies was lifted to double (1920-1929); the expansion of the Australian local automotive component industry (1920 to 1930) (Smyrk 2000).

5 The body was simply the sprung passenger carrying compartment, which equated to the coach and drew its design and manufacture directly from the existing coach and carriage builders (Australian Science and Technology Heritage Centre 1988).

1925	'Ford set up a plant in Geelong, to build bodies and assemble vehicles using imported chassis' (Smyrk 2000, p.22).
1926	GM set up an assembly operation in Melbourne (Smyrk 2000).
1929	Australian government imposed significant import duties on PMV's component and the prohibition of certain imports (Smyrk 2000).
1930	The industry was adversely affected by the Great Depression which commenced in 1929 (Smyrk 2000).
1936	The Australian automotive 'industry made a strong recovery and registered an annual 16 percent growth rate until the advent of WW II. By 1936 … majority of vehicles on the market were assembled locally from imported chassis' (Smyrk 2000, p.23).
1937 - 1963: Attracting global car manufacturers to produce in Australia	
1937	Australian government increased duties on imported engines and chassis and quotas on the importation of chassis (Hass 2013).
1945	Tariff protection for domestically produced PMVs in exchange/repayment to increase the Australian content of their products (Smyrk 2000).
1949	First mass produced, completely Australian built passenger car (Holden) entered in the local market (Smyrk 2000).
1950	GMH, Ford, Chrysler, VW, Austin and Morris develop their productions; import licensing restrictions (exclude goods imported from outside the dollar area) stimulated the Australian component industry (1920-1952) (Australian Science and Technology Heritage Centre 1988).
1952	Austin and Morris merged to form the British Motor Corporation (BMC) (Smyrk 2000).
1955	Success of Australian government policies in attracting major global car manufacturers. Company share of vehicles registered in 1955: GMH 34.3 percent, Ford 18 percent, and BMC 19.6 percent (Tariff Board Report 1957, p.11) (Smyrk 2000).
1956	There was one motor vehicle to every 4.1 persons in Australia; Australia was fourth on the list of most motorised countries in the world (Smyrk 2000).
1962	Abolition of import licensing controls (quantitative import restrictions on vehicle components were lifted) (Hass 2013; Smyrk 2000).
1963	Sharp rise in Completely Built Up (CBU) imports which continued until 1965; growing challenge of Japanese imports (Smyrk 2000, p.31).

The period from 1964 to 1984 was an era of complex policies and interventions by the Australian Government, such as the lifting of tariffs on imports and import quotas, and concessions on imported components in return for using more local components in their products to create a competitive import industry. As a result, the local industry declined and lost market share to imported cars. For instance, the market shares of four Australian producers including GMH, Ford, Chrysler and Leyland (BMC) declined from 84 percent in 1966 to 65 percent in 1973. One year later in 1974, Leyland (BMC) ceased production in Australia (Industry Commission 1990; Smyrk 2000).

In 1976 the Australian Government encouraged industry growth, granting permission to Toyota and Nissan to open local car manufacturing plants in Australia under the specific condition of using 95 percent local components. As a result, the number of local producers increased to five and intensified this problem (Smyrk 2000). As a proposed solution, the government increased the tariff rate on new finished passenger car imports to 57.5 percent at the end of this period in 1978 (Industry Commission 1990) (Table 4.2).

In 1982 the government introduced the 'Button car plan'[6]. The purpose of this plan was to increase pressure on the local car manufacturers and the component manufacturers to continuously improve their efficiency and to increase their competitiveness and engage with global car manufacturers to increase the Australian car export rate. As part of this plan, the import quotas were replaced in 1985 by tariff quotas, and in 1988 the import quota system was abolished and the government introduced its plan to decrease the import tariff on new passenger cars by 2.5 percent annually. The import tariff for passenger cars at the end of the 'Button car plan' in 1992 was 36.5 percent (Table 4.2).

The post Button car period occurred from 1992 to 2000 in which the import tariff for new passenger cars continued to decrease each year by 2.5 percent until it reached 15 percent in the year 2000. The purpose of this period was to continue the reduction of tariff protection and to enable car manufacturers to import components duty free. At the beginning of this period, Nissan ceased production in Australia and the number of local car producers was reduced to four companies (Toyota, GMH, Ford and Mitsubishi). By the end of this period, the number of models produced was reduced to five which improved the economies of scale per model per year (Smyrk 2000) (Table 4.2).

Table 4.2. The chronology of the Australian automotive industry 1964 - 2000.

Year	Event
1964 – 1984: Policy intervention by Australian government	
1966	High level of tariff (45 percent) by Australian government on the CBUs import (Hass 2013).

[6]. The Button car plan (1985 to 2000), was the informal name given to the Australian Motor Industry Development Plan which was initiated by John Button, the Minister for Industry and Trade in 1985.

1971	Australian government policies resulted in the ‘proliferation of low-volume models, which were completely unable to access economies of scale. Thus, the manufacturing of CBUs was both fragmented’ and became even more inefficient (Smyrk 2000, p.45).
1973	Four Australian producers, ‘GMH, Ford, Chrysler and Leyland saw their combined market share plummet from 84 percent in 1966 to 65 percent in 1973’ (Smyrk 2000, p.39).
1974	Leyland (BMC) left production in Australia (Hass 2013).
1976	Permission granted to Toyota and Nissan to produce in Australia in high-volume, with 95 percent Australian component usage.
1980	GMH closed its production plan in Sydney (Smyrk 2000). Chrysler Australia was bought by Mitsubishi (Hass 2013). From 1976 to 1984 ‘The addition of two further domestic producers led to increased low volume production runs and increased market fragmentation’, as well as declining market share for Australian producers (Smyrk 2000, p.61).
1985 - 1992: Australian government strategy known as the ‘Button car plan’	
1985	Import quotas were replaced by tariff quotas (Smyrk 2000).
1988	The abolition of import quota; ‘the tariff rate on passenger motor vehicles and parts declined 2.5 percentage points annually from 1988 to 2000’ (Productivity Commission 2014, p.108).
1991	Import tariff on passenger cars reduced to 36.5 percent (Figure 4.5).
1992	The market share of imports escalated to the point where imports held 40.2 percent of the market by 1992. Nissan stopped production of cars locally in Australia (Smyrk 2000).
1993 - 2000: The post-1992 PMV plan	
1995	Australian total vehicle production exceeded 300,000 (Smyrk 2000, p.105).
1996	Volume requirement of at least 30,000 units production per model per year to use duty free importation worth 15 percent of their value was abolished (Smyrk 2000, p.84).
2000	The number of PMV producers in Australia has been reduced from five to four. ‘Those remaining were Ford, Mitsubishi, GMH and Toyota…the number of models produced reduced to five with nine cars having ceased production in Australia’ (Smyrk 2000, p.126); the tariff rate for imported passenger cars reached 15 percent (Figure 4.5).

By the beginning of the 21st century, a series of industry-specific budgetary packages - The Automotive Competitiveness and Investment Scheme (ACIS) - each with specific deadlines (termination date), was suggested by the Government to assist the automotive industry to adjust to declining tariff protections and trade liberalisation. The purpose of this plan was to assist the Australian automotive industry to achieve sustainable growth both on a domestic and global scale. The ACIS was originally designed for a five-year period until 2005, but was later extended to 2015 to provide further transitional assistance to the industry until that time. The second five-year period of this plan became concurrent to the economic crisis and, following the drop in demand of Mitsubishi's large passenger car (the 380 sedan) in the Australian market in 2008, Mitsubishi decided to cease Australian production and focus solely on importation to Australia. The third stage of ACIS did not occur because in 2011 it was replaced with another plan known as the Automotive Transformation Scheme (ATS) to run until 2015 (Productivity Commission 2014). The goal of ATS was to help the internal car manufacturers sustain themselves against the import competition, allowing them to keep production in Australia and make Australia a relevant player in the global car production industry (Whytcross 2015).

Other additional federal and state governmental funds were directed to the industry in these stages through other programs such as the New Car Plan and co-investment grants to keep the production industry sustainable (Productivity Commission 2014). However, this assistance was not sufficiently effective to protect the local producers against the boost of new car importation to Australia. In 2013, for example**,** nearly 90 percent of new vehicles sold were imported (Productivity Commission 2014). The last hope for a sustainable and competitive domestic car production market in Australia was terminated in 2013 and 2014 when the three remaining car manufacturers announced that their production plants would close by the end of 2017. Ford announced that it would close its plants in 2016 and Holden and Toyota at the end of 2017 (Table 4.3). Following these announcements, the Federal Government plans to end the ATS by December 2017 due to these closures, but a premature end to the scheme has not been confirmed yet (Whytcross 2015).

Table 4.3. The chronology of the Australian automotive industry 2001-2017.

Year	**Event**
2001	The Automotive Competitiveness and Investment Scheme (ACIS) was introduced (Productivity Commission 2014, p.109).
2004	The total vehicle production rate in Australia reached its peak of approximately 410,000 units (Table 4.4).
2005	Tariff for new passenger car import decreased from 15 to 10 percent (Figure 4.5).
2008	Mitsubishi closed its production plant in Australia (Hass 2013).
2009	There remained just three local car producers including Toyota, Ford and GMH. These companies assembled six models in two states (Victoria and South Australia).
2010	Tariff for new passenger car import decreased from 10 to 5 percent (Figure 4.5).

2013	Ford announced it would cease vehicle production in Australia in October 2016 (Reuters 2013). GM's Holden announced the end of manufacturing in Australia in 2017 (Griffiths 2013).
2014	Toyota announced it will stop building cars in Australia in 2017 (Hawthrone 2014).
2015	The tariff rate on imported passenger cars is 5 percent (Figure 4.5).
2016	Ford stopped manufacturing in Australia in October (Butler 2016).
2017	End of automotive manufacturing chapter for Australia after Toyota and Holden stop manufacturing in Australia (Dowling 2017).

4.3 Ceased car production in Australia

There are many factors behind the short life-cycle of domestic car production in Australia which lasted less than 70 years (1949 to 2017).

Firstly, the automotive production industry is a global dynamic industry with Australia being a very small contributor. Table 4.4 notes that the maximum record for total car domestic production in Australia in 2004 was approximately 410,000 units (Federal Chamber of Automotive Industries 2009, p.3). The total global production rate of passenger cars in 2004 according to OICA (2004) was 64.5 million vehicle units which means Australia at its best production record could contribute only 0.6 percent of the total world production rate.

Table 4.4. Total production of PMVs in Australia between 2002 and 2012.

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total PMVs production (units)	359,751	406,668	407,537	387,821	329,428	335,625	324,684	218,258	242,941	221,957	221,254
Domestic market (units)	247,663	286,490	276,063	245,799	196,686	195,392	162,728	145,343	148,846	147,582	131,834
Export market (units)	112,088	120,178	131,474	142,022	132,742	140,233	161,956	72,915	94,095	74,375	89,420

Source: Adopted from Australian Department of Industry (2012, p.28)

Whilst car manufacturers in industrialised countries such as Japan and Germany have much greater economies of scale (Whytcross 2015), Australian car manufacturers have always suffered from insufficient economies of scale (Singh, Smith & Sohal 2005). 'A cost competitive scale for the types of vehicles manufactured in Australia is at least 200,000 to 300,000 vehicles annually per assembly plant' (Productivity Commission

2014, p.7), and the minimum production rate for a car manufacturing plant in order to be profitable is to operate at least 80 percent of its capacity (Maxton & Wormald 2004, p.224-225). Each domestic car producer, therefore, needs to produce at least 160,000 to 240,000 units per year to be profitable, which means at least 480,000 units across the three domestic car producers (Toyota, Ford and Holden) in Australia. This minimum production requirement has not been reached in Australia since 2000, noting that the peak of Australian vehicle production in 2004 was 410,000 units (Federal Chamber of Automotive Industries 2009, p.3) is far behind the minimum requirement (480,000). These conditions have made the automotive production in Australia fragile.

Australia is the most expensive country for vehicle production after Japan (Productivity Commission 2014, p.9). According to Bob Graziano, the chief executive of Ford Australia, 'the cost of motor vehicle manufacturing in Australia is two times higher than in Europe, and four times higher than in Asia' (Reuters 2013). Consequently, a lack of economies of scale and the expensive local production cost make vehicle production in Australia unprofitable.

Secondly, Table 4.4 notes that since 2002, Australian domestic car producers have lost their market share both inside and outside Australia to their competitors. Most Australian producers have designed and produced fuel intensive large passenger cars for their domestic market. The rise of petrol prices has increased the demand for fuel efficient small cars and compact Sport Utility Vehicles (SUVs) in Australia (Whytcross 2015). As a result, Australian automotive producers have lost their domestic market share over the past few years to the more economic imported vehicles which possess a similar quality but come at a cheaper price (Whytcross 2015).

Furthermore, the strategy of exporting Australian vehicles has not been successful either. For example, the Toyota Camry and Holden Commodore found a relatively strong export market in the Arabic countries within the Persian Gulf (Saudi Arabia, Kuwait and United Arab Emirates). However, the impact of the strong Australian dollar led to these strategies being unsuccessful. 'The strong Australian dollar has also contributed to industry stress by making Australian cars less competitive in the export market' (The Allen Consulting Group 2013, p.2).

Thirdly, domestic vehicle production in Australia in the 1960s was an inefficient industry which, without the Australian government tariff protection policies, would not have been able to compete with global competitors. Figure 4.5 shows the tariff rate for imported passenger cars and vehicles since 1984. To strengthen local production to enable it to compete against global producers, the Government decided to provide a series of non-tariff protection in the form of government assistance funds, plans and schemes after 1984, and to simultaneously reduce the import tariff on new passenger cars annually by 2.5 percent (Productivity Commission 2014).

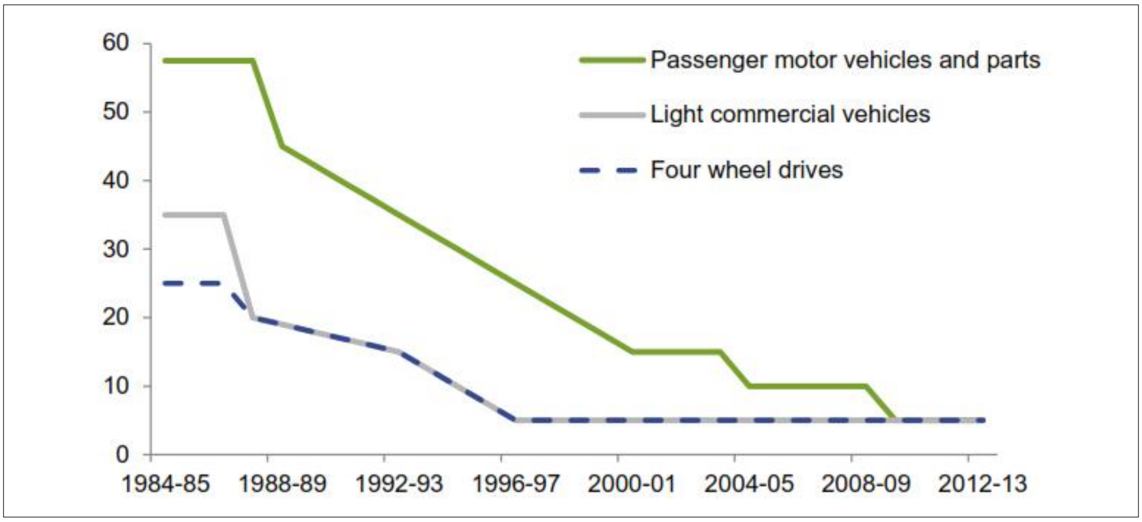

Figure 4.5. Tariff rates percentage for the Australian automotive industry since 1984.
Source: Productivity Commission (2014, p.108) based on data from Australian Automotive Intelligence Yearbook (2013) and Lloyd(2007).

Although these policies were relatively successful in creating an efficient production base for Australian manufacturers, such as lean manufacturing, high labour costs in Australia, the strength of the Australian dollar, and low profitability of the production industry in Australia compared with other countries finally led to the cessation of domestic car production in Australia.

4.4 Current Australian automotive market

The automobile industry possesses a large market globally, with more than 67 million cars sold in 2014. Compared with the global automotive market, the current automotive market in Australia is very small, but is one of the most open, competitive and fragmented automotive markets in the world. Whilst more populated countries have more car brands (for example, the UK has 49 different car brands and Canada has 53), the less populated Australia has 67 different brands of vehicles, with more than 350 models of light vehicles available within its vehicle market (Federal Chamber of Automotive Industries 2016). This means that each brand in Australia's vehicle market has less chance to sell its product and the number of new vehicle sales of each brand is much lower than other noted countries such as the UK and Canada.

Cars are made as per the requirement of consumers, and according to FCAI's classification, vehicles are categorised as passenger cars, SUVs, and commercial vehicles based on their utility. Passenger cars are those cars specifically designed for the transportation of up to ten people and are in different sizes, from mini size to upper-large, with hatch, sedan or wagon body styles. SUVs possess either a two or four door wagon body style, and a closed cargo space that has a high ground clearance. Commercial vehicles include light and heavy trucks that are basically designed for commercial purposes.

Figure 4.6 shows the number of new vehicle sales in Australia since 1994 based on FCAI classification. According to this graph, the total number of vehicles sold in Australia has almost doubled during the last two decades. However, although the majority of vehicles sold in Australia are in the 'passenger cars' category, the number of passenger cars has not increased at the same rate as SUVs and commercial vehicles especially since 2007 (Figure 4.6).

Historically, Australian manufacturers have had a tendency towards producing large passenger cars such as the Holden Commodore and Ford Falcon. However, these segments of passenger cars have become less popular among Australian consumers due to the high fuel cost for these vehicles (Wu 2016). Instead, Australians have shown more interest in buying medium size, small and fuel-efficient SUVs rather than large passenger cars which possess six-cylinder engines and consume a large amount of fuel. The growth of new vehicle imports to Australia has also contributed to this growth, especially in the SUV segment, as Ford Territory is the only SUV model that is currently produced in Australia (Wu 2016). Figure 4.7 illustrates that in 2014 more than 40 percent of the SUV cars sold in Australia came from Japan, including popular models such as Mazda CX-5 and Toyota RAV4. After Japan, the USA with 16 percent and Korea with 12 percent were the next producing countries for SUV models in Australia in 2014.

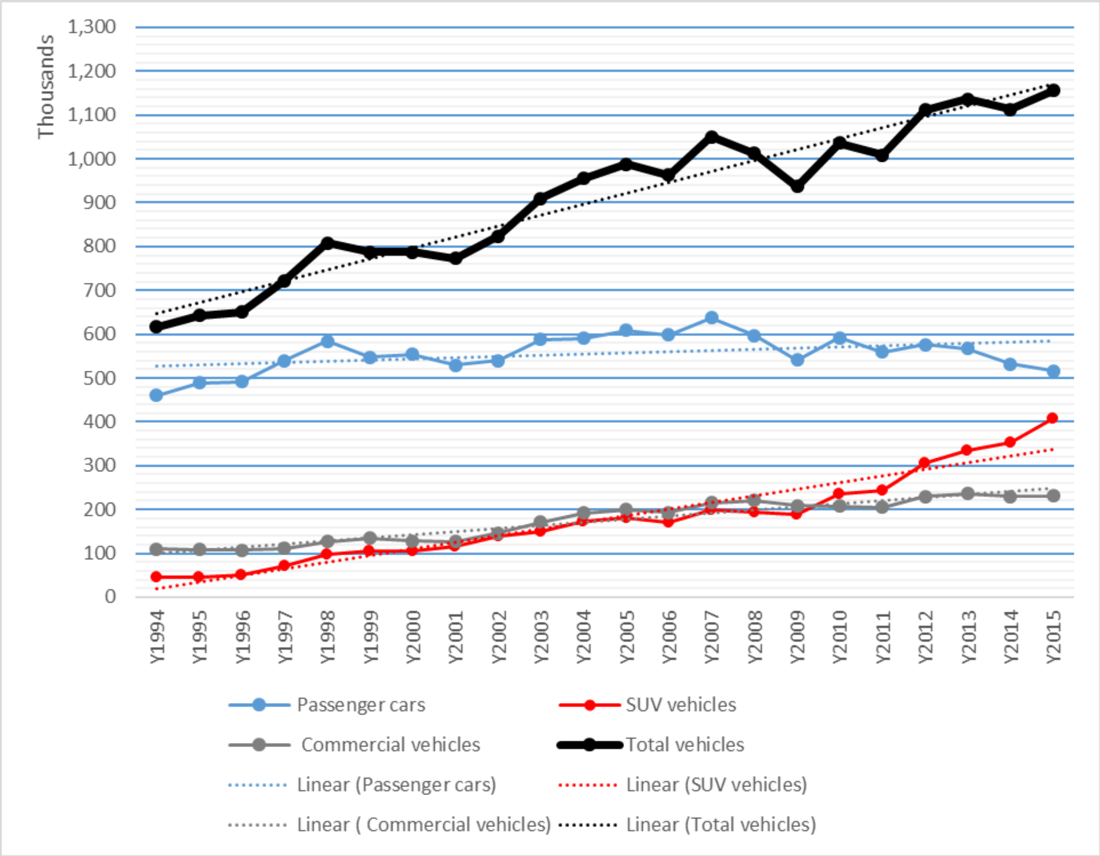

Figure 4.6. Number of sales of new motor vehicles in Australia.
Note: Based on data from Australian Bureau of Statistics (2016b).

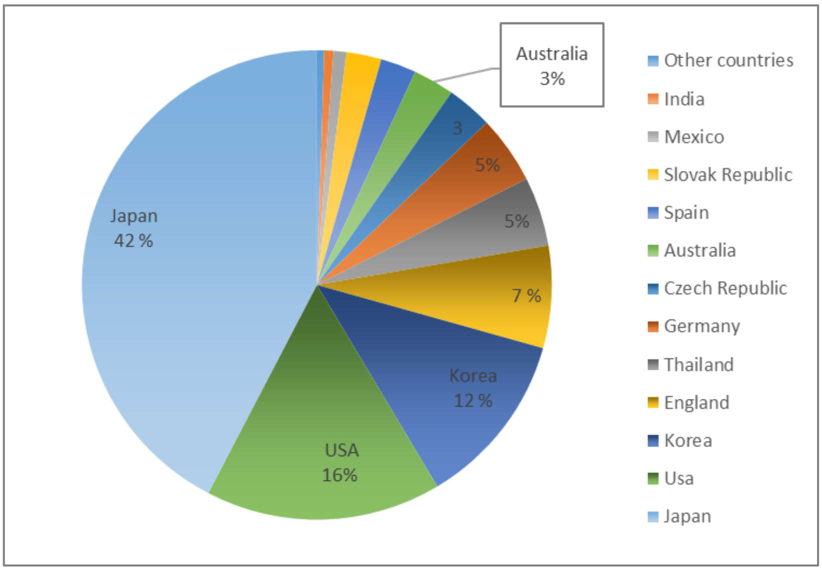

Figure 4.7. Percentages of SUV sales in Australia in 2014 based on the country of origin.
Note: Based on data from VFACTS

4.4.1 Boosting of vehicle imports to Australia

As noted above, following the Australian Government's decision in 1988 to decrease import tariffs on new passenger cars by 2.5 percent annually until 2000, the number of imports to Australia gradually increased.

The five percent tariff rate in 2015 for new vehicle imports (including passenger, commercial and four-wheel drives and their related components and equipment) is the lowest tariff rate in the past 30 years, making Australia a suitable destination for the import of new vehicles.

Figure 4.8 shows the growth of new vehicle imports to Australia since 2005. As noted in this graph, the number of new vehicle imports to Australia has increased every year since 2005. The only exceptions are between the years 2009 and 2011 where the number of imports to Australia was lower than the previous year due to the economic crisis in 2009 and Japan's earthquake and tsunami in 2011.

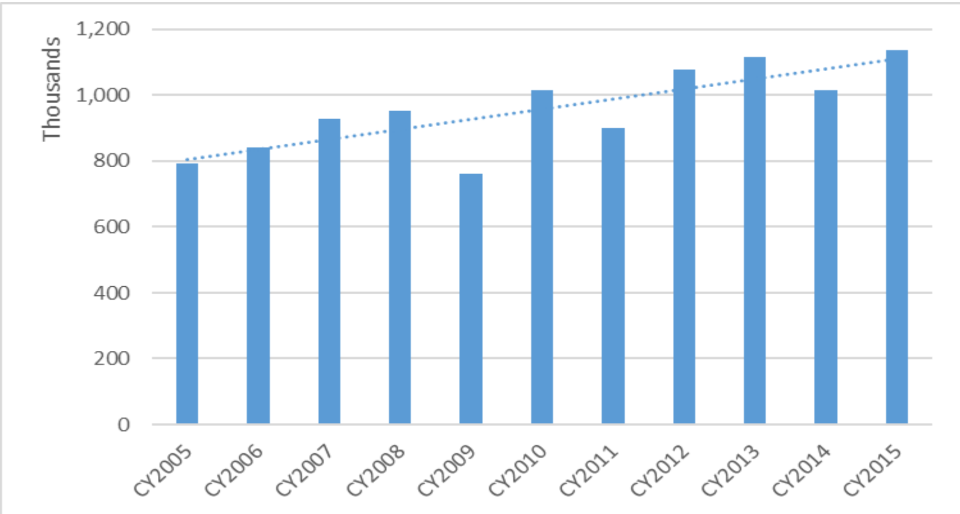

Figure 4.8. The number of motor vehicle imports to Australia (2005 - 2015).
Note: Based on data from the Australian Department of Foreign Affairs and Trade.

The number of imports in the future is expected to increase. The closure of the car manufacturing chapter in Australia announced in 2013 and the cessation of domestic car production in Australia by 2017 will make Australia fully dependent on the importation of foreign producers to supply its internal requirements for motor vehicles.

In addition, the free trade agreements between Australia and countries such as South Korea and Japan which were reached in 2014 and 2015 resulted in an increase in the number of motor vehicle imports to Australia because vehicle imports from these countries are not subject to any tariff (Federal Chamber of Automotive Industries 2014a). Tariff rates lower than the general rate apply to imports from some countries under other trade 'agreements that Australia already has in place with the United States, Chile, the Association of Southeast Asian Nations, New Zealand, Thailand, Malaysia and Singapore' (Productivity Commission 2014, p.109).

Table 4.5 shows the number of new assembled imported motor vehicles in the state of Victoria via the port of Melbourne. Outside of NSW, Victoria has possessed the biggest market of vehicles in Australia since 2005. According to this table, with the exception of 2005 at least 30 percent of the imported vehicles to Australia came through the PoM. As such, development of the RoRo terminals at Webb Dock has become a priority for the Port of Melbourne Corporation (PoMC). In chapter six the development of RoRo terminals in PoM will be discussed in more detail.

Table 4.5 Annual numbers of new assembled imported motor vehicles* to Australia 2005 - 2015.

Code	CY2005	CY2006	CY2007	CY2008	CY2009	CY2010	CY2011	CY2012	CY2013	CY2014	CY2015
Total vehicle import to Victoria via PoM	119,466	247,769	276,518	293,565	245,107	334,599	292,709	332,290	353,809	319,601	349,287
Total vehicle import to Australia	794,240	841,685	927,496	953,151	760,384	1,015,255	899,953	1,077,920	1,116,153	1,016,193	1,136,216
Share of PoM from imports to Australia (%)	15	29	30	31	32	33	33	31	32	31	31

*The vehicles involve new assembled motor vehicles principally designed for the transport of people and goods

Note: Based on data from the Australian Department of Foreign Affairs and Trade.

4.4.2 The new vehicle imports in Australia

In 2014 about 64 percent of new vehicles sold in Australia came from Asian countries (Figure 4.9), with Japan (30 percent), Thailand (20 percent), and Korea (12 percent) the top three Asian countries with the highest share of the Australian vehicle market. The Mazda 3 and Toyota Corolla from Japan, as well as the Toyota Hilux from Thailand, were the most popular models among 188 models that originated from Asia and were sold in Australia in 2014 (VFACTS data).

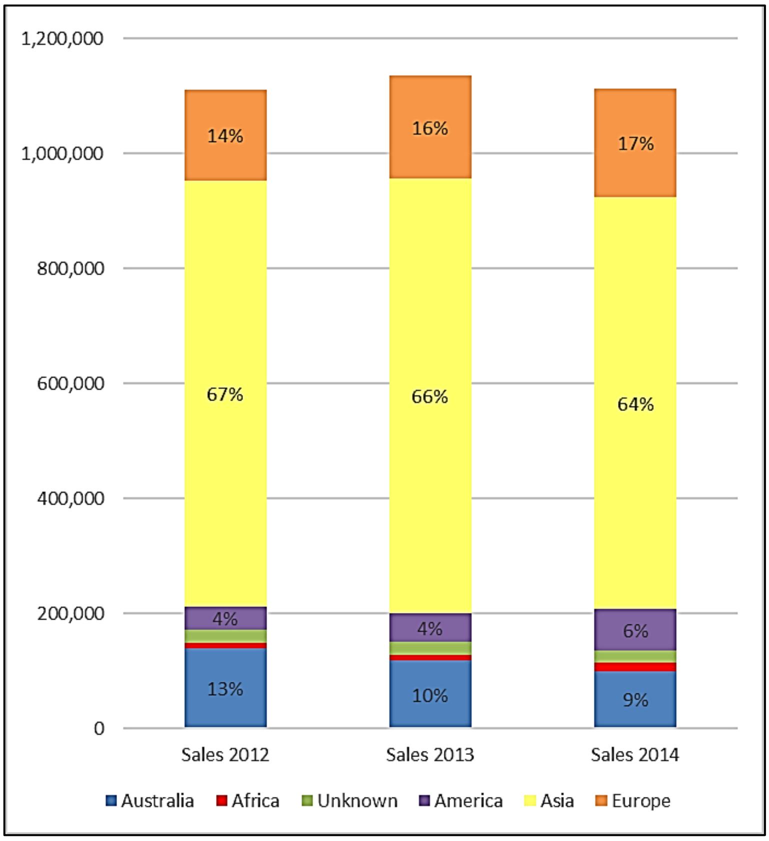

Figure 4.9. The number of new vehicle sales in Australia including passenger, SUV and commercial vehicles based on continent of origin.
Note: Based on data from VFACTS

After Asia, Europe is the second largest continent in terms of supplying new vehicles to the Australian market, with 17 percent of all new sold vehicles in Australia in 2014 coming from this continent (Figure 4.9). VW's Golf from Germany, followed by the Hyundai ix35 from the Czech Republic and Nissan's Dualis were the three most popular models among more than 200 models of vehicles that came from Europe in 2014 (VFACTS data).

Following the decision of the Australian Government to reduce the trade barriers for imports, domestic vehicle producers could not compete with their global competitors and consequently lost market share against the rapid growth of demand for imported cars. As a result, in 2013 nearly 90 percent of the new vehicles sold in Australia were imported (Productivity Commission 2014) and in 2015 only 8 percent of the new vehicles sold in Australia were produced locally (Figure 4.10).

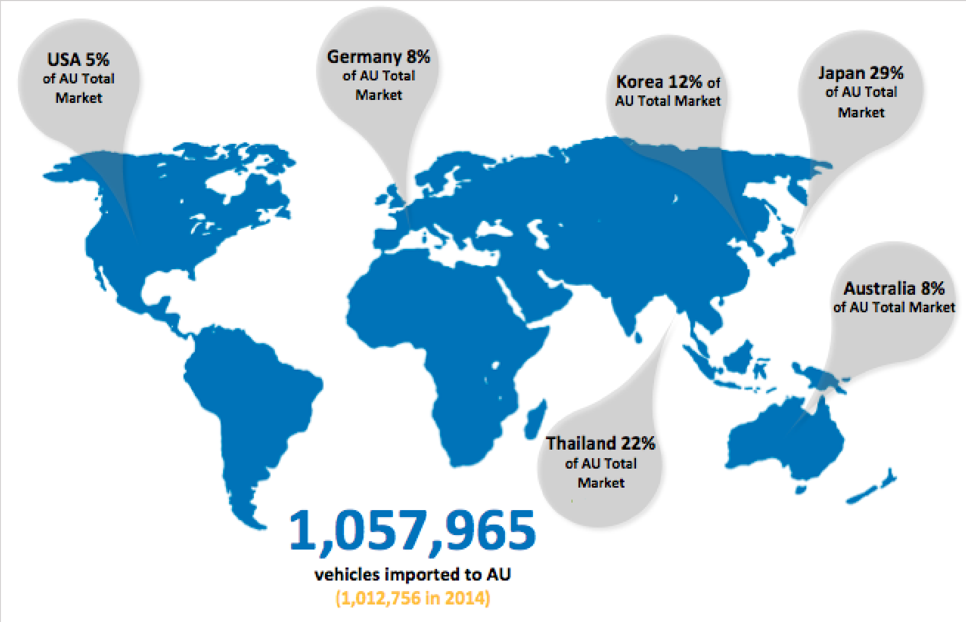

Figure 4.10. New vehicle sales in Australia by country of origin (December 2015).
Source: Nuttall (2016) based on data from VFACTS

4.5 Car manufacturers as part of the finished vehicle import chain to Australia

The above has pointed to the global nature of the automotive manufacturing sector. It has demonstrated the decline in Australian production and the growing reliance on imported vehicles. As a result, there are a number of participants in the supply chain from origin of manufacturer to the consumer in Australia. Figure 4.11 shows the position of the car manufacturers in a typical automobile import chain through PoM. As seen in this figure, car manufacturers are the producers and the main suppliers for the chain of importing finished vehicle through PoM.

In addition, car manufacturing requires accurate planning and a well-established network of suppliers and logistic providers to ensure a non-stop convergent flow of material upstream of the car assembly plant (or car's chain) and a divergent flow of finished cars downstream of the chain (Meyr 2004).

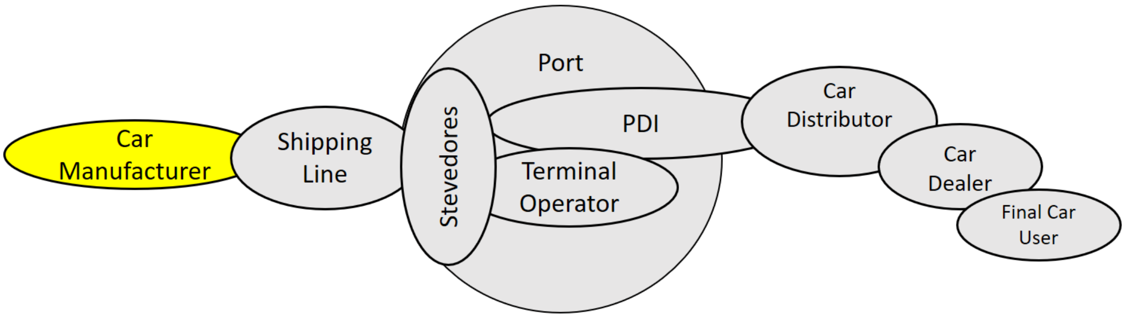

Figure 4.11. The position of the car manufacturers in the schematic chain of importing new vehicles through PoM.

Whilst today's car manufacturers are outsourcing their manufacturing divisions including raw materials, painting, in house production of selected modules such as engines, transmissions and exhaust systems more than any time in history, they are also paying attention to brand management and every value adding services such as new car sales and leasing, financing and insurance and fleet management, that can connect their brands directly with the final customers (Güttner & Sommer-Dittrich 2008, p.66). As such, their tendency for vertical integration with the distribution and logistics chain of their finished vehicles has increased.

Figure 4.12 shows the type of dyadic relationships that car manufacturers have with other chain players. As seen in this figure, the local car distributors and shipping lines are the only chain members that have direct links with the car manufacturers.

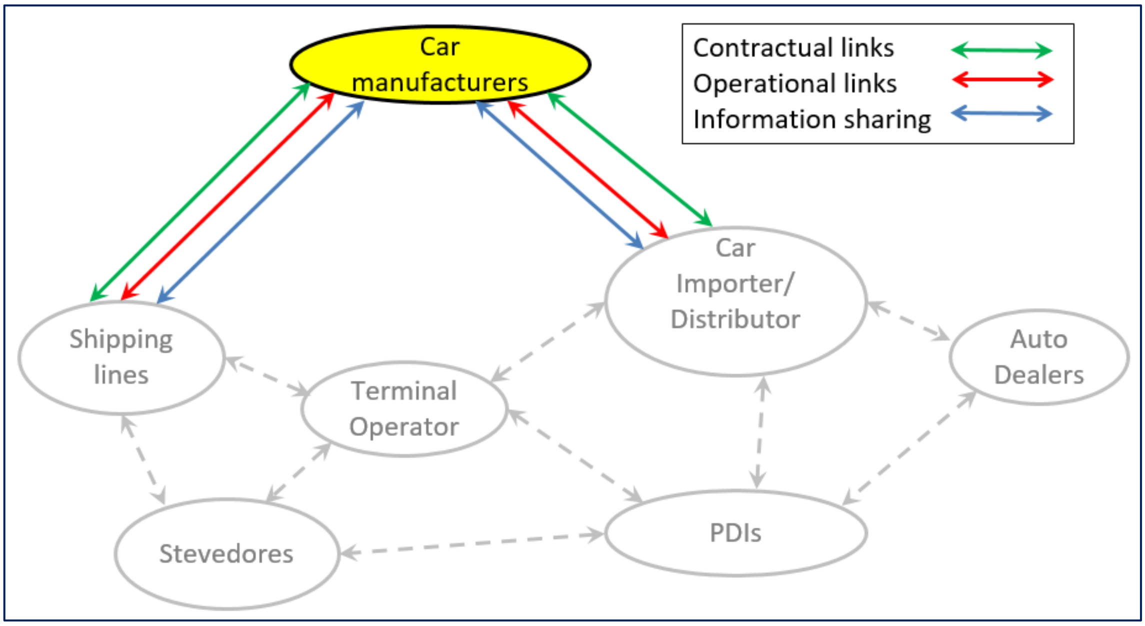

Figure 4.12. The different types of relationships between car manufacturers and other elements of the automotive import chain through PoM.

Below, each of these dyadic relationships is investigated.

4.5.1 Car manufacturer – shipping line

New vehicles are produced and exported into Australia from at least 26 different countries around the world. When a new vehicle is ordered in Australia, a place on a ship is booked by the car manufacturer. Then the vehicle is delivered by its estimated time of transportation to the ship that will travel to Australia to transport the vehicle. Since the car manufacturer is responsible for delivery of the cargo to the destination port, the responsibility of the required coordination with the shipping line and preparation of documentation for Australian Quarantine and Inspection Service (AQIS) and Australian Customs and Border Protection Service (ACBPS) of the port of delivery is with the car manufacturer. As such, there are operational links as well as information exchanges between a car manufacturer and the shipping lines for sending and receiving vehicle cargo. In addition, normally each car manufacturer signs a contractual agreement with some shipping lines that are able to collect their vehicle orders from the ports near their production sites and deliver them to the PoM. These contracts are normally three-year contracts in which the demand projection for vehicle cargo transportation will be sent to the shipping line by the car manufacturer.

Indeed, in some instances, automotive manufacturers either own or have formed a partnership with shipping companies. For example, as shown in Figure 4.13, the Toyota group have established the Toyofuji shipping line for water transportation of Toyota vehicles. In addition, the Korean shipping line Hyundai Glovis is part of the Kia Hyundai automotive group. Some corporate links and partnerships can also be found between certain Japanese car manufacturers and three Japanese shippings lines (MOL, K-line and NYK). MOL, for instance, has ownership links with Mitsubishi.

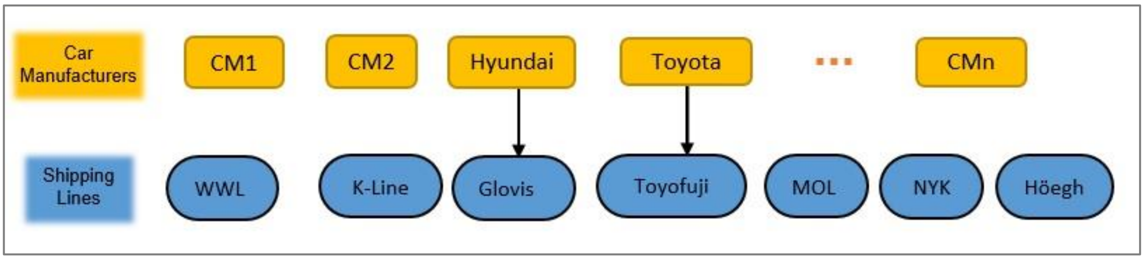

Figure 4.13. The corporate ownership links between car manufacturers and shipping lines in the auto chain.
Note: 'n' represents the number of car manufacturers in the auto chain.

4.5.2 Car distributor – car manufacturer

Each car manufacturer has a head office in the local consumer markets, and collects the local market trends and forecasts, and manages the dealership network to help with the marketing, production planning, and distribution of new vehicles for the head office. A transaction takes place between each car manufacturer and their local car agent for the importing and distribution of their products. As shown in Figure 4.12, there is a contractual agreement between a car manufacturer and its local car distributor/importer in the consuming markets. As part of these contractual agreements, there are many operational business matters that need continuous interactions in the form of information sharing between a car manufacturer's head office and their local car distributor.

4.6 Conclusion

The changing nature of the industry, intense and growing competition among manufacturers competing for and securing an increasingly discerning clientele, globalisation of production, and what are frequently long distances from the manufacturing plant to the consumer, has led to the demand for an increasingly efficient manufacturing process and supply chain. In the case of Australia, this will undoubtedly increase significantly in the future as domestic production continues to decline and will cease altogether in 2017.

Chapter 5 Shipping Lines

5.1 Introduction

Australia, an island continent, relies on ocean transport for the import of motor vehicles. This phenomenon will increase as the production of cars in Australia ceases altogether in 2017. The highly competitive nature of the automotive trade and shipping means that efficiency not only in the shipping leg but in the end-to-end supply chain is crucial in order to retain or capture competitive advantage.

Transporting vehicles by sea is diverse depending on volume as well as port facilities at the end destination. Some small cars are transported in containers, although the majority of vehicles are carried in RoRo vessels[7] (Øvstebø, Hvattum & Fagerholt 2011, p.1425) since they are the cheapest and most convenient method of maritime transportation (Universal Cargo 2013). Despite the popularity of containerships for transporting different ranges of cargo, containerships currently cannot compete with RoRo vessels for transporting finished vehicles (Xuan 2014). At present, RoRo ships are the preferred option for transporting volumes of cars or large size vehicles, and containerships might only be used to transport low quantities of small cars via some remote ports that are not equipped to handle RoRo vessels or high cost specialised vehicles. Furthermore, for the transportation of high and heavy cargo such as trucks, buses, boats, cranes, tractors, and other agriculture and construction machineries, some advanced models of the RoRo ocean carriers are the only type of ships that are capable of handling oversized and heavy cargo (NYK Group 2015).

In the last five years, almost one fifth of total new cars produced worldwide have been delivered to their consuming markets by car carriers via long distance water ways (Table 5.1). In 2014, for example, the total number of cars produced around the world was approximately 89.78 million (OICA 2016). With the exception of European short sea routes, 19.4 percent (or 17.4 million units) were transported by car carriers ("K" Line 2015, p.29).

[7] RoRo vessels are classified as general cargo ships, purposely designed to transfer wheeled cargo such as passenger cars, trucks, buses, farming, construction or military machines and equipment.

Table 5.1. Share of CBU vehicles transported via long ocean routes from their annual production.

Year	Worldwide vehicle production (million units) *	Worldwide freight movement of CBU vehicles excluding European short sea (million units)	Share of CBU vehicles transferred via long ocean routes to their annual production (percent)
2004	64.5	7.6	11.78
2005	66.72	10.9	16.34
2006	69.22	12.9	18.64
2007	73.27	16.9	23.07
2008	70.73	16.5	23.33
2009	61.76	11	17.81
2010	77.58	14.2	18.30
2011	79.89	15.1	18.90
2012	84.24	16.3	19.35
2013	87.6	16.1	18.38
2014	89.78	17.4	19.38
* includes passenger and commercial cars			

Sources: Data for 'worldwide vehicle production' from OICA (2016), data for 'worldwide freight movement of CBU vehicles excluding European short sea' from "K" Line (2015, p.29) and "K" Line (2012, p.22).

Transporting high value commodities, such as new cars, unmarked is a difficult task as they are not packable like other luxury products such as wide LCD monitors (NYK Group 2013, p.49). Unlike the containership with cargo packed in containers, the new automobiles are driven onto the deck without any packaging. As such, the quality of transportation and damage free delivery of cargo is critical.

In contrast to the container fleet, the intercontinental RoRo fleet, with vessels in excess of 2,000 unit capacity, is small (Øvstebø, Hvattum & Fagerholt 2011) and is controlled by a small number of large shipping lines (Figure 5.1). Five of the eight major shipping lines listed in Figure 5.1 include the three Japanese shipping lines of NYK, MOL and K-line. In addition, other shipping lines providing services to Australia include WWL, Hyundai Glovis, Höegh and Toyofuji.

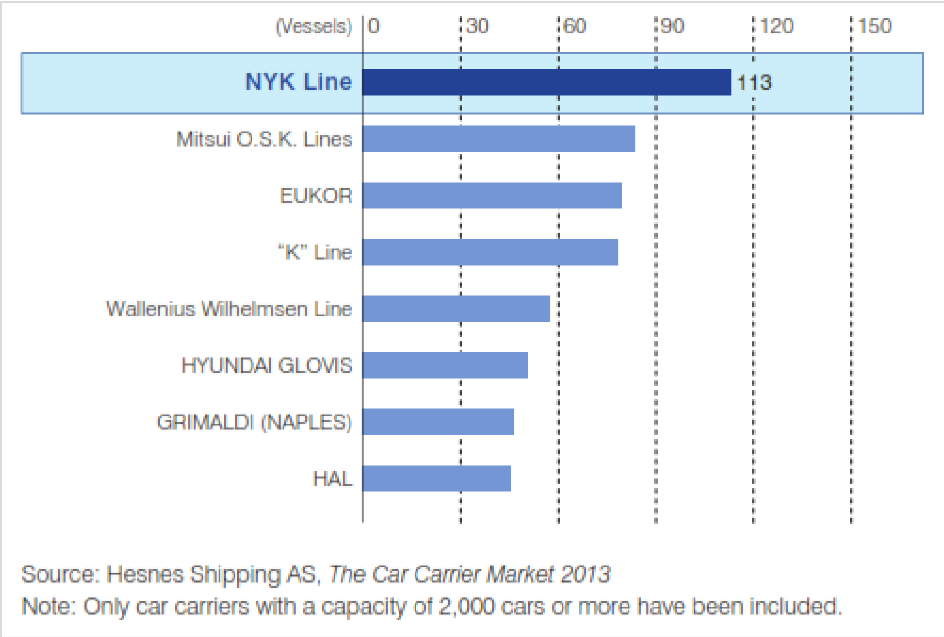

Figure 5.1. Global car transport fleet ranking.
Source: NYK Group (2013, p.31).

In terms of car carrying capacity, or Car Equivalent Units (CEU), the top ten vehicle carriers in 2014 are ranked in Figure 5.2 which illustrates the fleet size of different ocean car carriers based on the number of CEU capacity from 2011 to 2014 (Coia 2014). This figure indicates that there are approximately seven major deep sea RoRo shipping lines in the world including NYK, MOL, Eukor, K-line, WWL, Glovis and Höegh, each with a total carrying capacity exceeding 200,000 CEUs. This reflects the highly competitive nature of the ocean car carrying business and, as has occurred with container vessels, the need to capture economies of scale by way of increasing vessel size. It also reflects the high capital cost of shipping and that the majority of sea car carriers belong to a relatively small number of large shipping lines which dominate the market globally. Some sources estimate that 90 percent of the total fleet capacity of RoRo vessels are controlled by ten major companies (Williams 2014a).

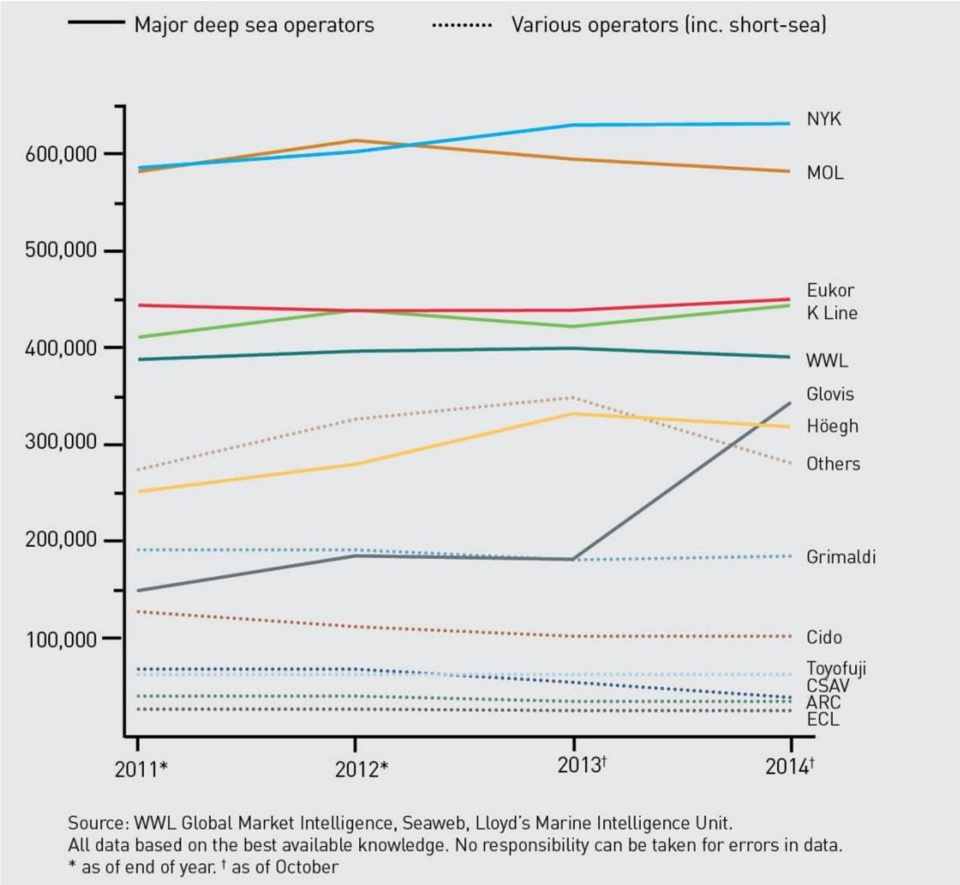

Figure 5.2. Deep sea car carrier fleet size based on CEU capacity (2011 – 2014).
Source: Coia (2014)

5.2 Ocean car carrying market in Australia

While the worldwide production of motor vehicles is expected to increase by five to six percent annually over the next couple of years, the ocean car carrier fleet will increase by two or three percent (NYK Group 2015, p.42). This apparent mismatch reflects auto manufacturer strategies to locate car production plants inside or near consumption markets such as China, India, South America and Russia. These new locations tend to not only have lower production costs, but also benefit from proximity to markets. Despite this slower growth of ocean car carrying demand in inter continent transportation, the ocean vehicle trade to Australia will continue to increase, particularly when car production in Australia ceases in 2017.

Currently, six of the ten major global car carriers which were ranked have services to Australia (Figure 5.2). These companies are dominant players serving the Australian market. The geographic location of Australia may not be a preferred destination for all shipping lines as the operator, first, needs to have established trade routes proximate to

Australian ports and, second, should also have sufficient capacity for transporting vehicles to Australia at a competitive price.

There are currently seven shipping lines including NYK, MOL, K-line, WWL, Höegh, Toyofuji and Glovis that have regular calls to the PoM. Figure 5.3 shows the trade routes of those shipping lines that currently have services to Australia and particularly to the PoM. The proximity of Australia to Japan and South East Asian countries exporting vehicles to the Australian market provides 'supply competitive advantages' to the shipping lines serving the market. A competitive advantage in the supply gives a company the ability to provide its product or service to the customers with much lower costs compared with other potential rival companies (Greenwald & Kahn 2005, p.9). As such, four Japanese shipping lines (NYK, MOL, K-line and Toyofuji), as well as the Korean shipping line Glovis, have routes to most of the Australian ports including PoM. The other two shipping lines, WWL and Höegh, have trade routes that connect Europe, South Africa and Oceania, or Europe, America and Oceania. These companies have supply competitive advantages in terms of availability of their services for Australian customers compared with competitors that do not have trade routes that pass closely or through Australian ports.

In addition, with the exception of Hyundai Glovis which recently started to provide ocean charter space services to Australia, other shipping lines have established trade services to Australia and long-term connections with the Australian ports and stevedoring services, and have secured 'demand competitive advantages' over shipping lines that have not entered this market. Demand competitive advantage indicates that the company has access to a category of customers that the other potential rivals cannot reach to those demand sections of the market. This demand privilege does not simply attain by simple product differentiation, or branding. Rather it happens because of the customer captivity which is based on habit or the cost of switching to a new supplier or service provider, or due to difficulties of searching for a new supplier or replacing them by customers (Greenwald & Kahn 2005, p.9). Some exceptions to new entries to the Australian market are for those shipping lines that have a partnership with OEMs such as Toyofuji which have a connection with Toyota, and Glovis which has links to Hyundai Motors Group.

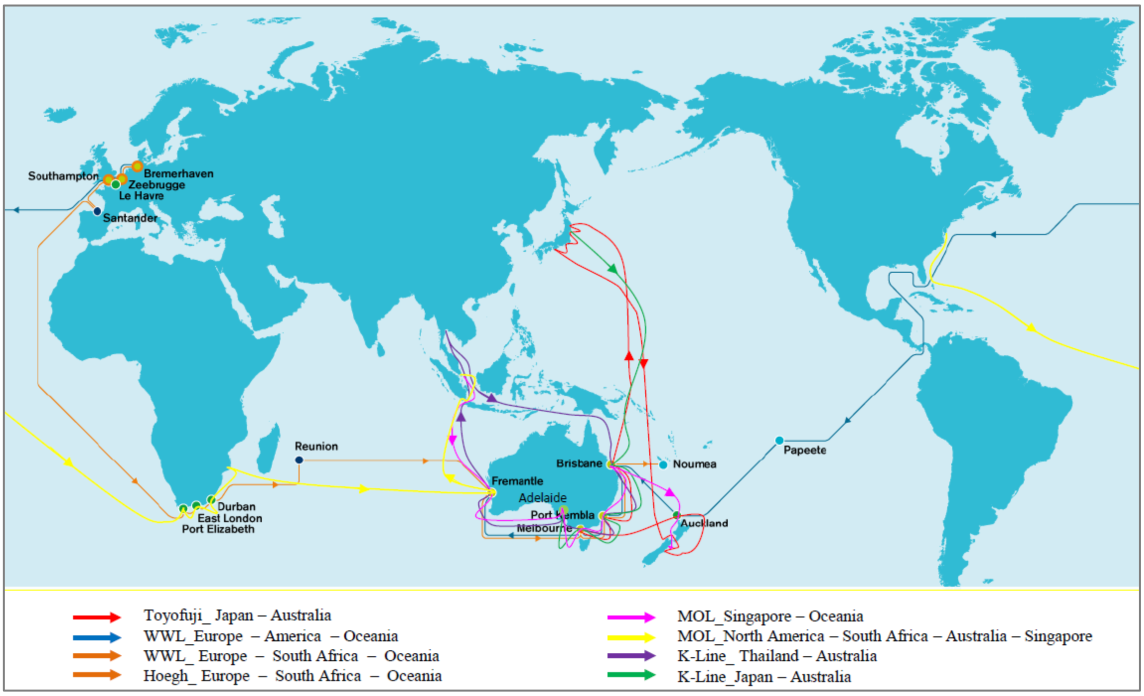

Figure 5.3. The current vehicle ocean transport routes to Australia.
Sources: Adopted from Mitsui O.S.K. Lines (2017), Högh Autoliners (2017), Wallenius Wilhelmsen Logistics (n.d), Toyofuji Shipping Co. (n.d) and "K" Line (Australia) (2015)
Note: Ocean transport routes of NYK and Glovis to Australia are not shown in this figure.

5.3 Capital cost of RoRo shipping

Like other forms of shipping, RoRo vessels have high fixed costs, making operational efficiency in both shipping and the supply chain crucial. Other costs carried by the companies include ongoing costs such as repair and maintenance, crewing charges and navigation, as well as demurrage, fuel consumption cost, port costs and associated charges, and ship insurance (Stopford 2003, p.25). Capturing economies of scale is an important principle, and those vessels that have higher CEU capacity can significantly reduce their costs per unit compared with small low volume vessels especially in long distance trade routes. A RoRo vessel designed to carry more than 8000 CEUs can enjoy lower cost per unit compared with competitors with lower carrying capacity. These giant pure car carriers (PCC) and pure truck/car carriers (PTCC) are mostly active on the long-distance routes from Europe, America, South Africa and Australia.

5.4 RoRo ocean routes to Australia

Shipping lines serving Australia and service routes are listed in Table 5.2. The paths of these services are noted in Figure 5.3. The frequency and number of services may depend on the quantity and type of cargo and the distance travelled. For example, the longer distance of vehicles shipped from Europe or the USA to Australia is likely to lead to less frequent services particularly with larger capacity vessels. Services from South East Asia, however, are likely to be more frequent (Table 5.2). In Australia, shipping lines will call at a number of ports, generally starting from the eastern side of the country serving the major demand centres of Brisbane, Port Kembla and Melbourne. Normally services run additional port calls to Adelaide and to Fremantle as they are passing the southern and western coast of Australia.

Table 5.2. The number and frequencies of different RoRo shipping line routes to Australia.

Shipping line	Service route	Frequency of services to visit PoM
WWL	Europe–America–Oceania	3-7/month
	Europe–South Africa–Oceania	
Höegh	Europe–South Africa–Oceania	3/month
NYK	Trans-shipment via Japan to Australia	2/month
K-Line	Japan–Australia	2-3/month
	Thailand–Australia	2-3/month
MOL	Thailand – Australia (including Melbourne)	3-4/month
	Japan – Australia (including Melbourne)	
Toyofuji	Japan – Australia	2/month
Hyundai Glovis	Space charter using MOL, South Korea-Eastern Australia (Brisbane, Kembla, Melbourne)	2-3/month

Sources: Modified from NYK RoRo (2016b), Mitsui O.S.K. Lines (2017), Höegh Autoliners (2017), Wallenius Wilhelmsen Logistics (n.d), Hyndai Glovis (2014b), Toyofuji Shipping Co. (n.d) and "K" Line (Australia) (2015)

The car carriers, particularly in the case of Japanese and other Asian lines, are often linked into a networked market structure. This is a form of inter-firm horizontal integration frequently practiced by large shipping lines either sharing vessels or offering joint services in some paths, in order to capture economies of scale, save costs and improve operational efficiency. NYK and K-line, for example, have shared services from Thailand to the eastern part of Australia, while MOL also shares services with NYK and K-line. These operational arrangements enable more effective management of their fleets and maximise vessel utilisation. Some discussion about the current RoRo routes to Australia is provided below (Figure 5.3). This will be followed by RoRo ships fleet optimisation and strategies implemented to maximise supply chain control.

5.4.1 Japan - Australia routes

Services from Japan to Australia are undertaken by three Japanese lines including K-line, NYK and MOL. As the demand in the eastern states is higher than in Western Australia and Darwin in the Northern Territory, shipping lines from Japan call in eastern and western states in separate services. As a result, there are more frequent services from Japan to the east coast, starting in Brisbane, Port Kembla and the Port of Melbourne. The frequency of these services is five times a month or more depending on the demand pattern. Periodically, services that call in the east coast might run additional port calls to Adelaide depending on demand. Other services from Japan to the western part of Australia make direct calls at Fremantle and Darwin. In addition, there are two services per month to eastern ports provided by Toyofuji. In total, there are seven to eight services from Japan to PoM each month.

The shipping services from Japan carry new vehicles including Toyota, Honda, Mazda, Mitsubishi, Lexus, Infiniti, Mitsubishi, Nissan, Subaru, Suzuki and some specific models of other brands (Peugeot, Citroen) via different ports in Japan including Nagoya, Yokohama and other Japanese ports (VFACTS data). Some services pass through South Korea and China, collecting vehicles from those areas. For example, MOL loads cargo in South Korea for delivery to eastern Australia. Hyundai Glovis charters services from South Korea to Australia. In addition, the three Japanese shipping lines also bring European and USA vehicles by way of transhipment through the Yokohama port in Japan.

5.4.2 Thailand - Australia routes

Some car manufacturers such as Honda, Nissan and Mitsubishi have opened factories in Thailand, taking advantage of low labour costs. Some of the passenger, commercial and SUV models are manufactured in Thailand, such as Holden (Colorado), Ford (Focus, Fiesta and Ranger), Toyota (Hilux and Corolla), Honda (Accord, City, Civic and Jazz). Other manufacturers producing in Thailand include Nissan, Mitsubishi, Mazda (Mazda2), Suzuki (Swift) and Isuzu (VFACTS data).

The Thailand to Australia routes are served by the three Japanese shipping lines NYK, K-line and MOL. NYK and K-line depart from Port Laem Chabang, calling at Brisbane, Port Kembla, Melbourne, Adelaide and Fremantle before returning to Thailand. The combined frequency of NYK and K-line services is five times per months. MOL services follow an opposite direction - from Thailand to Fremantle, Adelaide, Melbourne, Port Kembla and Brisbane, providing two to three services per month. In total, the frequency of all RoRo services from Thailand to the PoM is seven or eight per month. In addition, the three Japanese lines also bring European vehicles transhipped through Singapore.

5.4.3 Europe - Australia

Vehicles from Europe destined for Australia are produced in England, Germany, France, Italy, Spain, Sweden, Poland, Portugal, Belgium, Czech Republic, Austria and Slovakia, including brands such as VW, Jaguar, Volvo, Mercedes-Benz, BMW, Audi, Citroen, Peugeot, Fiat, Porsche and some non-European brands produced on behalf of Nissan, Ford and Honda (VFACTS data).

A number of different routes from Europe to Australia are employed. From Bremerhaven, Southampton, Zeebrugge along the west coast of Africa to Durban, and Elizabeth to Maputo to load/unload some vehicles to Australia's west coast port of Fremantle to Melbourne, Port Kembla and Brisbane. Currently there are two shipping lines, WWL and Höegh, that have services along this route. Another route provided by WWL starting in Bremerhaven, Southampton and Zeebrugge to the American north east, and via the Panama Canal and the Pacific Ocean to New Zealand and Australia unloads cargo at Brisbane, Port Kembla, Melbourne and Fremantle consecutively. The majority of European vehicles to Australia (approximately 70 percent) are carried by WWL along this route. In total, seven services each month are provided by WWL and four services by Höegh along this route. The number of services to the PoM from Europe is about 11 per month. In addition to these direct routes, some European vehicles are transhipped to Australia through Singapore. NYK, for example, provides a service from Europe to South East Asia and Japan through the Mediterranean Sea and via Suez Canal (Figure 5.4).

Figure 5.4. NYK's route from Europe to South East Asia and Japan.
Source: Modified from NYK RoRo (2016a).

5.4.4 North America and Mexico – Australia

WWL also provides a service from the USA to Australia, starting in Western Europe to the North American ports of Baltimore, Savannah, Galveston, and passing through the Panama Canal to Port Manzanillo in Mexico to New Zealand and Australia. In Australia ship calls are first in Brisbane, Port Kembla and Melbourne, continuing to the southern and western ports of Australia. The frequency of this service is approximately four each month and approximately 95 percent of North American vehicles are discharged in Melbourne via this route. Most of the SUV models of BMW, Jeep and Mercedes-Benz are produced in USA as well as other brands such as VW (Amarok), Chrysler (300 and Voyager), Holden (Volt), Dodge (Caliber), Toyota (Kluger) and Nissan (Pathfinder)(VFACTS data).

Other services provided by MOL carry vehicles from Baltimore, Brunswick and Jacksonville to South Africa via the Atlantic Ocean to Fremantle and Singapore. Fremantle is the sole port call along this route. Some of the vehicles from the USA are also carried by NYK and K-line, and are transhipped through Yokohama.

5.4.5 South Africa – Australia

A number of western car producers (VW, BMW, Mercedes and Ford, for example) have established plants in South Africa. Some of the models of these brands such as Ford

Ranger (commercial vehicle), Ford Focus, BMW 3, Mercedes-Benz C-Class and VW Polo are shipped to Australia (VFACTS data).

The routes that bring vehicles from Europe or east coast America usually stop at some South African ports including Durban, Elizabeth and East London. There are no shipping services that originate in South Africa, although WWL and Höegh call at South African ports on their route from Europe. These services call at all major Australian ports approximately seven times per month (WWL has three services and Höegh has four services each month). A further service provided by MOL originates in east coast USA, calls at South Africa to Australia, with its only port call in Fremantle.

5.5 RoRo ships fleet optimisation to align capacity in the auto chain

Inter-firm capacity alignment is one of the most important macro-efficiency factors for the efficiency of the whole chain and effective integration of business processes across the chain. Figure 5.5 shows the position of the shipping lines as a major player in the vehicle import chain through PoM.

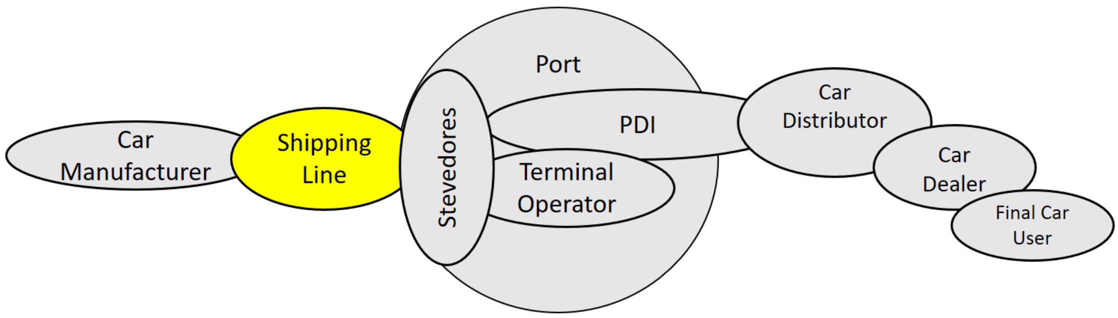

Figure 5.5. Position of the shipping lines in the schematic chain of importing vehicles through PoM.

The giant PCC and PCTC carriers are capital intensive with high operating costs, and fleet optimisation is essential to capture economies of scale and provide a reliable and viable shipping service. However, managing the size of the fleet is a difficult task and must cater for demand fluctuations. In addition, there is significant lead time and investment in new vessels which have an average life of 30 years (Coia 2014). As a result, fleet optimisation demands long term planning and establishing a close relationship with the clients to be able to forecast and plan the fleet size at least for the next three to five years. Long term planning for the fleet size is normally undertaken based on the demand projections that shipping lines receive from their customers (car manufacturers). Despite the need for long term planning, a degree of flexibility is required to cope with unexpected demand in the short term, as well as the ability to change the fleet size accordingly. Options such as laying down vessels or disposing of old ships in time of demand reduction, and chartering, sharing or buying new vessels to cope with increasing demand size, are short term strategies employed by shipping lines to keep their fleet size aligned with the demand. At the time of the global economic crisis in 2009, for example, the global ocean car trade dropped by 35 percent (Xuan 2014, p.11), and most of the shipping lines reduced their fleet size by disposing of their old vessels, or selling or laying down their unassigned vessels.

Our investigation suggests that shipping lines working on ocean car trade routes to Australia are effectively aligning their capacity with the flow of the cargo by setting different strategies, including sharing vessels particularly in low volume trades, offering joint-services and chartering space to minimise costs and maximise efficiency.

5.6 Dyadic relationships between shipping lines and other chain members

In order to recognise and classify the type of current integrative practices and mechanisms performed by the shipping lines in the auto chain, the interaction of all members of the chain with a link to the shipping lines needs to be considered.

Figure 5.6 shows three types of dyadic relationships (operational, information sharing and contractual links) that shipping lines have with other chain players. As seen in this figure, the car manufacturers, stevedore and terminal operator are major chain players that have direct links with the shipping lines as well as PoMC and the other statutory organisations such as ACBPS and AQIS.

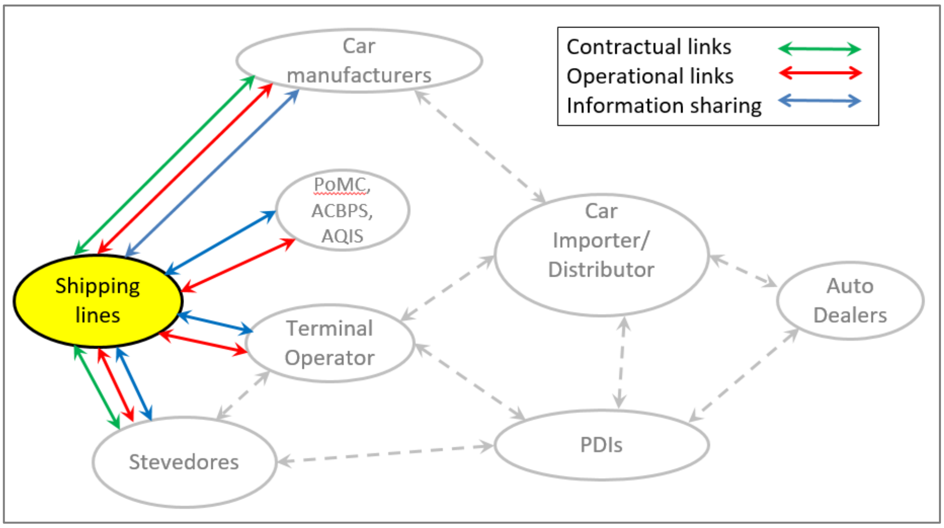

Figure 5.6. Operational, information sharing and contractual links between shipping lines and other members of the chain.

Dyadic relationships between chain players are discussed below.

5.6.1 Shipping lines - car manufacturers:

Shipping lines have contracts with car manufacturers for the delivery of their products to the destination ports, damage free and on time, from different loading ports around the world to the PoM. As a result, there is a transaction taking place between a car manufacturer and its contracted shipping line. Each shipping line generally has a three-year contract with different car manufacturers transporting their vehicles to different ports around the world. As part of their contract with car manufacturers, each shipping line receives booking orders for the delivery of vehicles to the PoM. All of these booking orders will be collected by the shipping line to choose and plan a sailing journey and assign the proper vessel to deliver different batches of new vehicles from different loading ports on one vessel/voyage for delivery to the PoM. For example, WWL signs a three-year contract with BMW to deliver its cargo to Australia from ports in Europe and South Africa. WWL might also sign other contracts with other European car producers such as Peugeot, Jaguar and Fiat to bring their vehicle cargo from Europe to Australia. After signing these contracts, car producers send their forecast for the next 12 months to the WWL head office, and the company will plan its fleet size accordingly.

Interaction between the shipping lines and car manufacturers, as shown in Figure 5.6, are in the form of operational and information sharing as well as contractual relationships.

5.6.2 Shipping lines - terminal operator

Shipping lines are expected to inform the terminal operator the estimated time of arrival (ETA) of their vessels. The terminal operator allows the vessel to berth three days before and leave the wharf within three days after the ETA. The terminal operator also provides a vessel safety checklist for each RoRo vessel berthing at the terminal for safe berthing and stevedoring procedures.

Interaction between the shipping lines and terminal operators, as shown in Figure 5.6, are in the form of operational interaction and information sharing to coordinate the operational procedures.

5.6.3 Shipping lines - stevedore

The different types of interactions between shipping lines and stevedores are shown in Figure 5.6, including operational, information sharing and contractual links. The contract between shipping lines and stevedores at PoM is generally for a three-year period. A transaction takes place between a shipping line and its contracted stevedore for the unloading of new vehicles from the ship into the terminal yard at port, damage free and on time. The absence of these contractual alignments between the stevedore companies and shipping lines can cause extra costs and the rise of inefficiency in the port-terminal operation and, consequently, in the chain of importing vehicles to Australia.

In addition to the contractual relationship between shipping lines and stevedoring companies, shipping lines and stevedores interact in the operational level by sharing information. For instance, prior to the arrival at the port, the shipping line sends the ‘order of work’ to the stevedore. This is the plan for the unloading process prepared by the shipping line, and shows the number of cars as well as discharge ports. After berthing the stevedoring, staff unlash the vehicles before driving them into the port terminal yard based on the ‘order of work’.

5.6.4 Shipping lines - PoMC

Upon their arrival at the port, RoRo ships communicate with the port officials to obtain direction and information for sailing the vessel through the shallow waters and certain channels until the berthing of the vessel. As part of the navigation operation, a pilot controls the navigation of the vessel through the port's channels to the berthing zone. Pilots provide the safe movement and navigation of commercial vessels in port waters and prevent hazards such as vessel collision or grounding (Port of Melbourne Corporation 2014b).

As noted in Figure 5.6, there are 'operational' and 'information sharing' interactions between shipping lines and PoMC at the time of arriving in the port.

5.6.5 Shipping line - ACBPS and AQIS

An important statutory operation for arriving vessels at the port is passing AQIS and ACBPS. All shipping lines are required to interact with both ACBPS and AQIS for the delivery of vehicles. Consequently, as shown in Figure 5.6, shipping lines have interactions in the form of operational and information sharing with ACBPS and AQIS. When the vehicle arrives 'in Australia, the Department of Agriculture's biosecurity officers will conduct surveillance inspections to ensure compliance with Australia's import requirements' (Department of Agriculture 2013, p.19). Most vessel inspections take place at the berths although the Department of Agriculture may undertake anchorage vessel inspections if considered appropriate. 'Pratique inspections may occur outside standard hours. Vessel masters and/or shipping agents may negotiate inspection times with the Department of Agriculture's quarantine/biosecurity officers in each state and territory' (Department of Agriculture and Water Resources 2017). 'If the shipment does not meet Australia's requirements, the department may conduct further inspections, or take remedial action to address the biosecurity risk' (Department of Agriculture 2013, p.19).

5.7 Integrating mechanisms using by shipping lines

Shipping companies are no longer simply moving cargo from port to port, but are expanding horizontally and vertically across the supply chain and taking responsibility for other areas of the chain.

In chapter four, the new trends in the car manufacturing business, such as globalisation, fragmentation of the automotive market, as well as the value migration in the automotive supply chain, were reviewed. Due to these changes in the automotive manufacturing business, the logistic requirements of car manufacturers as the main clients of RoRo shipping lines are becoming more complex and diverse (NYK Group 2014). With the globalisation of vehicle production, car manufacturers no longer rely simply on shipping services between two ports, but rather on efficient integrated transport services along the entire supply chain from factory location to end customer. In many instances, shipping lines are taking responsibility for much, or all, of the supply chain. Shipping lines, for example, are enlarging and optimising their network and expanding their scope of services by incorporating land distribution of vehicles and PDI services. Their contribution to these value-added activities is either through partnership with local service providers, such as joint venture, or by acquiring those businesses vertically integrating into their own business, providing a comprehensive logistic service to their client. It was noted by NYK Group (2012, p.52), for example, that it:

> completed the establishment of logistics bases in key regions worldwide including China, Thailand and Belgium. In each of these regions the company had built up systems that not only provide shipping but also enable integrated transportation from plants to automobile dealers.

Since entering the China market in 2003, the company had 'grown into one of the largest non-Chinese transporter of finished automobiles in the country' (NYK Group 2012, p.53). The company was operating RoRo terminals in four major ports in China, had established vehicle distribution centres, and was providing PDI. It had expanded into inland transportation services having acquired 700 car carrier trucks. Indeed, the company now provides not only shipping services, but has also expanded into land transport as well as terminals (NYK Group 2012).

The research below indicates a number of mechanisms and strategies that underline efforts by players in the auto chain to integrate the whole, or at least segments, of the chain and contribute to the efficiency of the chain.

Some integrating mechanisms are discussed briefly below.

5.7.1 Information sharing interdependences

The blue coloured lines in Figure 5.6 show the information links between shipping lines and other chain participants, including car manufacturers, stevedore, terminal operator, PoMC and statutory organisations such as ACBPS and AQIS. Constant information gathering is essential in the RoRo shipment business, such as receiving a demand forecast from the car manufacturer for at least the next 12 months to help with the efficient operation and survival of the businesses. However, shipping lines are not merely collectors of information, but they distribute this to other players in the chain, for coordination with the destination port and terminal operator and the stevedore companies, for example. They constantly interact with car manufacturers and stevedoring companies as their main business partners for long term planning of business operations. In addition, they maintain connections with terminal operators, the port corporation, and ACBPS and AQIS to obtain permission to discharge the cargo.

5.7.2 Operational integrative mechanisms

In addition to the horizontal operational links between shipping lines noted above, there are operational links between elements from different business areas (vertical integrative links). The operational integrative mechanisms refer to any day to day operational links that might exist between different elements of the chain to deliver value to the end-customer. It is the most basic element of integration for a chain as the existence of these links defines the chain and players that are involved in the chain.

These operational links between shipping lines and other elements of the chain are demonstrated diagrammatically in Figure 5.6 indicated by red lines. As indicated in Figure 5.6, shipping lines have direct operational links with many chain members including car manufacturers, terminal operators and stevedores. They also interact with the PoMC to access the port's pilots, as well as with ACBPS and AQIS to get permission to unload the vehicle cargo into the port.

5.7.3 Contractual integrative mechanisms

Robinson (2009, p.247) has argued that in some complex chains, contractual links between dyadic and non-dyadic partners will provide the most elemental basis for imposing control in the chain. The contractual links between ocean car carriers and other elements of the chain are illustrated in Figure 5.6 by green lines. Capacity-based contractual arrangement between car manufacturers and shipping lines make feasible the alignment of capacity of shipping lines with the actual demand. The fleet size optimisation for each shipping line is based on the contractual links and demand projections they receive from their customers (car manufacturers). For companies engaged in RoRo shipping, it is often in their best interest to secure long term contracts with car, truck and rolling equipment manufacturers (Wathne 2012, p.7). Contractual links between ocean car carriers and car manufacturers to transport and deliver their vehicles overseas are determining factors for cost efficient planning of shipping line operation.

5.7.4 Corporate ownership integrative mechanisms

Ownership or corporate ownership may be by way of mergers, joint ventures, acquisitions, and takeovers of one sort or another. Grey links noted in Figure 5.7 show the corporate ownership links between the shipping lines and other companies in the auto chain. These are diverse; two of the shipping lines, for example, are subsidiaries of car manufacturing companies. Toyota is a major shareholder of Toyofuji RoRo shipment, and Hyundai is the parent company of Hyundai Glovis RoRo shipment.

Furthermore, a number of informal interlocking links exist between Japanese car manufacturers and the other Japanese shipping lines and service providers. For example, Mitsubishi Heavy Industries Ltd is a principal shareholder of NYK shipping line (NYK Group 2015, p.151). In addition, there are many corporate ownership links between the shipping lines and other service providers in the chain such as stevedoring and PDI companies. For example, as noted in Figure 5.7, a joint venture company was formed between a shipping line and a stevedoring company. A stevedoring company (Patrick) and a shipping line (MOL) invested equally in creating a new company, Car Compound Australia. Furthermore, Qube and K-line created K-line Auto Logistics Company and invested equally in this company. NYK shipping line has 20 percent equity in Patrick

Autocare, one of the two major PDI companies. These joint ventures and collaborations are important mechanisms controlling significant areas of the chain, enhancing efficiency with the likely reduction or abolition of bottlenecks. These alignments between shipping lines and their dyadic partners, car manufacturers and stevedores, and non-dyadic partners, such as PDI companies, have rapidly restructured the chain, enhancing efficiency and control of the chain. These coalitions and alliances benefit all chain members, increasing the visibility, information sharing, capacity alignment and smarter allocation of costs and investments across the chain that can impact positively on the efficiency of the chain. 'Managing coalitions is an important challenge; and an effective integration of a freight system will reflect how well chain players manage these relationships' (Robinson 2009, p.44).

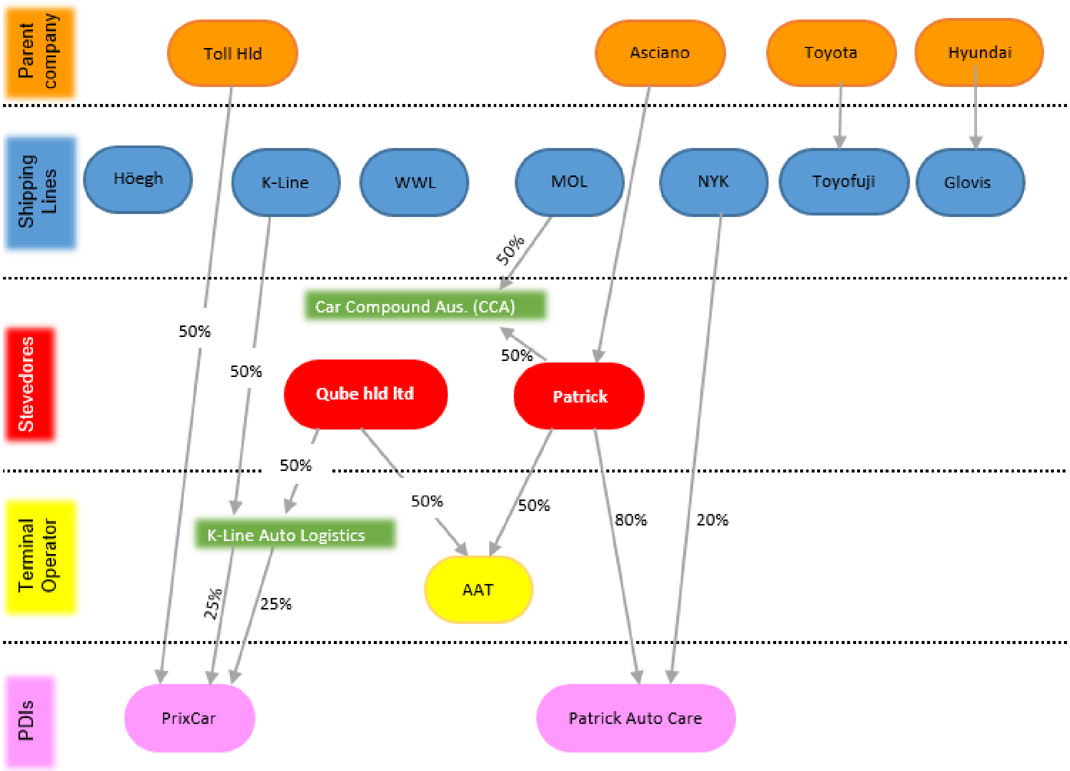

Figure 5.7. The corporate ownership links between shipping lines and other players of the vehicle import chain to PoM.

5.8 Conclusion

The global RoRo shipping market is an exceptionally concentrated market dominated by a limited number of large ocean car carriers. It is a market that is growing and which demands reliable shipping operations.

The RoRo shipping market is demand driven, and building long term relationships with car manufacturers as their main customers is essential in order to plan all trade routes and services at least one year ahead. Generally, shipping lines need to align their capacity with the actual demand by making short term and long term contractual links with car manufacturers and keeping their fleet optimised.

Most of the shipping lines have shown flexibility and are able to change their fleet size according to demand fluctuations by laying down vessels or disposing of old ships in times of demand reduction, or buying new vessels or chartering to meet growing demand. In addition, shipping lines use different vertical integrative mechanisms to be linked and integrated into their supply chain partners (car manufacturers and stevedoring services), to maximise their value and contribute to the efficiency of the whole chain. They have also tended to expand their operations, seeking greater control of the chain particularly in the landside operations and activities.

Chapter 6 The Port of Melbourne

The maritime gateway of the vehicle cargo trade to the state of Victoria is the PoM(Figure 6.1).

Figure 6.1. The schematic diagram of flow of vehicle cargo import to Melbourne.

This chapter discusses, in some detail, the role of the PoM in the auto chain and is designed in three parts. Part A describes the location, layout and physical characteristics of the PoM in terms of the automotive trade and a review of the history of automotive terminals at PoM. Part B focuses on the players in the port section of the auto chain, their individual functions, their dyadic relationships with other auto chain players, and the integrative strategies that are used by them. Part C outlines the recent development of automotive terminals at PoM.

Part A: The layout and history of PoM in relation to automotive trade

6.1 PoM as the major sea-land gate of vehicle trade in the Victoria region

Because Australia is an island continent, sea transportation of vehicles is the most viable option as vehicle imports are dependent on the availability of automotive-port terminals with efficient connections to inland transportation. Currently there are five ports in Australia that have dedicated sites for automotive terminals: Melbourne, Adelaide, Fremantle, Port Kembla and Brisbane (Figure 6.2). As seen in this figure, the PoM is currently the only port in Victoria capable of berthing the giant ocean car carriers and which has the required equipment for the unloading and processing of the RoRo cargo.

In addition, PoM is the largest sea-land hub in Australia (Port of Melbourne Corporation 2013, 2015a). The port has access to efficient land-transport links, and for many years has been a major hub for importing to Victoria, and attracting the world's major ocean car carriers on regular call schedules.

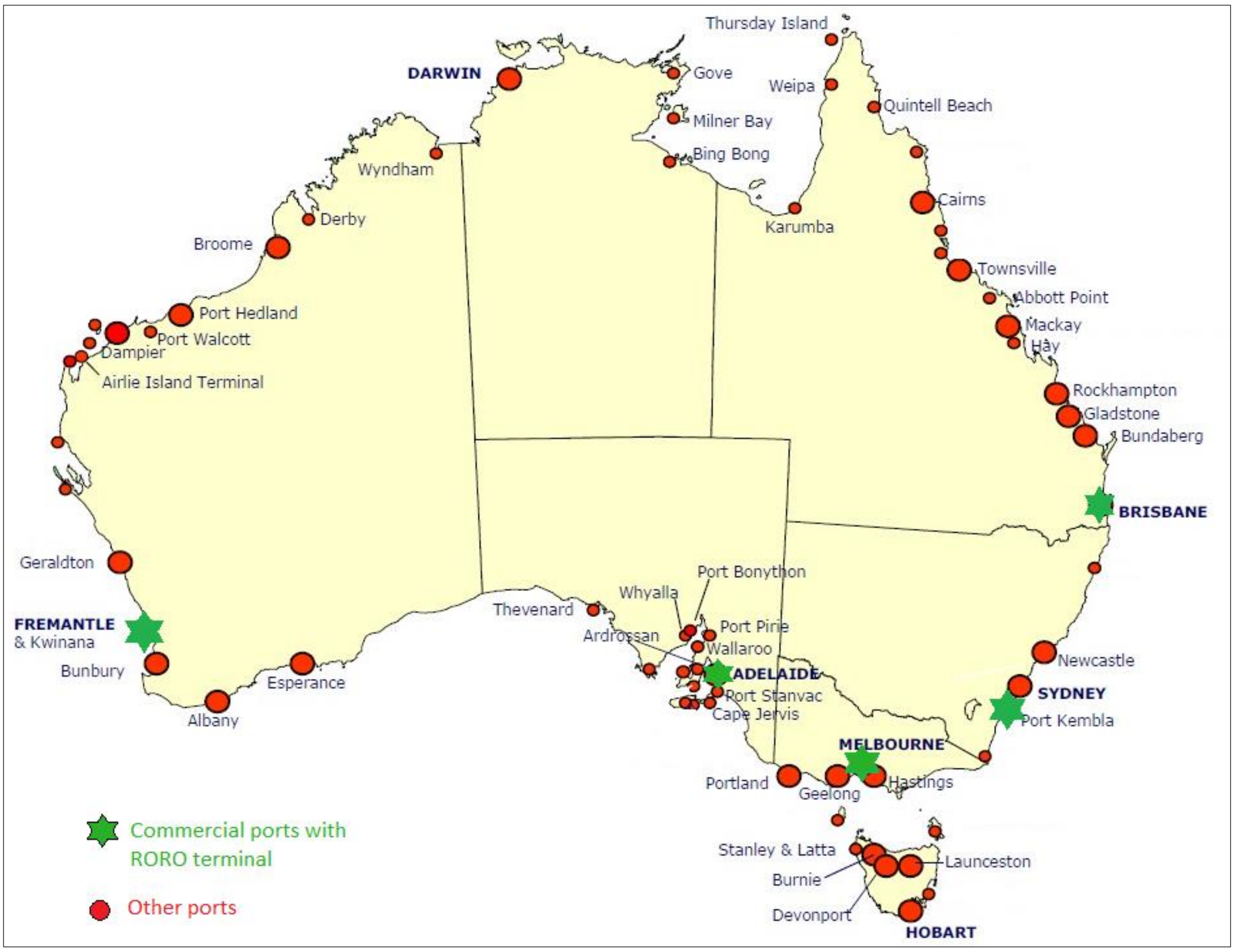

Figure 6.2. The location of PoM and other ports in Australia.
Source: Modified from Ports Australia (2013b)
Note: The auto terminals are noted by green stars.

From the beginning of automotive trade in Melbourne, the PoM has been the preferred sea-land intermodal logistic point for the import and export of vehicle trade in and out of Victoria. Based on the available trade statistics in Ports Australia (2013a), since 2009 approximately 24 per cent of the total ship calls of car carrying to Australia have been to PoM. From 2005 to 2013, the number of annual calls to the PoM by car carriers (as indicated in Figure 6.3) had increased by 30 per cent. This increase was the result of the growth of automotive imports to Australia since 2005, as well as relatively rapid population growth. It is anticipated that growth of automotive imports will continue in the coming decades, particularly as Australia's domestic automobile production will cease in 2017.

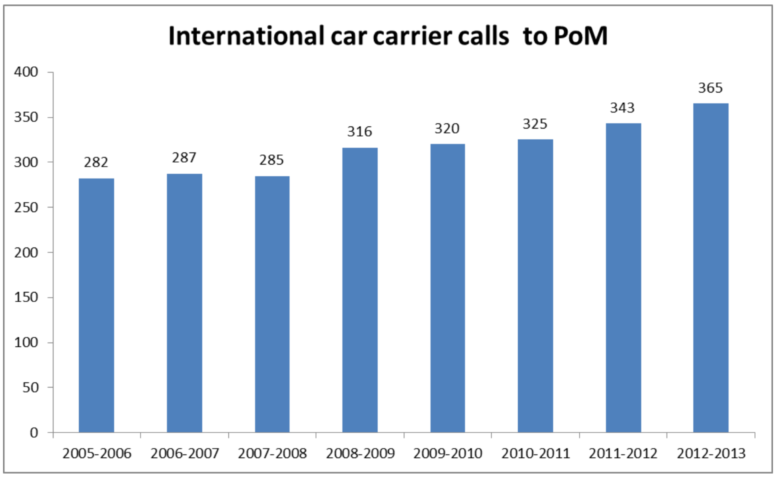

Figure 6.3. RoRo vessel annual calls to the PoM.
Note: Based on data from Ports Australia (2013a).

For at least the next 20 years, the PoM is expected to reach its vehicle trade capacity, and until then will likely remain the only port in Victoria for unloading and processing of the RoRo cargo.

6.1.1 The layout and physical characteristics of the PoM

Figure 6.4 shows the geographical location of PoM and its proximity to the heart of the central business district in the mouth of the Yarra River west of Melbourne. The PoM is centrally located and it is in a relatively equal distance to the most remote areas of Victoria. This has transformed PoM over the years as the hub of a logistic network connected by road and rail throughout south eastern Australia (Port of Melbourne Corporation 2013).

Figure 6.4. Location of PoM in the central area of Melbourne city.

Figure 6.5 shows the layout of this port. The green area in this map represents the port land: approximately 510 hectares surrounded by metropolitan and highly capitalised areas (Port of Melbourne Corporation 2014a).

The PoM has 36 commercial berths with a total berth length of about seven kilometres in five docks. It currently has the biggest containership and automotive port terminal in Australia (Port of Melbourne Corporation 2015a).

Figure 6.5. The map of Port of Melbourne.
Source: Port of Melbourne Corporation (2014a, p.9)
Note: The port area is shown by the green colour.

6.1.2 The automotive terminals at PoM

The automotive terminal is the industrial site of the port designed for berthing, particular RoRo vessels such as the large PCC and PTCC loading/unloading vehicle cargo, PDI operation and the processing of each. The terminal operator is responsible for the day-to-day operations of the terminal which includes managing the arrival of vessels, providing temporary storage for cargo at the First Place to Rest (FPR) zone, and facilitating secure access to the terminal for other users and service providers including stevedores, PDIs staff, and land based transport carriers. An automotive terminal requires significant infrastructure including facilities and access space for loading and unloading cargo on trucks and trains, dedicated automotive laydown area for inspection, weatherproof storage area, buildings, offices and amenities for staff, and a dedicated site for on-wharf PDI activities and vehicle processing. Until 2014, the PoM had used three sites for motor vehicle cargo: Appleton Dock (AD), number three in Figure 6.5, which is located downriver in the Yarra channel, and the other two terminals at Webb Dock in the mouth of Yarra River (Webb Dock West (WDW) and Webb Dock East (WDE)), numbers 9 and 11 in Figure 6.5.

6.2 History of automotive terminals at PoM

RoRo shipping lines as the main users of automotive port terminals have always preferred a one-stop efficient and cost-effective load/unloading operation (in any port). To meet these expectations, terminal operators need stability, efficiency and economies of scale in their terminal sites, operations and services. However, despite a relatively concentrated automotive terminal market in Australia, there has been uncertainty in some ports around Australia, including PoM, about the locations of the automotive terminals, their type of management and access (open versus exclusive), and whether they are multi-purpose or dedicated terminals. These periods of general instability have occurred due to a change of leasing conditions, port zoning regulations, or introduction of new port development plans by the port authorities. These changes can sometimes negatively impact the operational efficiency of automotive terminals. The operational inefficiencies in the port section of the auto chain can result in delays and bottlenecks, negatively affecting the integration and efficiency level of the entire chain. In this section, a brief history of these changes and their effect on the operation of automotive port terminals at PoM is reviewed.

6.2.1 Automotive terminals at PoM before 2001

As noted above, three sites were used in the past in PoM including AD, WDE and WDW (Figure 6.6). AD and WDE have been used as multi-purpose terminals and WDW is a dedicated auto terminal. These three sites were leased by PoM authorities to different stevedores or terminal operators. AD was used by P&O, Patrick was in WDE, and Strang held the contract for WDW.

Strang, as a key stevedoring company dealing with automotive imports, was one of the first companies that created an end-to end integrated auto chain through PoM in the

1970s. This leading and farsighted company formed an alliance with K-Line in 1976, creating a 'one stop shop' from assembly plant to dealers' showrooms (Everett 2008). The trucking company Finemores became part of the alliance, providing land transport. Note this alliance formally became Prix Car in 1989.

In 1980, Strang merged with a major stevedoring company, Patrick, and began trading as Strang Patrick. When the Patrick part of the alliance merged with National Terminals of Australia in 1993, Strang relinquished control and established an independent company trading as Strang Stevedoring Australia, which opened a 'state of the art' vehicle terminal and depot at WDW in 1993.

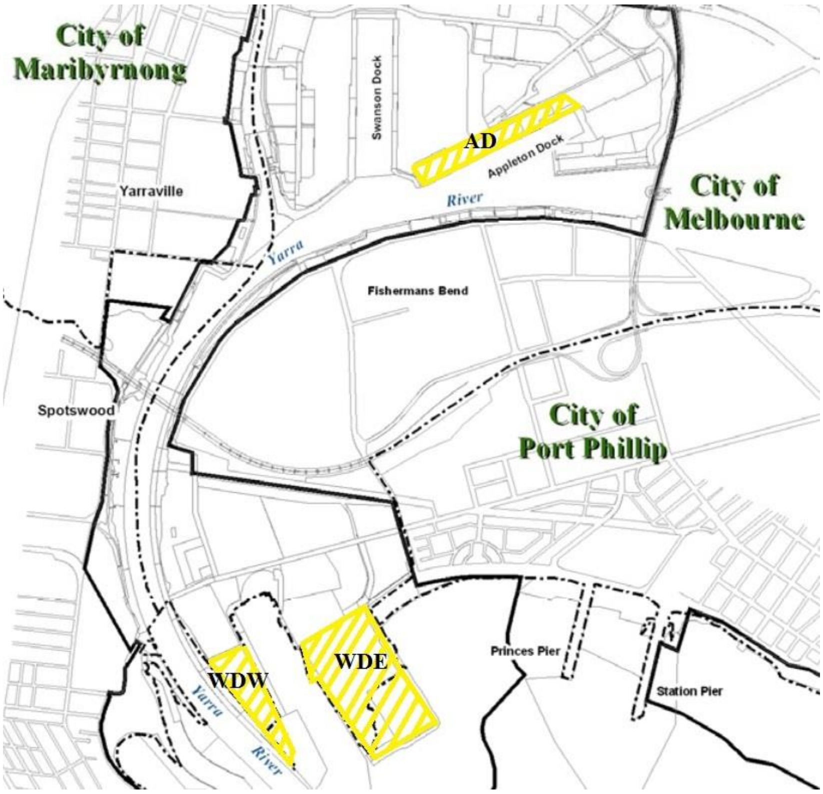

Figure 6.6. The location of three automotive terminals at PoM in the year 2001, including WDW (the dedicated automotive terminal), AD and WDE (multi-purpose terminals).

Thus, the operators of the automotive port terminals at PoM in 1993 were Strang at WDW, Patrick at WDE and P&O at AD (Table 6.1).

Table 6.1. Summary of development and restructuring of automotive terminals at PoM in the last two decades.

Year	Terminal operator and type of access		
	WDW (dedicated auto terminal)	AD (multipurpose terminal)	WDE (multipurpose terminal)
1993	Strang (exclusive access)	P&O (exclusive access)	Patrick (exclusive access)
2000	Strang (exclusive access)	P&O (exclusive access)	Patrick (exclusive access)
2001	Toll (exclusive access)	P&O (exclusive access)	Patrick (exclusive access)
June 2005	Toll (exclusive access)	P&O (exclusive access)	Patrick (exclusive access)
July 2005	AAT (exclusive access)	P&O (exclusive access)	Patrick (exclusive access)
2006	AAT (exclusive access)	AAT (exclusive access)	AAT (exclusive access)
2009	AAT (open access)	POAGS (exclusive access)	Patrick (exclusive access)
2012	AAT (open access)	Qube (exclusive access)	Patrick (exclusive access)
2014	AAT (open access)	AAT (open access)	---
March 2017	MIRRAT (open access)	AAT (open access)	---
April 2017	MIRRAT (open access)	---	---
2040	MIRRAT (open access)	---	---

6.2.2 Automotive terminals at PoM (2001 to May 2005)

In 2001, Toll acquired Finemore Holdings, Strang Stevedoring and Autotrans, and became the operator of WDW (Toll Holdings Limited 2017a), while Patrick and P&O were operating at WDE and AD as shown in Table 6.1.

In terms of terminal operations, each of these three terminals had their own advantages and disadvantages, and together were serving the arrival of motor vehicle cargo to the PoM.

For example, AD had the ability to use two RoRo berths, but the terminal was in a difficult location downriver, subject to draught restrictions, and was scarce in land area for on-wharf PDI operations. In addition, there was insufficient storage space for vehicle cargo. WDE, in contrast, was a multi-purpose RoRo terminal for general cargo, and had two berths and some PDI space. Unlike WDW, it was not a dedicated automotive terminal and other non-RoRo ships such as containerships could also berth there for unloading general cargo. WDW was a dedicated terminal and had large storage space, but had a single berth for RoRo ships with a length restriction of 200m.

In addition, the utilisation of the automotive port terminal space in those years (2001 to 2005) was poor, in part due to the separate management of each terminal which did not allow for the pooling and sharing of their significant resources and space. There were a number of inefficiencies associated with the running of three separate automotive terminals in this period:

1- **Poor utilisation of berths:** Ships coming to port could only berth at the terminal as per the contract with their stevedores. This limited their choice of berth and, in the event that the berth at the terminal that they had contract with was busy, they had to stay in a queue to berth at one terminal while the berth at the other terminal lay empty (ACCC 2009).

2- **Poor utilisation of assets:** Three separate automotive terminals meant duplication of offices, facilities, cranes, staff, machinery and equipment (ACCC 2009).

3- **Poor utilisation of terminal space**: Three separate automotive terminals did not lead to efficient use of space because the terminal space ‘could not be swapped between the parties to take account of peaks and troughs in demand’ (ACCC 2009, p.27).

4- **Inefficient inland distribution of imported vehicles because of shuttling cost of vehicles:** There was not enough space in some terminals for on-wharf PDI and processing of the imported vehicles. As a result, some vehicles had to go to off-wharf PDI centres at the western parts of Melbourne and, upon completion of their PDI and processing operation, had to be transported back to other areas of Melbourne where the dealerships are located (ACCC 2009).

6.2.3 Automotive terminals at PoM (June 2005 to 2010)

Patrick (Asciano) and P&O (Qube) have been two key stevedore companies providing stevedore services for containerised and non-containerised cargo including break-bulk cargo and motor vehicles in many ports across Australia. In 2002, these companies agreed to jointly establish the Australian Amalgamated Terminals (AAT) in order to control, operate and develop RoRo terminal facilities on behalf of the parent companies and for the joint benefits in various ports across Australia (AAT 2009). This agreement did not affect the operation of automotive terminals at PoM until 2005 when Toll assigned its lease over WDW to AAT. It was noted by AAT (2009, p.21) that:

> Toll operated the site on a vertically integrated basis. Accordingly, the viability of Toll's business depended on Toll's stevedoring contracts, and was affected by insufficient and fluctuating utilization levels. In 2005, when Toll assigned its lease over WDW to AAT, Toll had been in default of its throughput obligations under the lease with PoMC for approximately 12-18 months and was simply using WDW to store vehicles.

As such, in June 2005 there were three different terminal operators at PoM (AAT at WDW, P&O in AD and Patrick at WDE) (Table 6.1). By 2006, AAT started operation at the other two terminals (AD and WDE) in addition to WDW for the joint benefits of its parent companies (Patrick and P&O). Under this new structure, AAT became the sole terminal operator of all three automotive terminal facilities at PoM. The formation of a single terminal operator leads to the reduction of operational costs as it eliminates the need for duplicated infrastructure, multiple IT systems and terminal staff providing one pool of machinery and equipment, a centralised IT system, and one set of personnel in a single point of vehicle cargo discharge, processing and collections (ACCC 2009, p.17). While this model was demonstrably more efficient, its monopoly control led to legal action based on the allegation of price fixing and abuse of monopoly power.

In addition, the AAT model had a number of benefits for other automotive and logistics service providers in the auto chain including stevedores, PDI companies and shipping lines (ACCC 2009, p.27).

For the stevedores, for example, consolidation of terminals provided more efficient utilisation of the storage space at the terminal wharf, as one of the stevedoring companies states that when terminal services are supplied individually by different terminal operators, the terminal space

> could not be swapped between the parties to take account of peaks and troughs in demand. Improved utilisation rates mean that AAT is able to handle a greater volume of freight per square metre of terminal space and end-consignees receive their cargo faster (ACCC 2009, p.27).

For the PDI companies, the greater utilisation of terminal space provided more opportunities for them to perform on-wharf PDI services for the arrival of motor vehicle cargo and send them directly to the dealership or storage areas without the need to send them to off-wharf PDI centres (ACCC 2009, p.14).

For the shipping lines, the number of calls at terminals at Australian ports is important, and they prefer a terminal with multiple berths that can give them a one-stop berthing experience with efficient and cost effective terminal operation. Prior to the AAT model, each berth was operated and utilised exclusively by a particular terminal operator and its contracted shipping lines. As such, it was not uncommon for the RoRo vessels that had a contract with a particular terminal operator to be in a queue to berth at that terminal, while the berth at the other terminal that they did not have a contract with was empty (ACCC 2009, p.27). However, after consolidation of the automotive terminal facilities and the adoption of the AAT model, multiple berths were available for arriving RoRo vessels regardless of the stevedoring company they had contracts with. This could reduce the waiting time for vessels to get a berth at the terminal, and provide a better experience for shipping lines to meet their shipping schedule (ACCC 2009, p.27).

The AAT model resulted in the control of all three auto terminals at PoM in 2006 which led to the rationalisation of terminal operations and business processes. It improved efficiency by way of increasing economies of scale, and enabled greater efficiency to be achieved and a more effective utilisation of the terminal space and its significant terminal assets.

Despite these operational benefits, a number of problems arose. AAT, for example, became the monopoly provider of all automotive facilities at PoM and access to the terminals was restricted to its shareholders, Patrick and P&O (Qube). This led to regulator intervention.

In August 2007, the ACCC accused the AAT, its shareholders and stevedoring companies of abusing its monopoly power by reducing competition and setting its prices at levels that were substantially higher than the efficient cost of providing those services (ACCC 2007). These excessive charges were passed on to the customers. Legal action in the Federal Court followed and led to AAT subsequently applying for authorisation and granting access to the terminals to other competing stevedoring companies. The action against the individual parties was ultimately dismissed in July 2009 when the Federal Court imposed a fine of $3.8m on Patrick and P&O to end the collusion and price-fixing (The Sydney Morning Herald 3 July 2009). This coincided with AAT removing the exclusivity of terminal rights to the two shareholders (Patrick and P&O) and opened the facilities to third party access.

Later in June and August 2009, AAT lodged 'applications for authorisation to give effect to the agreements and related arrangements which established the AAT joint venture' to develop and operate motor vehicle and general cargo terminals at various Australian ports including PoM (ACCC 2009, p.ii). Clearly, the ACCC did not oppose the consolidation and operation of a single terminal at a port as the ACCC (2009, p.28) confirmed that:

> Efficiencies arise from the consolidation and operation of a single terminal at a port, if that terminal is of sufficient size and adequately equipped to deal with the volume of cargo delivered to the port. In particular, the establishment and operation of a well-designed, well-equipped terminal enables the efficient use of scarce land within the port precinct and reduces the need for significant assets such as cranes and other lifting equipment to be duplicated at another site within the port precinct.

The regulator did, however, object to its abuse of monopoly power and exclusive access to its owners. Authorisation was subsequently granted to the AAT by the ACCC under a specific regulatory framework:

- 'Provide a mechanism for stevedores to seek access to AAT's terminals'
- 'Impose a process for independent review of AAT's pricing increases'
- 'Require AAT to provide end-users with a dispute resolution process for non-price disputes' (ACCC 2009, p.ii).

As a result, the AAT received authorisation to continue operating at WDW but under an open access regime.

Table 6.2 lists the names of automotive terminals at PoM, their physical and operational specifications, their operators and their access regimes that existed in 2010. According to this table, in 2010 WDW was the only open access terminal at PoM operated by AAT, while Patrick had exclusive access to WDE and Qube[8] was the sole operator at AD.

Table 6.2. The physical and operational specifications of three automotive terminals at PoM in 2010.

Wharf	Terminal Operator	Trades accommodated/ type of cargo	Total available berths	Berths in use of vehicles	Total berth length	Max draught	On wharf area/ total wharf area	PDI facility	Vehicle storage capacity
Appleton Dock	Qube (or POAGS) (Private)	Motor vehicles, RoRo, break, bulk, general	B, C, D, E, F.	C, D	264 m	10.7 m	(5 shade + 1.5 open) ha/ 6.5 ha	Nil	1500
Webb Dock East	Patrick (private)	Motor vehicles, RoRo, break, bulk, general	E1, E2, E3, E4, E5	E4, E5	250 m	11.9 m	5 ha/ 15 ha	10 ha	6000-7000
Webb Dock West	AAT (open access)	Motor vehicles, RoRo	W2 (Pontoon)	W2 (Pontoon)	200 m	8.5 m	19.9 ha/ 22.9 ha	3 ha	3000-4000

Source: Based on data from Victoria Department of Transport (2011, p.11) and confidential interviews

Part B: PoM as part of the auto chain

6.3 PoM as the most complex element of the auto chain

Ports are considered an important and complex element of any freight chain. For example, whilst Figure 6.7 shows the PoM as a single element of the chain, different players such as stevedores, terminal operators and PDI operators are active participants in the chain.

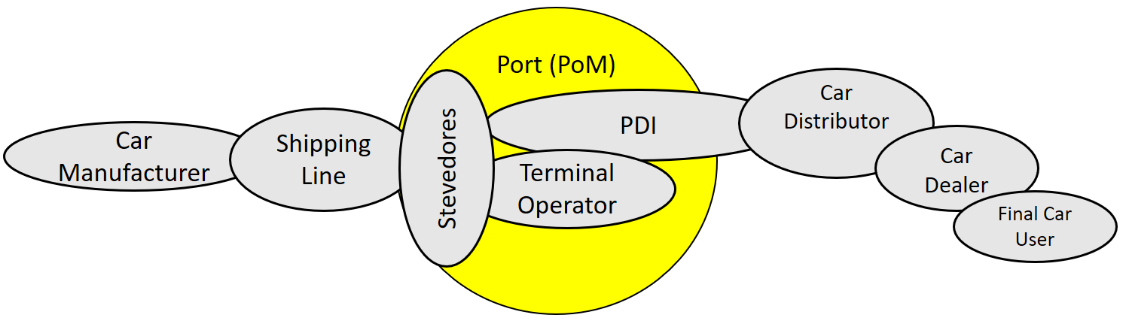

Figure 6.7. Position of the PoM in the schematic auto import chain.

[8] P&O changed its name to POAGS and was later rebranded as Qube.

In order to understand the chain construct, architecture and dynamics, it is essential to know the role and functionality of all elements in the port component of the chain.

6.3.1 Port administration

Most of the major ports in Australia are a mix of public and private ownership. They differ as ports in Australia are within the jurisdiction of state governments. The Port of Fremantle in Western Australia, for example, is a government owned port whilst the ports of Sydney and Brisbane were privatised in 2013 and 2011 respectively. The PoM was government owned until recently, but in March 2016 the State Government of Victoria agreed to privatise it. On 19 September 2016, the Victorian Government legislated the Lonsdale Consortium as the leaseholder for the PoM (Victoria Department of Treasury and Finance 2016). Privatisation of the port is by way of a 50-year lease. Currently the privatisation process is underway and, like other privatised ports, the PoM will be regulated by both state and federal government regulators: the ACCC at the federal level and the Essential Services Commission, Victoria's independent economic regulator of prescribed essential utility services, at the state government level.

The earliest administrator of PoM was the PoMC - a statutory corporation created by the State Government of Victoria in July 2003. Prior to that, the earliest administration of PoM was Melbourne Harbour Trust which had the authority for the management and development of the port since 1877. In 1958, the Melbourne Harbour Trust was replaced with the Port of Melbourne Authority (PMA) for the administration of PoM. Further change in 2003 saw the PMA split into three state-owned enterprises including: the Melbourne Port Corporation (MPC) which was the statutory landlord and the administrator, planner and developer of PoM; the Victorian Channels Authority which controlled the shipping channels; and Melbourne Port Services which was responsible for the mooring, patrolling and scouring of the PoM (Trace 2008). The PoMC was the successor of MPC (Victoria Department of Environment 2016).

While most of the commercial operations in the port including terminal operations, stevedoring, pilotage and towage are performed by private sector operators, PoMC performed a strategic management role for port planning and infrastructure delivery (Port of Melbourne Corporation 2014a). All commercial terminals and wharfs within

PoM were under lease to the private sector with the PoMC as the landlord. In recent years the PoMC also had the responsibility to maintain shipping channels, berth infrastructure and serviced sites within the port zones to long-term tenants, as well as maintaining some common user facilities.

One of the key roles of PoMC is ‘to plan and coordinate future development of the port’, and to develop a safe and efficient integrated sea-land transportation network and maximise the use of existing infrastructure in order to provide an efficient and cost-effective cargo handling and trade network within the port precinct and access to and from the Port (Victoria Department of Environment 2016). The PoMC is a strategic manager of PoM with functions and powers ‘to undertake the integrated management and development of the land and maritime functions of the port and its integration with the broader freight and logistics systems’ (Victoria Department of Environment 2016, p.143).

6.3.2 Stevedoring and terminal operators

Although the main operation of stevedores is the loading and discharging of cargo on and off vessels, they may also provide port terminal space for temporary storage, movement of cargo in the port areas, and in most cases extend their service to land transportation in and out of the port terminal. Indeed, they act as mediators between sea and landside operations in port area and arranging intermodal transportation.

Since 2000 there have been two major logistic companies providing stevedoring services at most of the ports around Australia - P&O (Qube) and Patrick (Asciano). These companies provide stevedoring services in the PoM and have expanded their operations into integrated logistic networks.

Qube Holding Limited is ‘Australia's largest integrated provider of import and export logistics services with national operations that provide a broad range of services’ (Qube 2017a). This company has been a major provider of stevedoring services for motor vehicles in Australia for many years and has changed its name and brand under various ownerships (the company was formerly known as P&O). In 2009, with the change in the company’s corporate ownership, its name changed to P&O Automotive & General

Stevedoring Pty Limited (POAGS), and in 2012 it was again rebranded to Qube (Qube 2017b).

Qube currently has three divisions, namely Qube Ports and Bulk, Qube Logistics and Qube Strategic Assets. Qube Ports and Bulk provides a diverse range of integrated port and logistics services for the import and export of non-containerised cargo with major focus on automotive, bulk and break-bulk cargo (Qube 2016). In the port logistic segment, Qube particularly focuses on providing 'an integrated logistic solution for the automotive industry' by providing a diverse range of activities including stevedoring, vehicle processing and delivery and facility management (Qube 2016, p.65).

Patrick is the other major stevedoring company in the market. The company was acquired by Toll in 2006 (Toll Holdings Limited 2017a) operating under the Asciano brand (Pacific National 2017). In 2007 Asciano was demerged from the Toll group (Toll Holdings Limited 2017b) while Patrick Corporation remained a subsidiary company under the ownership of Asciano. In 2010, the Asciano Group became Asciano Limited (Pacific National 2017), and in August 2016 Asciano was split into three companies under separate ownership structure (Asciano 2016): Pacific National, Bulk and Automotive Port Services (BAPS), and Patrick.

BAPS is a sub-division of Asciano with particular expertise in managing bulk ports and related infrastructure and logistic services (Asciano 2015, p.7). A major part of the business provides 'port services and integrated supply chain solutions' including automotive stevedoring, vehicle processing, transport and storage port logistics services (Asciano 2015, p.91). After demerging from Asciano in August 2016, BAPS was acquired by a Brookfield-led consortium (Asciano 2016).

Although Qube and Patrick are competing in the Australian stevedoring market, as noted above these two companies jointly establish Australian Amalgamated Terminal (AAT) as the facilities manager in 2002 in order to control, operate and develop RoRo terminal facilities on behalf of the parent companies, and for their joint and exclusive benefits (AAT 2009). While promoting an efficient operation, its monopolistic practices brought down the ire of the regulator.

6.3.3 PDI companies

PDI companies provide automotive processing services, storage, and inland transportation of vehicles from ports to the dealerships or final customers. They are the providers of value-added activities, and vehicle related services for the car importer and dealerships. Their main customers are car importers and their beneficial freight owners are the car dealerships. Some PDI activities are carried out on-shore in the port terminal area, while others are undertaken off-shore. The business activities and strategies of PDI companies in the landside section of the auto chain will be discussed in the following chapter.

With over 50 years' experience, Patrick Autocare (Patrick Autocare n.d) is one of the major PDI companies in the auto chain and handles approximately half of the new automobile imports into Australia (Asciano 2015, p.41). This company has its own car carrying truck fleet and is vertically linked with Asciano (Patrick). Currently Patrick Autocare has seven depots in major cities in Australia including Melbourne, Sydney, Adelaide, Perth, Brisbane, Darwin and Townsville (Patrick Autocare n.d.-c).

The other major PDI company, PrixCar, also has its own integrated transportation service. This company began as Autotrans, initially established as a car carrying company (vehicle handling trucks) in Western Australia in 1973, and developed by opening new branches in other states of Australia (PrixCar Transport Services Pty. Ltd. n.d.-b). In 2001, this family owned business was acquired by the Toll Group and changed its name to Toll Auto Logistics and Autotrans Express. On 31 July 2012, PrixCar Transport Services acquired Toll Auto Logistics and Autotrans Express (PrixCar Transport Services Pty. Ltd. 2016a). Currently, PrixCar has 27 depots in states across Australia (PrixCar Transport Services Pty. Ltd. n.d.-a).

6.4 Dyadic relationships of players in the port

In order to recognise and classify the type of current integrative practices and mechanisms among the players in the port section of the chain, the dyadic relationship between the players in the port section is discussed.

6.4.1 PoMC – terminal operator

As noted above, the PoMC is the landlord and there is a contractual relationship between PoMC and the terminal operator, AAT, as noted by green arrows in Figure 6.8. In addition, there are operational and information sharing interactions between PoMC and the terminal operator associated with vessel arrival, shown by red and blue arrows in Figure 6.8 respectively.

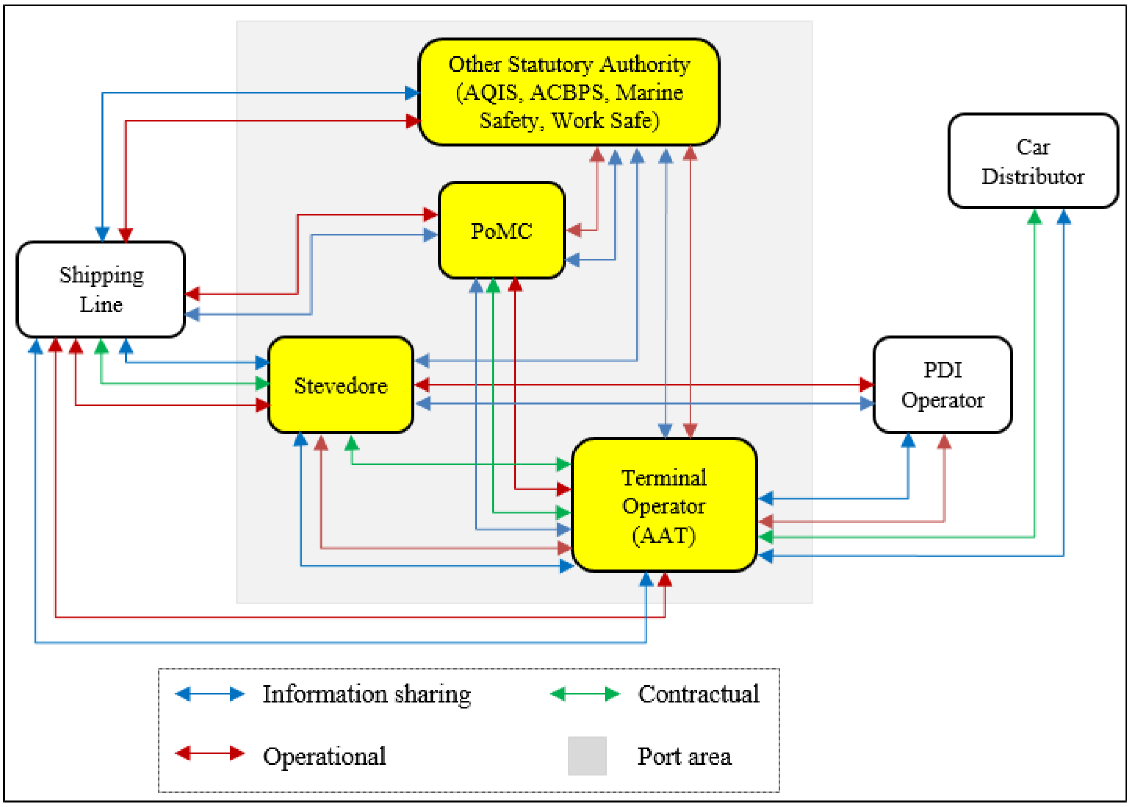

Figure 6.8. Three types of dyadic interaction including information sharing, contractual and operational relationships between different players in the port section of the auto chain.

6.4.2 PoMC – stevedore

Stevedoring companies have dyadic relationships with shipping lines to provide services to the lines, and in some cases are also terminal operators. In that event, there is a contractual relationship between PoMC and the stevedore companies as noted by green arrows in Figure 6.8. In addition, there are operational and information sharing interactions between PoMC and the terminal operator associated with vessel arrival, shown by red and blue arrows in Figure 6.8 respectively.

6.4.3 PoMC – other statutory authorities

PoMC, as administrator of PoM, works in partnership with a range of government departments and community stakeholders such as the Minister for Planning and the Department of Sustainability and Environment. This link is to ensure that the usage of publicly available assets, land and infrastructure of the port, and its development plans work in the interests of the providers and users of port services, the state government and the community (Victoria Department of Environment 2016, p.143). As shown in Figure 6.8, PoMC has interactions in the form of operational and information sharing with other statutory authorities, shown by red and blue arrows in Figure 6.8 respectively.

6.4.4 Stevedore – other statutory authorities

Although the operation of driving vehicles by stevedoring staff out of the ship may seem simple, the criticality of performing the job perfectly is high because any damage caused by an accident to such expensive vehicles is not only costly, but also complicated. The complexity arises as the foreign vessel is in an Australian port with an Australian labour force. This is particularly relevant if and when an accident causing a damage occurs. Who is responsible for the damage: the vessel owner, the stevedoring company or the port authority?

The jurisdiction and responsibility of such accidents can be unclear. For this reason, under some circumstances, there are operational and information sharing interactions between the stevedoring company and other statutory authorities in PoM as shown in Figure 6.8 by red and blue arrows respectively.

6.4.5 Stevedore – PDI company

There are interactions between stevedores and PDIs in the form of information sharing and operational interactions as shown in Figure 6.8 by blue and red arrows respectively. For example, one of the procedures that stevedoring staff undertake on behalf of the PDI companies is scanning the vehicle on-board before driving them out of the vessel into the FPR zone in the terminal yard. By scanning the barcode of each vessel, the electronic data attached to the vehicle number is recorded in the electronic information system of the PDI company, informing them which vehicles and specifications have arrived in the cargo.

6.4.6 Terminal operator – stevedore

If the terminal operator and the stevedoring company are separate companies, there will be a contractual arrangement between the terminal operator and the stevedoring company. This contractual relationship has been shown by green arrows in Figure 6.8.

There are operational relationships between these two elements of the chain. As noted above, stevedoring staff drive the vehicles out of the vessel into the FPR zone on the terminal wharf in their planned location based on their priorities. The stevedoring operation needs precise planning in terms of the minimisation of travel time between the vessel and the FPR zone to ensure efficient operation and quick vessel turnaround. The terminal operator plans the yard in accordance with the information received from the shipping line (cargo manifest) and will inform the stevedore where to park each vehicle in the FPR zone of the terminal.

The terminal operator also provides safety guidelines for stevedoring operations in the terminal yard. As such, there are operational and information sharing interactions between the stevedore and the terminal operator as shown in Figure 6.8 by red and blue arrows respectively.

6.4.7 Terminal operator – other statutory authorities

There are many statutory obligations involved within the automotive terminal in the PoM. These include security, safety, environmental protection, road and sea access, customs, and quarantine obligations that need to be followed for the imported motor vehicle cargo, and any workers, vessels or heavy trucks entering and operating in a terminal area (Port of Melbourne Corporation 2015b). The terminal operator works and coordinates with these statutory authorities to make sure that the statutory requirements are met. For example, the terminal operator will not release the imported vehicles from the terminal unless their import duties and charges are completely cleared by ACBPS. The terminal operator will also hold motor vehicles that are found to be contaminated until their contamination is removed and the vehicles are cleared by AQIS. The interaction between the terminal operator and other statutory authorities as shown in Figure 6.8 are usually in the form of operational interaction and information sharing to coordinate the operational procedures.

6.4.8 Terminal operator – PDI company

There are operational interactions as well as information sharing between the terminal operator and the PDI company as shown in Figure 6.8 by red and blue arrows respectively. After the new vehicles are parked in the FPR zone of the terminal yard, the PDI company, as the representative of the car importer, inspects the new vehicles in the terminal yard and prepares them for their delivery based on their priorities. Some vehicles will be prepared on-wharf to be sent directly to the dealerships, while others will be sent to the off-shore PDI centres for further PDI procedures. The PDI staff has 24 hours' access to the terminal yard and coordinates with the terminal operator to conduct the PDI operations and transport the vehicles out of the terminal.

6.4.9 Terminal operator – car distributor/importer

The vehicle cargo is required to be cleared from the wharf within three business days of their arrival. In some circumstances this period is extended. This is generally associated with quarantine inspection or custom charges. In that event, the terminal operator will hold the cargo until its contamination is removed or its customs charges are fully cleared. The related information regarding the vehicles' quarantine and customs will be exchanged between the car importer and terminal operator before and at the time of releasing the cargo out of the terminal port. In most cases of contaminated cargo, the car importer may pay the terminal operator to clean the contaminated vehicles to meet AQIS requirements before releasing the cargo. Interactions that might occur between a terminal operator and car importer are information sharing and contractual links for cleaning the contaminated cargo as shown in Figure 6.8 by blue and green arrows respectively.

6.4.10 Corporate ownership interactions

Figure 6.9 illustrates corporate ownership linkages among the chain players in the port section of the existing chain between 2014 and 2016. The companies are indicated by the cyan coloured area of the figure. As seen in this figure, the two stevedores in PoM (Qube and Asciano) have jointly established AAT to manage automotive terminal operations at PoM. Note that from April 2016, the new terminal operator in PoM is Melbourne International RoRo and Auto Terminal Pty Ltd (MIRRAT) which is a subsidiary of WWL, one of the major ocean car carriers in the auto chain.

The two stevedoring companies have extended their businesses into the PDI market by forming alliances with some of the PDI companies. For example, Patrick Autocare handles approximately half of the new automobile imports into Australia (Asciano 2015, p.41), and is 80 percent owned by Patrick (Asciano). In addition, Patrick and the MOL jointly own Car Compound Australia which has been active as a PDI company for certain car brands.

The other stevedoring company, Qube, has built vertical links with the other major PDI company, PrixCar. Qube and K-line jointly own K-line Auto Logistics, and this joint venture company owns 50 percent of PrixCar.

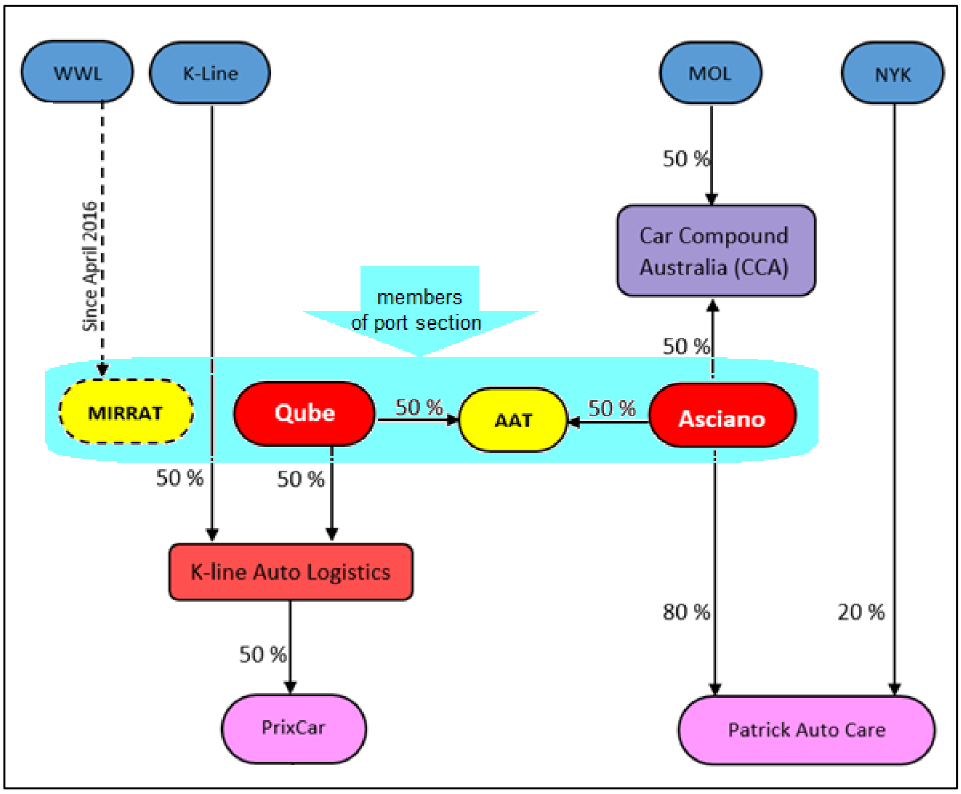

Figure 6.9. Corporate ownership links among players of the port section of the auto chain from 2014 to August 2016.

6.5 Recognising the integrative mechanisms in the port section of the chain

Figure 6.8 and Figure 6.9 illustrated four types of interactions including operational, information sharing, contractual and corporate ownership interactions that exist between different players in the port section of the auto chain and their dyadic partners. These figures demonstrate that every element in the port section of the auto chain is strongly interrelated with other elements of the chain. The figures reveal a disseminated relationship structure of this part of the chain in which every business is highly dependent on the other chain businesses, relying on cooperative strategies. Integrative mechanisms help to increase the coordination, collaboration and capacity alignment across the chain, leading to efficiency improvement in the chain. The type of integrative mechanisms that have been applied in the port is discussed below.

6.5.1 Operational, information sharing, contractual and corporate ownership integrative machanisms

The existence and type of any link between two members of the chain reveals the fundamental information which helps in understanding the underlying chain architecture and dynamics. Consecutive sets of dyadic operational and information sharing links among different players in PoM determine which firms are the influential members of the chain network. These influential entities might not be involved directly in the material handling or the logistic function of the chain as shown by thin red arrows in Figure 6.10. However, their indirect involvement in the other related operational activities indirectly affects the movement of the cargo and the integration and efficiency of the chain. For example, in the PoM, entities such as ACBPS and AQIS do not have any direct involvement in the movement of new vehicles across the chain. However, if ACBPS or AQIS does not verify the clearance or safety of an imported vehicle, the vehicle cannot leave the terminal yard. As such, their participation can affect the movement of cargo in the auto chain, and consequently impact the chain performance.

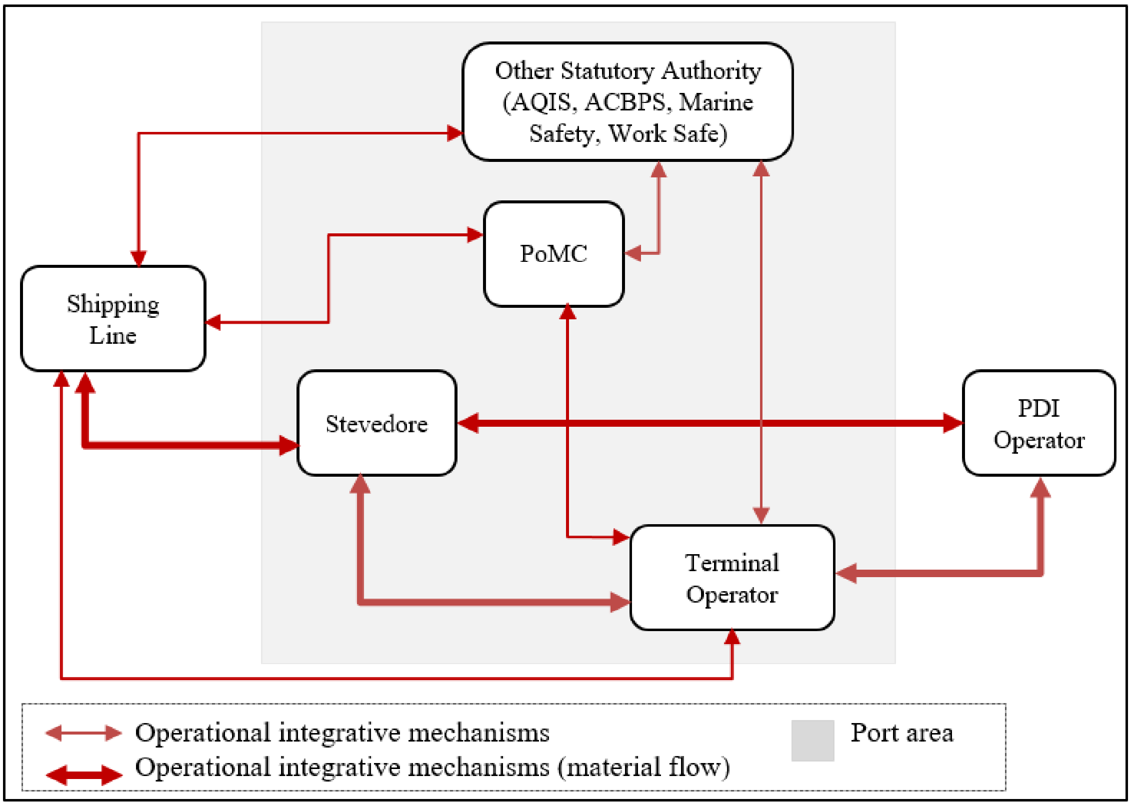

Figure 6.10. Operational integrative mechanisms in the port section of the auto chain.
Note: The red arrows represent these mechanisms applied by different entities.

A further issue noted in Figure 6.10 relates to the functions of different entities and their abilities to impact on other chain players which can trigger operational inefficiency in other parts of the chain. For example, the efficiency of stevedoring operations has a direct impact on the operational efficiency of the ship by minimising the cost of berthing and the time that a ship spends at the berth.

Effective information sharing procedures are fundamental for the efficient integration and efficiency of the business processes. Simple information exchange between two dyadic partners acts as an effective integrative mechanism for better coordination of business activities throughout the chain. If AQIS found that a number of imported vehicles are contaminated, the terminal operator and the other entities engaged in the movement and processing of the cargo, such as PDI and car distributor, will be informed. These entities must then adjust their operational plans and inform other business partners of an expected delay in the processing and delivery of the vehicles. The integrative mechanisms in the form of information sharing by different players in PoM to coordinate the operational procedures more smoothly and efficiently are shown by the blue arrows in Figure 6.11.

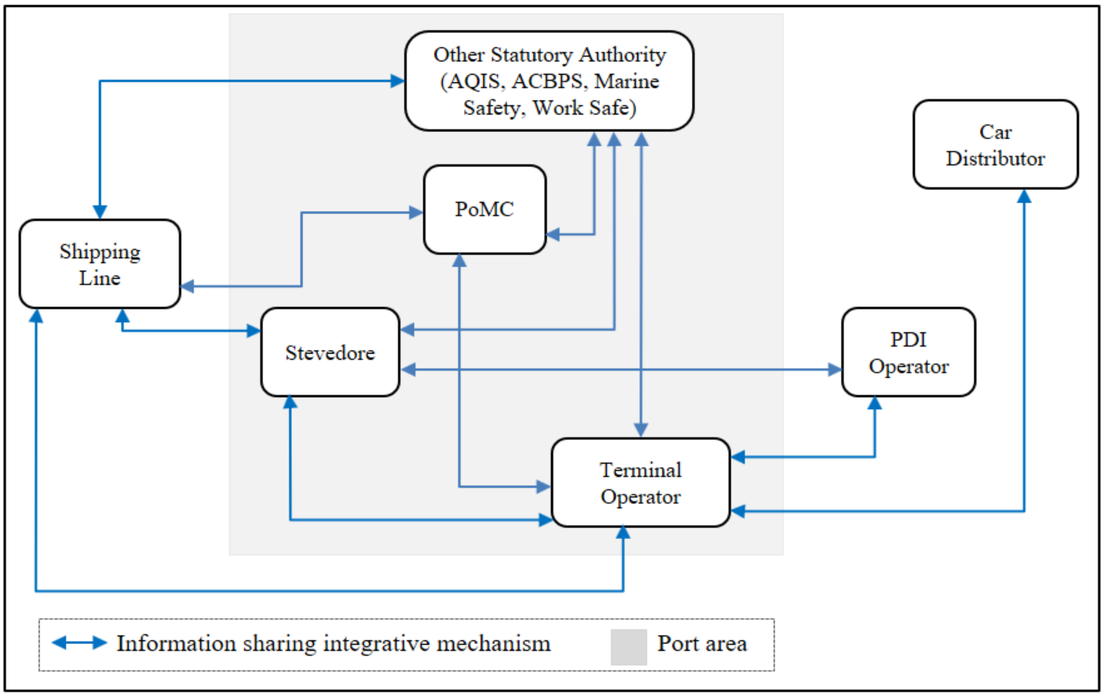

Figure 6.11. Information sharing integrative mechanisms in the port section of the auto chain.
Note: The blue arrows represent these mechanisms applied by different entities.

The other important integrative mechanism which aids in the coordination and alignment of business activities in the longer term (longer than a day-to-day basis), are the contractual arrangement between the chain players. The contractual links in the form of formal arms-length relationships determine which entities are doing business together, and where the flow of money in the chain is. As shown in Figure 6.12, there are transactions between the PoMC and terminal operator, shipping lines and stevedores, and terminal operator and car distributor. These contractual mechanisms reveal the role of the main players, and lead to sequential capacity matching (for a defined period) with dyadic business partners across the chain, to improve the integration and efficiency of the whole chain. For example, a stevedore acts as a service provider for a shipping line, and its business coordination and relationships exclusively rely on the contractual arrangements between them. In PoM the contractual agreement between a stevedore and a shipping line is usually for a duration of three years. This contractual agreement determines the number of vehicles and frequency of delivery by the shipping line. A stevedore company, as a result, will align its capacity each year based on the total number of vehicles that are expected to be discharged based on the contractual information with different shipping lines.

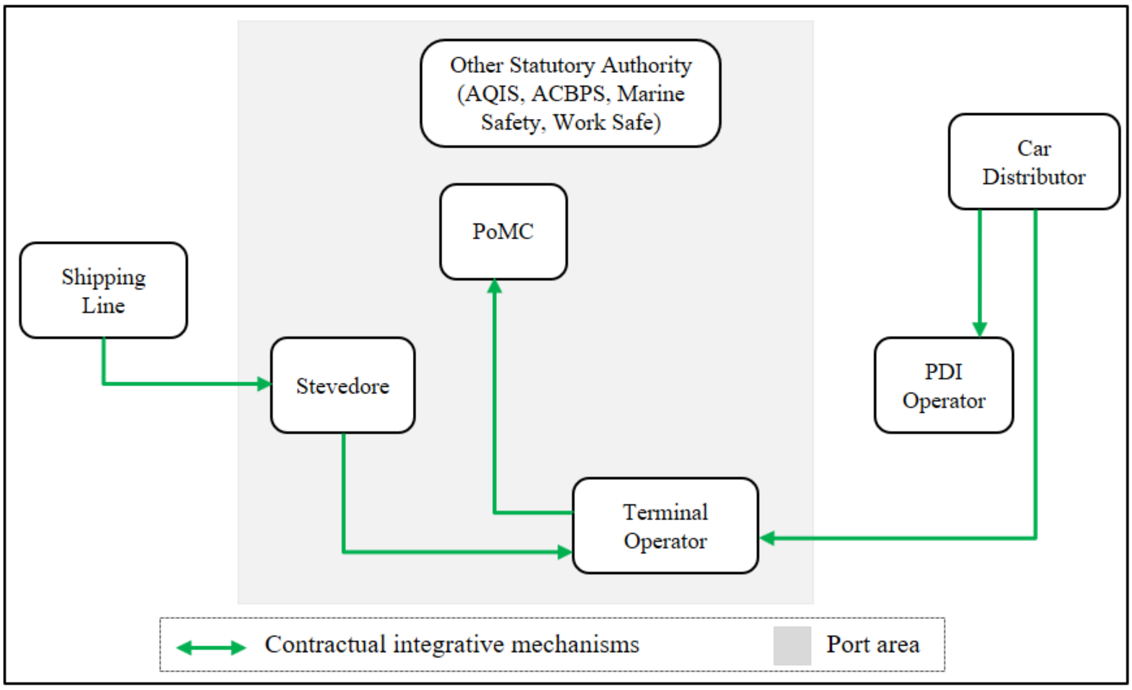

Figure 6.12. Contractual integrative mechanisms in the port section of the auto chain.
Note: The green arrows represent these mechanisms applied by different entities.

Besides contractual relationships being effective integrative mechanisms used by different players in the chain, corporate ownership relationships can also be used as a more powerful integrative mechanism by aligning the interests of different players to secure a long-term commitment and partnership amongst chain players. For instance, as shown in Figure 6.9, there are alliances between a group of shipping lines, stevedores and PDIs. One such alliances is between Qube, K-line and PrixCar. The other alliance is between Asciano, MOL, NYK and Patrick AutoCare. These alliances have secured the interests of their companies through corporate links to ensure control and cooperation in the port segment of this chain. By forming such alliances, each group can offer a vertically integrated end-to-end service to their clients in the auto chain. On the one hand, these two groups compete to capture more value of the auto chain by expanding their economies of scope. On the other hand, the joint venture of the two stevedoring companies to consolidate automotive terminal operation at PoM is a form of horizontal integration used by these two companies to increase economies of scale for both companies, as well as better rationalisation and efficiency for the use of the terminal port area.

6.5.2 Regulatory integrative mechanism

From an operational point of view, the management of the automotive port terminal in the auto chain needs to be carefully performed in order to maximise the effective and efficient utilisation of such assets. Strategies of rationalisations and consolidations of terminal operations were adopted, creating a single entity rather than being divided and controlled by separate competing organisations. However, a monopoly entity might abuse its monopoly power in terms of price fixing, for example, and make decisions that might not be aligned with the public interest. To avoid abuse of monopoly power by a single monopoly operator, the regulator can 'authorise' the operator to function as a monopolist but under rigid terms and conditions. In this event, authorisation is

> a transparent process where the ACCC may grant immunity from legal action for conduct that might otherwise breach the Trade Practices Act 1974. The ACCC may authorise businesses to engage in anti-competitive conduct where it is satisfied that the public benefit from the conduct outweighs any public detriment (ACCC 2009, p.6).

It is the regulator such as the ACCC who determines which firm will be the monopolist and controller of the asset, and authorisation is granted under conditions that prevent the abuse of their monopoly power. For instance, in PoM, the regulated integrative mechanism was used by the ACCC when the authorisation to control and manage all three automotive terminals at PoM was given to AAT under an open access regime. The authorisation was granted based on the view that the 'consolidation and operation of a single terminal at a port generates efficiencies. These efficiencies arise whether the terminal is operated by AAT, its shareholders or another party' (ACCC 2009, p.ii).

This regulatory mechanism prevented the fragmentation of the automotive terminal operations at PoM, which was essential for operational efficiency whilst protecting and ensuring access to the terminal. This model was later repeated after the management and development of the WDW terminal was given to another company (MIRRAT) until 2040 under a strict regulatory framework and open access regime.

Part C: PoM recent development

6.6 Automotive terminals at PoM (2010 to 2014)

In March 2010, PoMC announced the plan for the development of a container terminal at WDE, which meant that the automotive terminal operations would cease at WDE by July 2014. The cessation of automotive terminal operations at WDE reduced the number of available berths for RoRo vessels as only two automotive terminals were left to serve automotive trade at PoM (Figure 6.13). To compensate for the loss of this facility, in 2013/2014 the PoMC and AAT invested significantly in upgrading AD to accommodate additional PCC and PCTC RoRo vessels after the closure of berths E3, E4 and E5 at the WDE terminal (AAT 2014a; Port of Melbourne Corporation 2011). As part of this upgrade and development plan, berth priority arrangements were put in place to efficiently accommodate the car trade in Victoria. A secure car park north of Williamstown Road was also specified for temporary automotive laydown in the short term. In addition, the control of terminal operation and berth allocation of AD and WDW terminal berths were given to AAT (Port of Melbourne Corporation 2011). Consequently, AAT commenced a common user facility operation at AD on the 1st of April 2014.

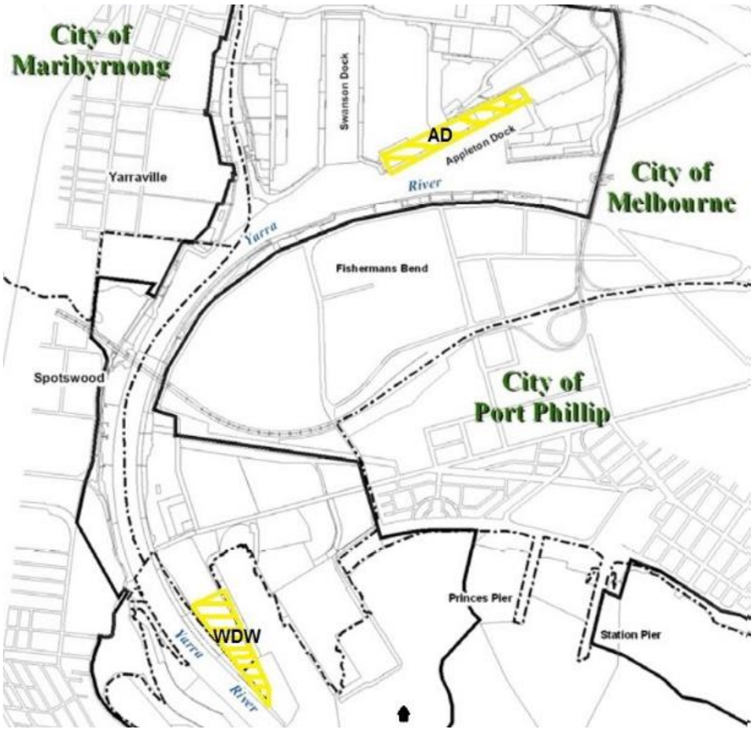

Figure 6.13. The location of two automotive terminals at PoM after April 2014.

AD was redeveloped by AAT to handle vessels up to 265 metres in overall length and to 'provide capacity in excess of 3,500 cars in fully line marked and numbered auto lanes' (AAT 2014b).

6.7 Redevelopment of automotive terminals at PoM

Before the cessation of car manufacturing in Australia in 2017 and according to the 2035 vision of PoM's development strategy (Port of Melbourne Corporation 2009, p.12), the number of new vehicle imports for 2025 and 2035 was predicted to be 534,000 and 720,000 respectively (Table 6.3).

Table 6.3. New vehicle trade forecast for PoM in 2035 vision.

Year	2005 Forecasts Vehicles (thousands)	CAGR
2010	324	
2015	388	3.7%
2025	534	3.2%
2035	720	3.0%

Source: Port of Melbourne Corporation (2009, p.12)

This projection was subsequently updated, and the prediction changed to 600,000 vehicles by 2025 and one million vehicles by 2040 (Port of Melbourne Corporation 2014a, p.6 & p.37). To meet this increased demand, the development of additional RoRo terminals became an important priority for PoMC. Accordingly, the planning was undertaken to develop a sustainable world class automotive terminal to consolidate vehicle processing operations (storage, maintenance and PDIs) at a single location in the port that is capable of handling the forecasted demand of 600,000 vehicles per year by 2025 and one million vehicles by 2040.

Whilst AAT's lease will not expire until the end of 2017, PoMC initiated action by inviting parties to participate in the development of a new single automotive terminal capable of handling the projected throughputs at WDW. Invitations were sent to potential bidders to submit their proposals, and in April 2013 three bidders were shortlisted. The winning bidder would be appointed as the sole operator, lessee and developer of the WDW terminal under a non-discriminatory open access regime until

30th June 2040. Among the bidders was MIRRAT, a local subsidiary of WWL, a leading global ocean shipping company which offers logistic solutions for automotive cargo, rolling equipment, high and heavy and breakbulk units globally through its wide network of servicing to six continents via 12 trade routes with more than 50 vessels. The company has more than 7,000 employees across 27 countries, and operates 65 processing centres as well as 13 automotive terminals worldwide (MIRRAT 2017b; WWL 2017).

Since 2008, MIRRAT's parent company WWL has operated a $19m automotive processing centre in Laverton North, approximately 15km from WDW, which was opened to support its increase in RoRo activity in the region. This 100,000-square metre technical services facility offers an 8,500-square-metre workshop for processing, painting, quality inspection and service pits for high and heavy RoRo vehicles and equipment (Williams 2014b).

PoMC required the successful bidder to publish its management plan including the tariffs, rules and conditions. The company would operate the terminal under an open access regime to all ocean car carriers, stevedoring companies, mooring service providers, PDI service providers, car companies and other automotive terminal end users. The PoMC stipulated that the access regime should meet the following guiding principles as follows:

- 'a fair mechanism for service providers to access the automotive terminal' (ACCC 2014b, p.3);
- An independent dispute resolution process and review for price related debates;
- 'a dispute resolution process for non-price related disputes' (ACCC 2014b, p.3)

Following the completion of the tender process, MIRRAT was announced the successful bidder and entered into a development agreement, automotive terminal lease and terminal operations deed with PoMC. The ACCC commenced its review on the open access regime proposed by MIRRAT. As part of its reviewing process, ACCC 'conducted market inquiries with a range of industry participants, including shipping lines, stevedores, car manufacturers, industry bodies, and other interested parties' (ACCC 2014b, p.4). The result of these discussions increased the doubts of ACCC about the effectiveness of MIRRAT's open access proposal for non-discriminatory operation of the terminal. The concern expressed by the ACCC was that MIRRATS's proposed open access regime might not be sufficiently effective in avoiding the possible discriminatory behaviour of MIRRAT against other competitors in favour of its parent company WWL and against other terminal users that MIRRAT may compete with in the future, including stevedores and PDI facility operators (ACCC 2014c). The ACCC claimed that MIRRAT might provide preferential treatment to WWL in shipping schedules, berthing allocations and the provision of ancillary services, to the disadvantage of other shipping companies. In addition, ACCC was concerned that MIRRAT might potentially use its ability as the sole operator of the only automotive terminal at PoM to discriminate against its rivals by raising the cost of terminal access to its competitors, making it more difficult for them 'to compete in the supply of shipping and other terminal services' (ACCC 2014a).

To address the competition concerns identified by the ACCC, MIRRAT offered the ACCC a court enforceable promise/obligation to not act discriminately and not breach any rules. This offer empowers the ACCC to take legal action against MIRRAT if required (ACCC 2014c). MIRRAT's suggestion went under careful review by the ACCC, and after six months of exchanging information (letters between the two parties), the ACCC announced that it would not oppose the proposed acquisition (ACCC 2014a). In July 2014 the ACCC (2014b) announced that the rights to develop and operate the WDW terminal was awarded to MIRRAT as a contractual agreement between the PoMC and MIRRAT.

Some of the conditions that MIRRAT must comply with are as follows:

- abiding with open access conditions with an indiscriminate berthing allocation process (ACCC 2014b, p.7);
- protecting confidential information of terminal users by not revealing information to unauthorised personnel (ACCC 2014b, p.8);
- complying with a price dispute resolution process under ACCC independent price expert approval (ACCC 2014b, p.8); and
- willing to go under inspection by an ACCC-approved independent auditor upon the request of a terminal user at any time (ACCC 2014b, p.8).

Regulatory oversight would continue and be reviewed every two years after the commencement of this agreement and no more than once in five-year intervals to ensure that the undertaking operations continues to meet its objectives until 30 June 2040 when the contract will end.

Figure 6.14 shows the development plans of the automotive terminal at WDW. The orange areas in this figure represent the expanded automotive terminal to be designed and built by MIRRAT in two phases.

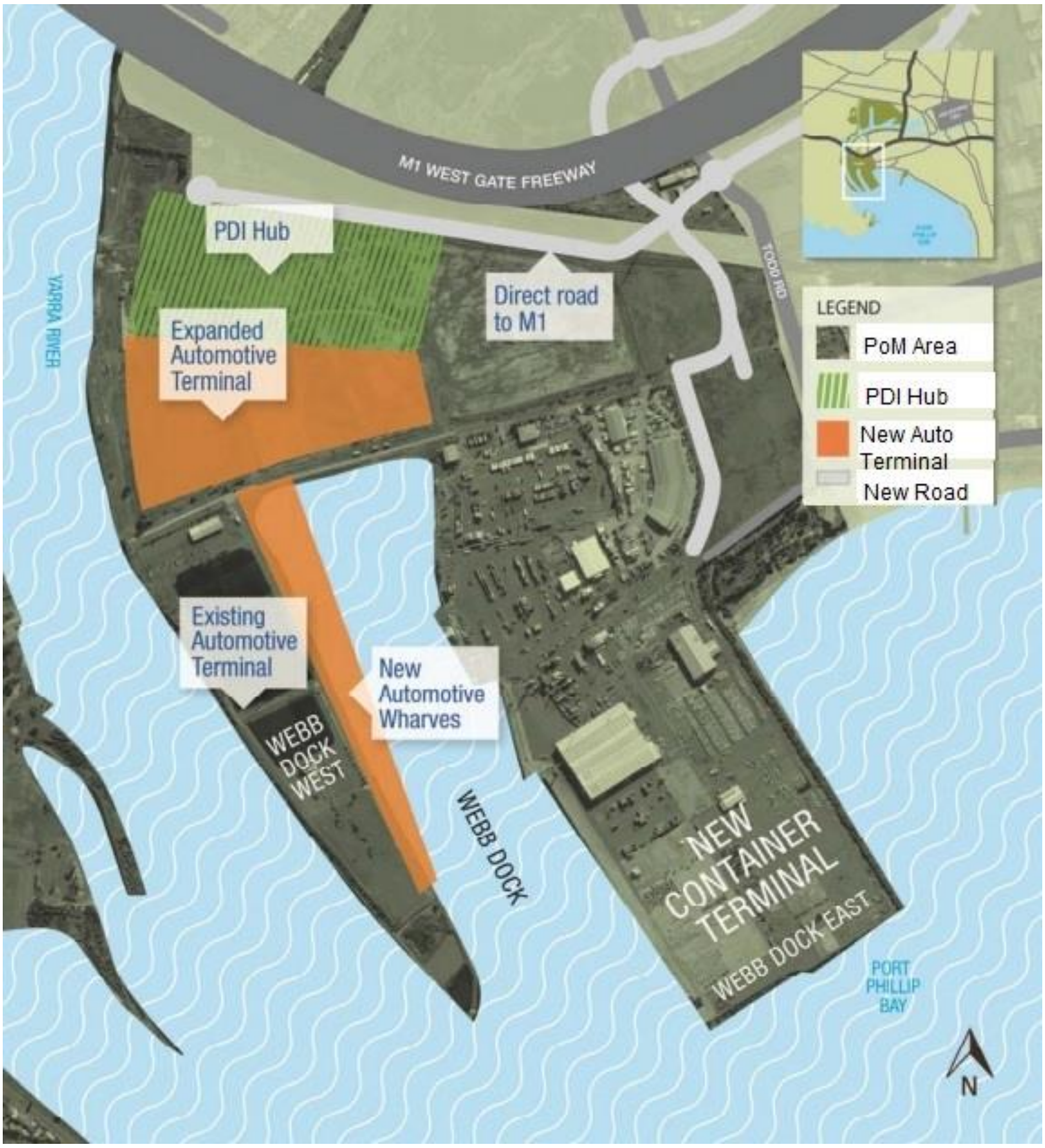

Figure 6.14. Development plan of automotive terminal at Webb Dock in Port of Melbourne.
Source: Modified from Port of Melbourne Corporation (2011).

The first phase which is a new 18.5 hectare facility in the north of the current WDW automotive terminal was constructed in 2016. This facility has 4,800 temporary storage/parking areas for passenger cars, and two hectares of heavy-duty hardstand. The current new MIRRAT facility provides a dedicated vehicle inspection zone where inspections will take place before the cargo leaves the terminal, a truck staging area, and direct access to PDI facility hub (MIRRAT 2017c). Figure 6.15 shows the current completed MIRRAT facility in the north of WDW.

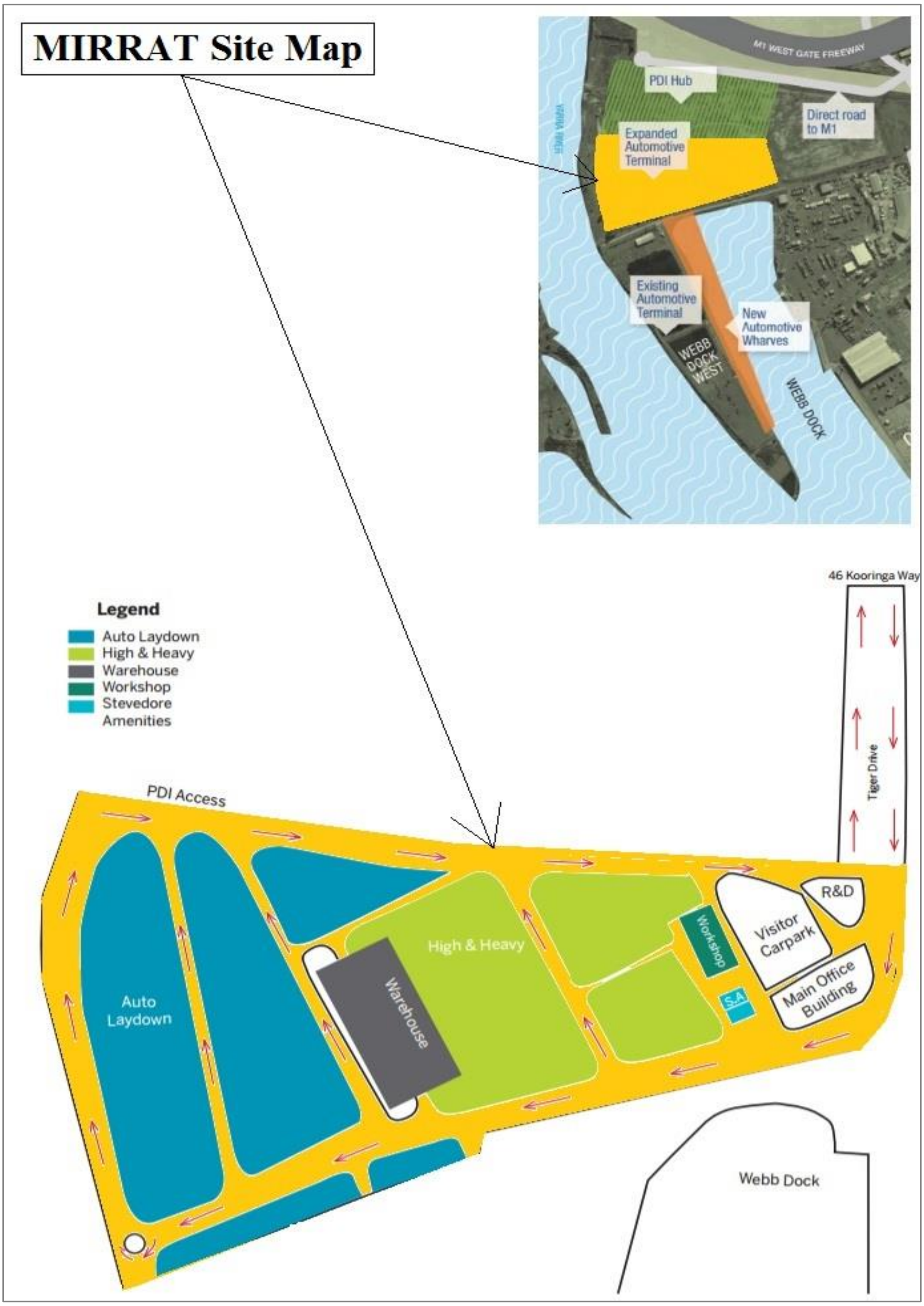

Figure 6.15. Site map of new MIRRAT facility in Webb Dock.
Source: Modified from MIRRAT (2017a) and Port of Melbourne Corporation (2011).

Besides the importance of efficient utilisation of a port terminal, an efficient characteristic for today's world class automotive port terminal near consuming markets is to provide a value-added platform or a 'delayed customisation point' for the imported motor vehicles before being delivered to their final consumers. This important characteristic has been considered in the construction of the new automotive terminal in PoM. With the completion of the second phase and creation of a new 12-hectare PDI facility north of the current site with direct access to the M1 freeway, vehicles will be delivered directly to the dealerships from the port terminal. Thus, the shuttling of vehicles between the port, the off-wharf PDI facilities in the west of Melbourne and the dealerships will be reduced[9], enhancing chain efficiency.

In addition, the new consolidated automotive terminal and facility in WDW will significantly benefit the users by providing them a seamless service and an efficient supply chain that minimises the lead time of car delivery from the overseas factories to the local dealerships.

Furthermore, having a sustainable, environmentally friendly and innovative consolidated automotive terminal in the PoM will create an integrated factory to dealership vehicle chain. This integrated chain increases control, velocity over the chain by reducing complexity, production volatility and risks as well as required investment and operational costs. This will result in an efficient supply chain that streamlines supplier management and procurement processes (MIRRAT 2017d).

Consequently, the new MIRRAT terminal at PoM not only has all the operational benefits of the previous AAT model, but also MIRRAT (2017d) provides more support for 'an integrated factory to dealer' approach for the auto chain and acts as a sole logistic hub for imported vehicles to Melbourne (MIRRAT (2017d).

The new MIRRAT model will rationalise port automotive operation in the PoM by providing a single on-wharf platform for PDI activities within the port for imported vehicles which will significantly reduce complexity, bottlenecks and operational costs for effective distribution of vehicles from the PoM to dealerships.

[9] Note that due to the lack of space for PDI operations at PoM, part of the imported motor vehicles is sent to off-wharf PDI centres in the area west of Melbourne before being sent to the dealerships. This would likely cause extra travel for vehicles that had designated dealerships in the eastern part of Melbourne, as their vehicles have to travel twice across the West Gate bridge going to and coming back from the PDI centres in the west area of Melbourne.

6.8 Conclusion

In this chapter, the role of the PoM in relation to the automotive trade in Victoria, its physical and logistic characteristics, the players in the port section of the auto chain, their functions, and their dyadic relationships with other participants of the chain were investigated. In addition, the integrative mechanisms used by different players in the port section of the auto chain were recognised.

The automotive terminal market in Australia has been a relatively concentrated market, with some changes in the ownership structure. However, over the last three decades, the automotive terminals at PoM have experienced periods of uncertainty in terms of their locations, leasing and management conditions. The increasing automotive import volumes, the pressure from ocean car carriers for a one-stop efficient and cost effective terminal operation, and the tendency for more on-wharf PDI operation at the terminal site to reduce the transportation cost of vehicles by processing a seamless and efficient vehicle distribution, has put pressure on the terminal operators to rationalise their terminal operation capacity and management, despite the noted periods of instability in their operation. The different stages of development of automotive terminals at PoM provided an insight to the important role of the port in enabling an integrated and seamless logistic operation within the auto chain.

The new automotive terminal at PoM will rationalise port automotive infrastructure and operations, and will increase economies of scale as it provides a single point of discharge and a single 'on-wharf' value-added platform for imported vehicles which will significantly reduce complexity, bottlenecks and the risks across the auto chain, leading to less operational costs and time for processing and distribution of imported motor vehicles.

Chapter 7 Landside Operations

7.1 Introduction

In the previous chapter, the role of the influential entities in the port section of the automotive import chain through PoM and their use of strategies to improve integration and efficiency in the port sector of the chain was investigated. In this chapter, the role of other players in the landside of the chain is discussed, including PDI companies, car importers/distributors, car dealerships and consumers (Figure 7.1).

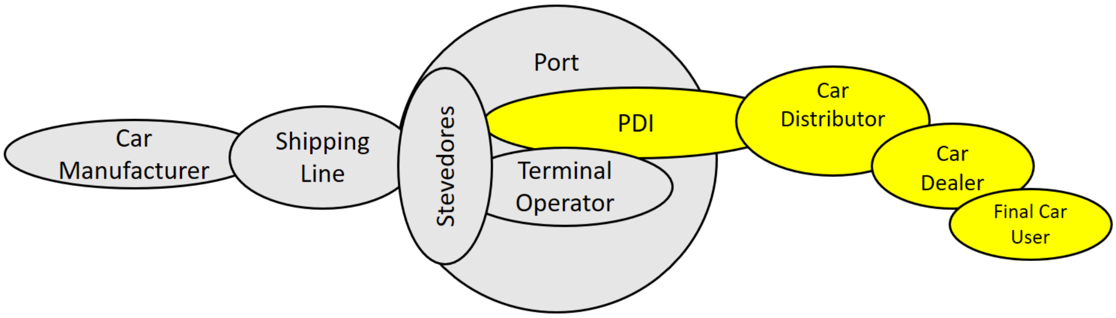

Figure 7.1. The position of players in the landside section of the schematic auto import chain through PoM.
Note: The landside players are depicted in yellow.

The landside operation of the automobile import chain includes all processes, services and operations performed by different parties of the chain for the processing and distribution of imported vehicles, from the time of their arrival at the automobile terminal until they are delivered to their various land destinations.

7.2 Australian car consumers

Currently, individual car consumers in Australia do not have the legal right to import new automobiles directly, although an Australian government decision has indicated that from 2018 consumers will be permitted to import new cars directly from Japan and the United Kingdom under strict conditions (Taylor 2016). Until that time, Australian individual consumers have no choice other than to buy new automobiles from car dealerships. This does limit consumer choice because not all new car models are available in the Australian market. Despite these limitations, Australian car consumers benefit from one of the most open and diverse automotive markets in the world, covering more than 350 different models of light vehicles from 67 different brands (Federal Chamber of Automotive Industries 2016). In the 2016 Australian financial year, more than 1.175 million new motor vehicles were sold in Australia, while the total value of new imported vehicles in the same period was A$28,668 million (Australian Bureau of Statistics 2016a, 2016b).

7.3 Car dealerships

At the end of the chain, the role of car dealerships is very important. They are the only chain player in direct contact with the actual consumers or buyers of new cars. Their major role as mediator between the final user and car producers is to recognise the local market trends and to make a BTO purchase from car manufacturers based on the local consumers' needs. Some are BTO vehicles, others are from their stock inventory. For example, 60 percent of the sales might be BTO and the remaining 40 percent might be sales from the inventory stock models (confidential interviews 2014 and 2015). In most cases, the majority of vehicles will be sold before arriving at the dealership whilst the vehicle is being transported to Australia.

Sometimes the dealers introduce a promotion on some stock models to sell the products quickly and open inventory for incoming models. In addition, customers who don't want to wait some months to receive a customised BTO vehicle may prefer to adjust their taste to one of the available stock car options and receive their car immediately.

There are three types of dealerships in Australia: franchised dealerships, multi-franchised dealerships and private (independent) dealerships. All franchised dealerships of a particular car brand work in collaboration with the car manufacturer under the supervision of their main local agent, the distributor/importer who provides training for selling the new models and holds the manufacturers' inventory.

A franchised dealership of a particular brand plays a vital role in the success of its relevant car manufacturer in the local market. It is the responsibility of the dealership to provide the technical information, marketing and sales support for potential customers with regard to any new model. This is essential for new models that are in the beginning stage of their product-life cycle. As a result, new brand models will frequently be sent to dealership showrooms to be visible to potential customers and the general public. It is an essential part of the promotion programs.

In addition, car dealerships provide advice to buyers for the BTO vehicles providing options and features of choice. Automotive dealerships provide a communication bridge between the car users and car manufacturers for customised orders. They keep in touch with the customer to update them about the status of their order and the delivery time. In the event of delays, until the delivery of the new car, it is the responsibility of the dealership to communicate with the customers and keep them informed.

7.4 Car importer

Car importers are the agents of car manufacturers in Australia. Each overseas car manufacturer usually employs an agent acting as distributor and local market evaluator.

Upon the arrival of the new vehicles to the FPR in the terminal yard, the general responsibility of the imported cargo will be switched from car producer to the car importer agent. It is the car importer’s responsibility to deal with all related procedures of the cargo in order to deliver vehicles to their customers (the dealerships) according to their requests and requirements. The car importer is also responsible for any damage to the cargo that might occur during the transportation or inspection process from this point until delivery to the dealership. This responsibility might be taken over by a third-party service provider such as a PDI or a transportation company, depending upon the contract of the car importer.

Duties of local car importers/distributors in Australia include, but are not limited to, the following tasks (confidential interviews 2014 and 2015):

1. Management of local car market prices and promotions for the dealerships.
2. Training local car dealers on how to treat the customer and market their products.
3. Providing a regular forecast of the local market trend for the car manufacturer.
4. Managing the local franchised dealerships for ordering the new automobile.
5. Accepting the responsibility of the imported automobiles after their arrivals to the FPR at terminal.
6. Paying all ACBPS and AQIS charges.
7. After sale service and technical support to final vehicle consumers/users.

8. Storage, transportations and prioritisation of imported vehicles for their effective distribution among customers.
9. Prioritisation of the arrival of new vehicles for their effective distribution.

As noted above, the tasks and duties of each local car importer/distributor is diverse and extensive, and can be very costly considering the relatively wide range of vehicle choice. The low range of economies of scale results in low profit margins in the Australian vehicle market.

7.5 PDI companies

PDIs are service providers for car importers. Traditionally, PDI companies are responsible for their vehicle transportation, storage and delivery services to their primary clients (car importers/distributors) and secondary clients (car dealerships). They deliver imported cars from ports to different inland destinations, using their inland transportation fleet via roads or rail lines. They also ensure that the new vehicles are ready for sale and delivery to the purchaser according to the Australian design rules, car manufacturers' standard, and specifications and dealership requirements.

As noted in chapter four, by shifting the supply chain business model of car manufacturers from BTS to BTO and the mass-customisation policy of car producers, there was an increase in the need for a built-up platform for customisation of new automobiles very close to their consumption market. Today's PDI companies deliver extended activities and services, from transportation and storage to processing, detailing and value-added activities on the arrival vehicle cargo.

Some of the activities undertaken by PDI companies in Melbourne include (Confidential interviews 2014):

1. Quality inspection
2. Vehicle cleanskin and damage mark-up survey
3. Vehicle washing and waxing and de-wax and refuelling
4. Print shop
5. Management of paint and panel repair
6. Repair and customisation of vehicle to dealership's requirements
7. Detailing services to retail standard with optional buff
8. Installing custom designed interior parts and accessories such as floor mats, seat covers, dash kits, etc, as well as exterior parts and accessories such as window rain guards, grill guards, custom wheels, etc

9. Fitting electronic systems such as cameras, entertainment systems and navigation
10. Alteration and adaptation of interior and exterior design of vehicles based on special customer requirements, such as alteration for disabled drivers, or commercial purposes
11. Providing a proper place to store the stock vehicles
12. Press and motor show vehicle preparation
13. Modifications
14. Vehicle registration
15. Preservation programs
16. Customer car delivery service
17. Car transport management

Considering the diverse range of activities in the above list, PDI companies in Australia are important service providers in the auto chain, serving OEMs, distributors and dealerships.

One of the main enablers of the PDI business, particularly in small local vehicle markets such as Australia, is performing these services for a large quantity of different models and brands to reach sufficient economies of scale. Their business success is dependent upon volume and turnover, and associated economies of scale similar to other service providers in the new vehicle import chain.

The number of PDI companies serving the local market are few. For example, in the case of the automotive import chain to Melbourne, there are currently three PDI companies (PrixCar, Patrick Autocare and Autoneus). Prixcar and Patrick Autocare are major PDI companies with significant market share, and together cover the vehicle processing of the majority of imported automobiles in Victoria as well as other states in Australia.

PrixCar, one of the two largest PDI companies in Australia, has its own transportation service and is able to provide an integrated service to its clients. The history of this company began with Autotrans, established initially as a car carrying company (vehicle handling trucks) in Western Australia in 1973, and developed by opening new branches in other states of Australia (PrixCar Transport Services Pty. Ltd. n.d.-b). In 2001, this family oriented business was acquired by the Toll Group and changed its name to Toll Auto Logistics and Autotrans Express. On 31 July 2012, PrixCar acquired Toll Auto Logistics and Autotrans Express (PrixCar Transport Services Pty. Ltd. 2016a).

Currently, PrixCar has 27 depots across Australia (PrixCar Transport Services Pty. Ltd. n.d.-a).

Patrick Autocare is the other PDI company in Australia which provides both vehicle processing and vehicle transportation services to its clients. It is vertically linked to the Patrick Division of Asciano (a major Australian stevedoring company), and is a provider of shore to door services for the car importers and car dealerships (Patrick Autocare n.d.-b).

In terms of providing an end-to-end solution from the wharf to the dealership, PrixCar and Patrick Autocare are similar and have their own transportation fleet, but they have different business models and market share patterns. Currently, PrixCar covers a large number of luxury brands such as Mercedes-Benz, BMW, Jaguar and Jeep. However, Patrick Autocare might have a higher quantity of popular models with brands such as Toyota, Nissan, Renault and Mitsubishi. Besides these two PDI companies, there are other companies such as Autonexus that hold smaller market share for other car brands. For example, Autonexus currently provides PDI operations for vehicle brands such as Subaru, Mazda, Citroen and Peugeot. Autonexus outsources the transportation service for their clients to logistic companies such as CEVA logistics. As such, CEVA and Autonexus together cover the minority of the PDI operations of the imported vehicle.

Although these PDI companies have the ability to provide the required vehicle processing, transportation and storage of vehicles for their customers, the range of their involvement depends on their customers' options and orders. For example, some dealerships or distributors may request a different domestic line-haul for the transportation of their cargo. As such, depending on the customer request, the other independent car carriers might be involved for the transportation of the vehicles rather than transporting them in their own line-haul trucks.

7.5.1 PDI operations

The PDI operations can be undertaken on-wharf or off-wharf (Figure 7.2). When new vehicles are discharged from the ships into the terminal port yard, they may pass through different paths until their final delivery to dealerships.

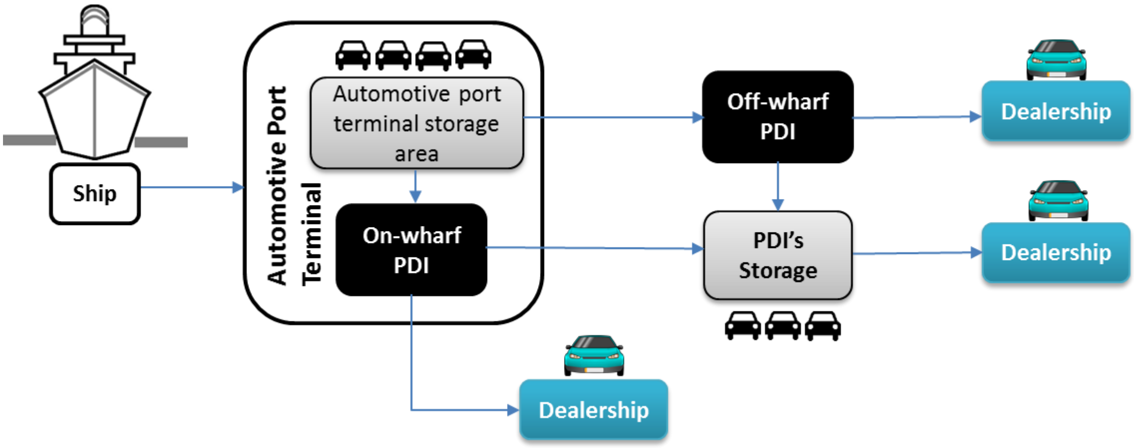

Figure 7.2. The paths of processing and distribution of imported vehicles after discharge from the ship.

Some of the imported vehicles are sent by trucks into the dealerships after the completion of their on-wharf PDI procedures. However, some of the vehicles that have passed on-wharf PDI procedures might be sent to the PDI storage sites which are mostly located in the western areas of Melbourne to be stored as stock for dealerships. The rest of the vehicles will be transferred by trucks to the off-wharf PDI processing locations for further PDI operations and vehicle processing. After completion of their PDI operation, some of these cars will be sent directly to dealerships and some will be stored in PDI storage areas as stock for dealerships.

There might be different charges associated with on-wharf or off-wharf vehicle processing. The maximum free on-wharf storage period is three days, and any required on-wharf PDI operations, prioritisation or grouping of the automobiles must be done in this period. Otherwise, the cargo owner must pay additional fees for the storage cost to the terminal operator. Some of the PDI's customers (car distributors) may prefer the vehicle processing of their cargo to be done entirely on-wharf, whilst other customers may prefer to split their requirements and request on-wharf PDI processing of those vehicles that have been sold or have higher priority for delivery. The rest of their low priority vehicle cargo are sent to the inland PDI facility where they will be taken for processing and released to dealerships in accordance with instructions from distributors and dealerships.

Most of the current PDI processing and storage centres are located in the western areas of Melbourne (Patrick Autocare n.d.-c; PrixCar Transport Services Pty. Ltd. n.d.-c). According to Port of Melbourne Corporation (2011), 60 percent of all new imported automobiles are distributed to dealerships in the east and south-east of metropolitan

Melbourne and the rest will be sent to dealerships in the west and north of the metropolitan area. A large number of these vehicles have to go first from the port to the PDI processing centres in the western suburbs of Melbourne for further processing, and then transported back to dealerships on the other side of Melbourne.

One of the objectives for developing the terminal at WDW was to locate all PDI processing centres inside or near to the automotive terminal at PoM to increase the transport efficiency of the automotive import chain (Port of Melbourne Corporation 2011). It is anticipated that with the completion of the WDW PDI processing centre, many of the new imported vehicles that are sold to eastern suburb dealerships will be sent directly to their destination without the need to be sent to off-wharf processing centres in the west of Melbourne.

7.6 Dyadic relationships of the players in the landside of the chain

In order to recognise and classify the type of current integrative practices and mechanisms among the players in the land side section of the chain, the interaction of any two members is discussed below. Figure 7.3 shows all the possible interactions in three forms of information sharing, operational and contractual relationships between landside players of the automotive import chain and other players of the chain.

The basis of dyadic interactions between these chain players is explained below.

7.6.1 Car distributor – car manufacturer

A transaction takes place between each car manufacturer and their local car agent for importing and distribution of their products. As shown in Figure 7.3, there is a contractual agreement between a car manufacturer and its local car distributor/importer in the consuming markets. As part of these contractual agreements, there are many operational business matters that need continuous interactions in the form of information sharing between the manufacturer’s head office and their local car distributor. As such, the local car distributor acts as a mediator and a communication bridge between the local dealerships and the head office of the overseas car producer. They also act as a ‘sensor’ of car manufacturers in the consuming markets by collecting the orders of the local markets through the dealership networks and reporting them to the head office of car manufacturers overseas.

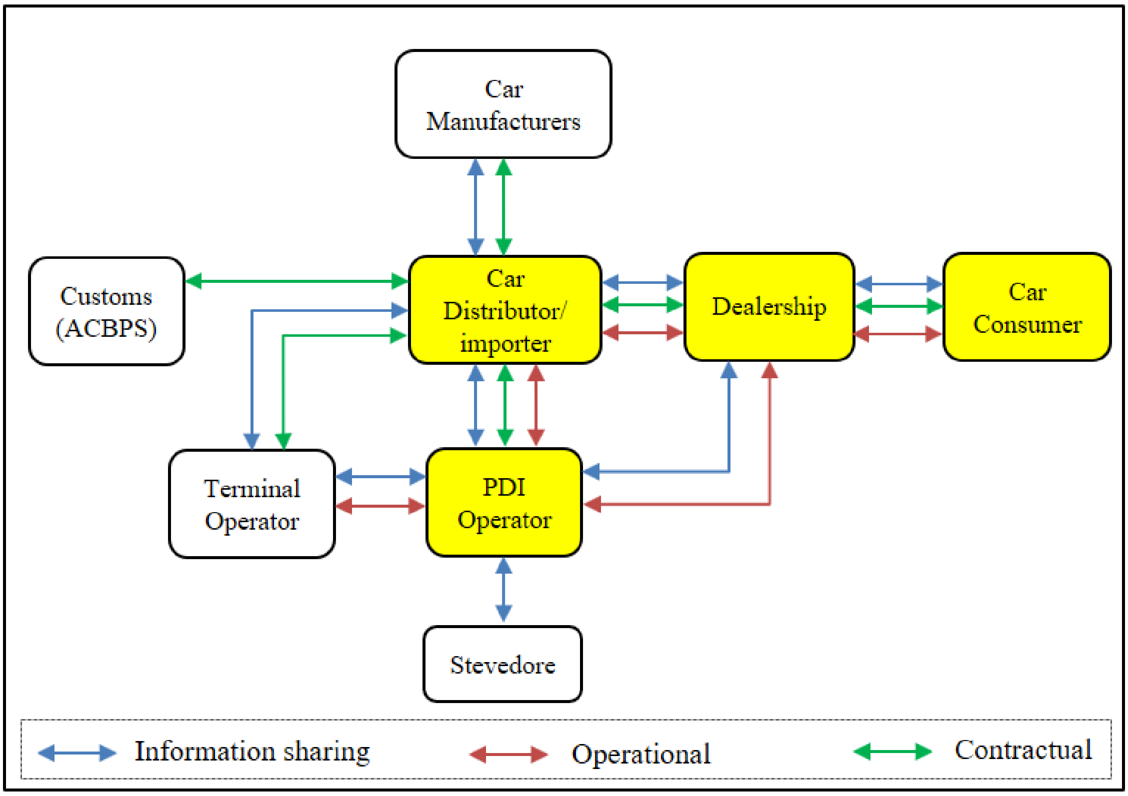

Figure 7.3. Three types of dyadic interactions between different players in the landside section of the auto chain.
Note: The landside players are depicted in yellow.

The car importer also collaborates with the central head office of the car manufacturer about the latest trends in the local markets and their forecast for the future demand of the market, and helps them in their future production plans. For instance, the Honda distribution centre in Melbourne sends its prediction for the local market demand of Honda cars in Victoria every three or six months to Honda's head office in Japan. Every month these predictions might be amended based on the newest market trends. The production plans of the Honda manufacturers will be shaped based on the information they receive from their different distributors in different consuming markets around the world.

7.6.2 Car distributor – car dealership

The relationship between a car distributor and a franchised car dealership as noted in Figure 7.3 involves many interactions in the form of operational business activities, information sharing and transactions. There is a contractual agreement between a car distributor and a franchised dealership for selling and marketing of certain car brands. There is continuous communications and information sharing between the car dealerships and the car importer as the agent of the car manufacturers about the latest trend in the market, and consumers' expectations, tastes and feedback about the products. Car distributors/importers also interact with the franchised dealerships to arrange selling strategies, marketing and promotions. Franchised car dealership staff and sales representatives receive training from a car distributor as the agent of the car manufacturer about the marketing techniques, product specification and technical support for the products to promote selling to potential customers.

7.6.3 Car distributor – PDI

Car importers in Melbourne have many operational duties which are performed in association with PDI companies. The extent of vehicle processing activities, their storage, and their damage free transportation management are wide and beyond the business ability and function of a single car importer/distributor as the local agent of the car manufacturers. Considering the small number of each brand in the Australian market, managing and resourcing all of these activities by car importer can be costly. However, when each importer outsources these vehicle processing activities to the PDI companies, the cost of all multi brands and multi-make processing operations will be beneficial in terms of economies of scale for both PDI companies and their primary customers (car importers). For instance, most car importers/distributors do not have storage for made-to-stock cars. If the car has not been sold, the PDI sends it to their car storage areas for the car importer. Having a contract with a PDI company for conducting and managing these activities is essential for each local car importer. Since there are only a few major PDI companies in Melbourne, car importers prefer long term contracts with these companies. As such, as shown in Figure 7.3, there are many business interactions between a car importer and its contracted PDI company in the form of information exchange, operational relationships and transactions.

For example, after the arrival of imported cargo into the port area, the PDI company as service provider of the car importer will manage the priority of the imported cargo for processing based on the information they receive from the car importer. This prioritisation for most of the car brands is similar, with possible small changes. For instance, one distributor may prioritise imported cars to five categories (Confidential interviews 2015):

A. National priority (ordered by government organisations)
B. Customer vehicles (prior purchased)
C. Dealerships (go to the dealerships, to showrooms)
D. Company fleet (ordered by distributor workers)
E. Stock vehicles (to be kept for inventory purpose)

The first three categories (A to C) are important and are shipped first, while the other two categories will be sent later.

For some other brands, the car priority might be (Confidential interviews 2014):

A. Company fleet (ordered by distributors)
B. Customer vehicles (prior purchased)
C. Dealerships (go to the dealerships, to showrooms)
D. Stock vehicles (to be kept for inventory purpose)

The highest priorities for customers are B and C which are different levels of priorities: D is for stock vehicles and A is for the vehicles which are kept for a company fleet.

7.6.4 Car distributor – ACBPS

The clearance of ACBPS charges is undertaken by car importers. For the customs process, the detailed listing of the cargo will be sent to the ACBPS before the arrival of the cargo, and will be checked by ACBPS upon the arrival of the cargo at the terminal. Any custom related issues and charges such as paying taxes and tariffs for the importation of vehicles need to be cleared between the car importer and the ACBPS. As such, as shown in Figure 7.3, transactions occur between a car distributor and ACBPS for paying taxes and release charges on imported vehicles.

7.6.5 Car distributor – terminal operator

The condition of cargo in terms of AQIS requirements is assessed by the AQIS after arrival of the cargo at the terminal area. In the event of contamination and hazardous materials, the appropriate procedures will be requested by the AQIS. It is the responsibility of the car importer to act according to the AQIS requirement for removing any contamination. This procedure must be undertaken inside the terminal area before release of the cargo. As mentioned in the previous chapter, a transaction might happen between the terminal operator and the car importer for cleaning the contaminated cargo inside the terminal and according to the AQIS requirement. Consequently, as shown in Figure 7.3, there might be operational and contractual links between the car distributor and the terminal operator to be able to release their cargo from the terminal area.

7.6.6 Car distributor – final car user

Car importers are not usually in direct contact with the public and individual consumers for selling the new vehicles. However, they might be in direct contact with the final automotive users for after-sale service and support.

7.6.7 PDI – stevedore

As shown in Figure 7.3, there might be some operational business interactions between stevedore and PDI companies upon the arrival of the cargo in the port area. For instance, before the stevedoring staff drive the cars out of the vessel, the vehicle is scanned on board by stevedoring staff in order to record its attached electronic information to the PDI company system.

7.6.8 PDI – terminal operator

As mentioned in the previous chapter and shown in Figure 7.3, there are operational interactions as well as information sharing between the terminal operator and the PDI company. The PDI company acts as the representative of the car importer in the terminal yard to inspect the new vehicles and prepare them for their final delivery to the dealership based on their priorities. The terminal operator gives the PDI staff 24-hour access to the terminal area for the processing and transportation of their clients' cargo. The terminal operator then provides access to truck operators (which in most cases are part of the PDI company) to load the vehicles for distribution. There are other statutory obligations that terminal operators and truck operators need to meet, such as the requirements of Marine Safety, WorkSafe, and National Heavy Vehicle Regulator. The priority of the arrival cargo for their loading sequence from the terminal yard will be given to the terminal operator to plan the yard and lay down area for the arrival cargo based on these priorities.

7.6.9 PDI – final car user

PDI companies do not deal directly with the public or individual user for delivery of the vehicles. Their primary clients are car importers and, for their primary customers, they might deliver the vehicles as instructed to their secondary customers which in most cases are dealerships.

7.6.10 Car dealership – final car users

Car dealerships are the only chain players that are in direct contact with the final car users. They communicate with the potential customers to recognise their needs and help to select their preferred vehicles. There are, therefore, business interactions in the form of operational and information sharing between car dealerships and potential car consumers. In addition, at the time a consumer buys a new vehicle, a transaction between the car dealership and the consumer has occurred (Figure 7.3).

7.6.11 PDI – car dealership

There are likely to be business interactions in the form of information exchange and operational activities between a PDI company and a car dealership as shown in Figure 7.3. PDI companies see their primary customers as the car distributors, and their secondary customers as the retail outlets. Sometimes the distributor can sell to the dealership (retailer) but the vehicle may not go to the dealership immediately on completion of the primary customer’s cycle. In those cases, the dealership may ask the PDI company to redirect the vehicle to their own customer account on completion of the primary cycle. For example, if the car distributor or owner is BMW, and one of BMW’s dealerships purchases the vehicle, the vehicle is prepared and upon completion will move to the dealership’s account. The dealership then owns the vehicle, and will instruct the PDI company whether it wants additional fitments, or when it wants to receive the vehicle.

7.6.12 Corporate ownership interactions

The corporate ownership interactions were not included in Figure 7.3 because the described relationships in this diagram are among general companies while the corporate ownership relationships are among specific companies in each category of business. Therefore, these relationships are described in a separate diagram. Figure 7.4 shows such corporate partnership relationships between particular PDI companies and other players.

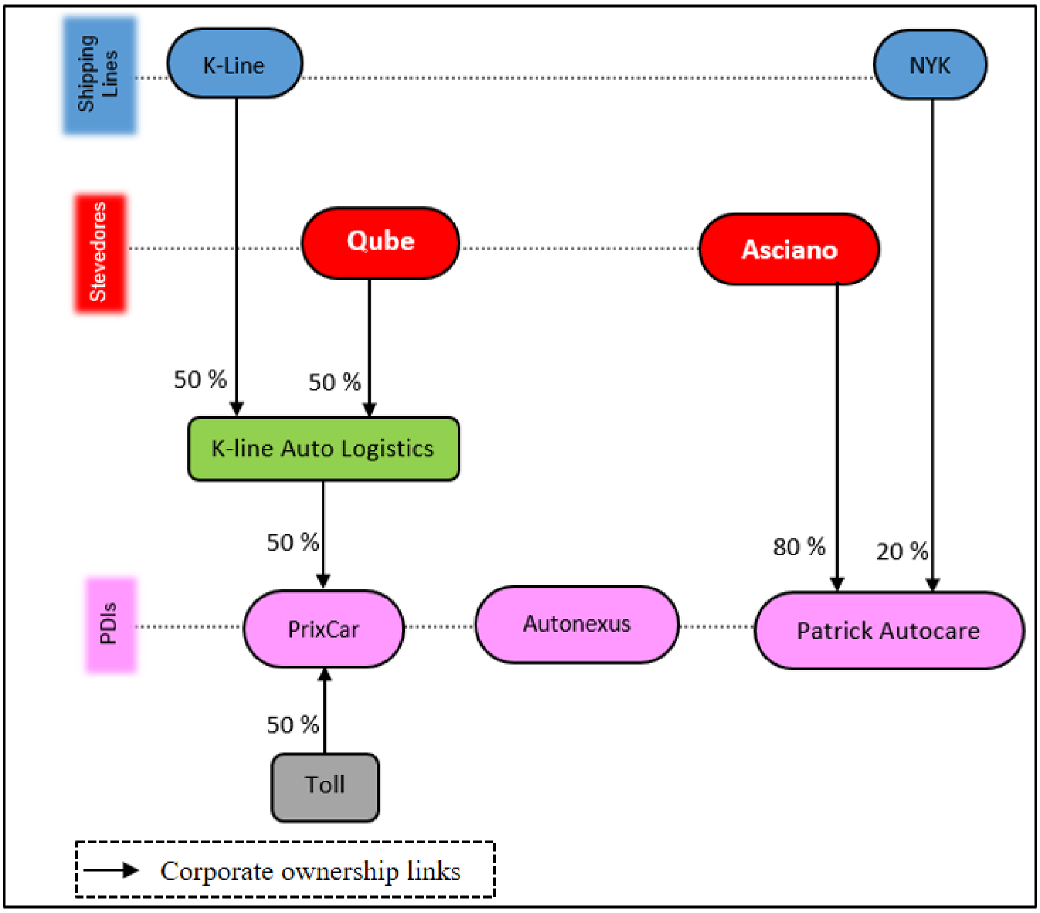

Figure 7.4. Corporate ownership links among certain players in the landside section of the chain and the other players.

As noted in Figure 7.4, K-line Auto Logistics, for example, is a joint venture of Qube and K-line which also owns 50 percent share of PrixCar PDI. The remaining 50 percent belongs to Toll PDI Investment (PrixCar Transport Services Pty. Ltd. 2016b). This PDI company currently owns both the vehicle processing and vehicle transport division aligned to its company.

The other major PDI company shown in Figure 7.4 is Patrick Autocare which is part of Asciano's Patrick stevedoring business. 20 percent equity in this company belongs to NYK and 80 percent belongs to Patrick. Patrick Autocare also has its own transportation fleet and is aligned with Patrick stevedoring and other shipping lines such as NYK.

Patrick Autocare and PrixCar are two major PDI companies that cover the processing and preparation of the majority of imported vehicles to Australia. The alignments that these two companies have built with some of the shipping lines and stevedoring companies in the auto chain via their corporate ownership links give them the ability to provide an integrated wharf-to-door service to their clients.

7.7 Recognising the integrative mechanisms in the landside of the chain

Integrative mechanisms are used to improve the coordination, collaboration and efficiency across the chain. The dyadic interactions of different players in the landside section of the chain with other players in the automotive import chain was investigated in the above section. The underlying chain architecture and dynamics will be revealed by detailed mapping of the sequential patterns of activities among different chain players, and the underlying chain structure will be exposed. The dynamic of the chain and the preferred strategies applied by the chain players (i.e., cooperative strategies or competitive strategies) will be discovered and understood by analysing this structure.

Consecutive sets of dyadic operational and information sharing links among different players in the landside section of the chain determine which firms are the influential members of the chain network.

Figure 7.3 shows three types of interactions, including operational, information sharing and contractual interactions, that exist among different players in the landside section of the automotive import chain. This diagram demonstrates that every element in the landside section of this chain is strongly inter-related to other elements of the chain. The diagram reveals a disseminated relationship structure of this part of the chain in which every business is highly dependent on the other businesses. Under these circumstances, relying on cooperative strategies is likely to be more attractive to the chain members.

These strategies (in the form of cooperative mechanisms) are applied and practiced by different players of the chain.

The red arrows in Figure 7.5 shows the integrative mechanisms in the form of operational relationships that are practiced by the landside players of the automotive import chain. The central role of a PDI company as a service provider to both car distributors and their customers (car dealerships) in the landside section of the chain is clear in this figure.

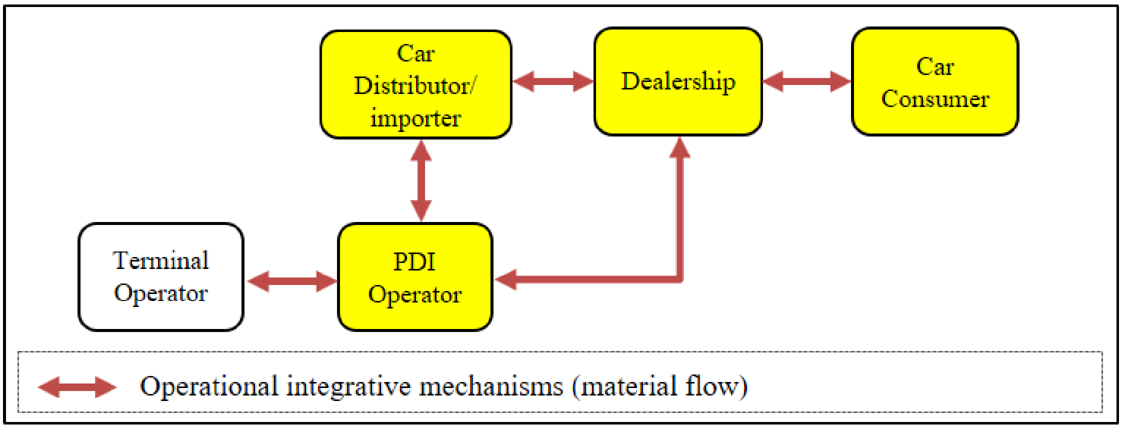

Figure 7.5. Operational integrative mechanisms in the landside section of the auto chain.
Note: The red arrows represent these mechanisms applied by different players.

The other important integrative mechanism which targets coordination and alignment of business activities in a longer period of time (longer than a day-to-day basis) is the contractual arrangement between the chain players. The contractual integrative mechanisms in the form of formal arms-length relationships determine what entities are doing business together, and the flow of money in the chain. As shown in Figure 7.6, there are transactions between car distributors/importers with many other players and service providers in the landside section of the chain.

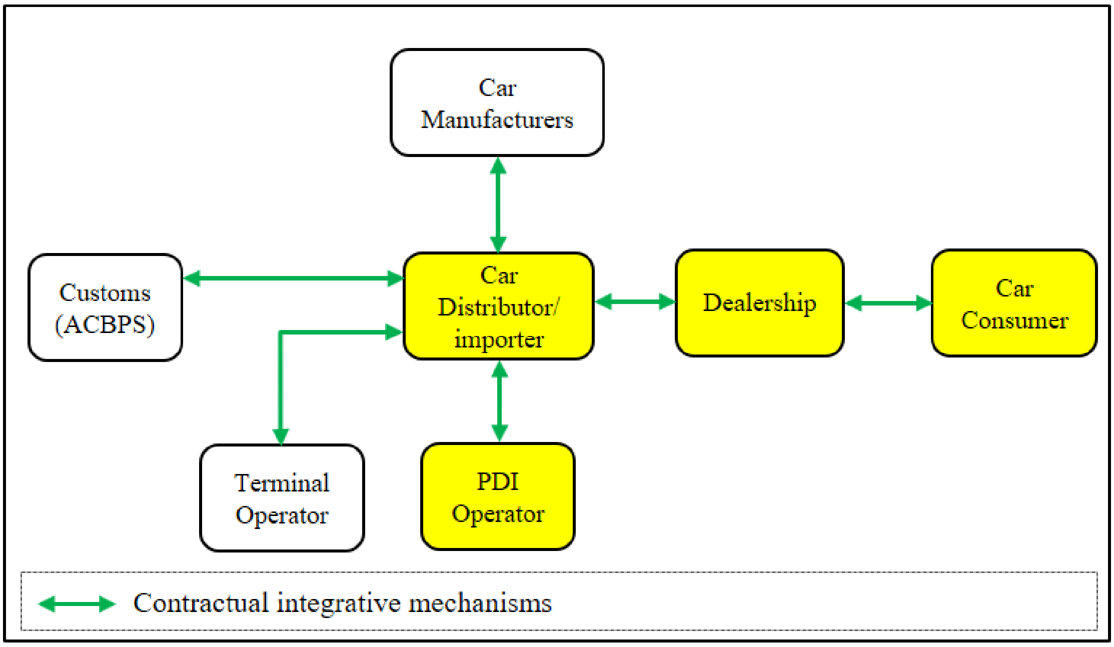

Figure 7.6. Contractual integrative mechanisms in the landside section of the auto chain.
Note: The green arrows represent these mechanisms applied by different entities.

This figure indicates the central role of a car importer in arranging all landside business contracts with other service providers to support required operations for processing and distribution of imported vehicles after their arrival at the port until their delivery to the dealership. This figure also indicates that the car importer is responsible for the cargo after their delivery by shipping lines to the port of discharge.

In addition to the benefits of contractual relationships as effective integrative mechanisms used by different players of a freight chain to improve the operational efficiency, corporate ownership relationships can be used as a more powerful integrative mechanism by aligning the interests of different players to secure a long-term commitment and partnership. Therefore, as shown in Figure 7.4, there are alliances among certain PDIs with other entities in the other sections of the chain, such as shipping lines, stevedoring operators or inland logistic companies.

By making such alliances, each group is able to offer a vertically integrated end-to-end service to their client in the SCN. For PDI companies, like their other business partners (shipping lines and stevedores), economies of scale are important to keep their businesses profitable. As such, companies that are service providers to car manufacturers and car importers are more interested in building long term partnerships with each other, not only to increase their economies of scope and the range of services they provide their clients, but also to increase the efficiency of their services through increased coordination and integration with other service providers in the chain, and to secure their competitive position in the chain. For instance, in 2012 Toll group (which owns a 50 percent share of PrixCar) sold its Australian finished vehicle distribution business to PrixCar (Toll Group 2012a) for the purpose of establishing 'a more sustainable and competitive business model that will produce stronger outcomes for both companies' (Toll group 2012b). Toll group (2012b) also announced:

> The change will provide customers with a fully integrated, end-to-end supply chain management service, and comes in response to broader automotive industry trends, such as the decline in local manufacturing and the increase in vehicle imports. PrixCar performs strongly in vehicle importing and commissioning, and the restructure will ensure it will be well positioned to continue its growth.

The other 50 percent ownership share of PrixCar belongs to K-Line Auto Logistics, a joint venture of Qube and Kawasaki Australia (PrixCar Transport Services Pty. Ltd. 2016b). Since Qube owns a 50 percent share of K-line Auto Logistics, Qube indirectly owns 25 percent of PrixCar's shares. With such ownership arrangements, Qube can extend its 'capability across automotive logistics supply chain' (Qube Logistics 2012).

The other PDI company, Patrick Autocare, claiming to be 'Australia's premier provider of shore to door services to the auto industry' (Patrick Autocare n.d.-b) has its own truck fleet to support inland distribution, and also has corporate ownership connections with NYK shipping line and the Asciano logistics group, as these firms hold 20 percent and 80 percent respectively of their company's shares (Asciano 2015).

These sets of alliances, mergers, acquisitions, takeovers and joint ventures of one sort or another among firms in the same supply chain network are considered to be strategic moves to involve the most powerful firms and eliminate unnecessary players from the chain network. The underlying corporate ownership structure that the two major PDI companies (PrixCar and Patrick Autocare) have built in the automotive import chain give them the opportunity to provide an integrated wharf-to-door service to their clients.

In addition, in such an inter-connected business environment, effective information sharing procedures are fundamental for efficient integration and efficiency of business processes. Therefore, a simple information exchange between two dyadic supply chain partners acts as an effective integrative mechanism for efficient coordination of business activities throughout the chain. All blue arrows in Figure 7.7 represent integrative mechanisms in the form of information sharing, practiced by different players in the landside section of the chain to coordinate the operational procedures more smoothly and efficiently. This figure also demonstrates the central role of a PDI company in coordination and management of the inland operations of the automotive import chain, as an entity that has information exchanges with many other entities such as car importers, dealerships, stevedoring companies and the terminal operator.

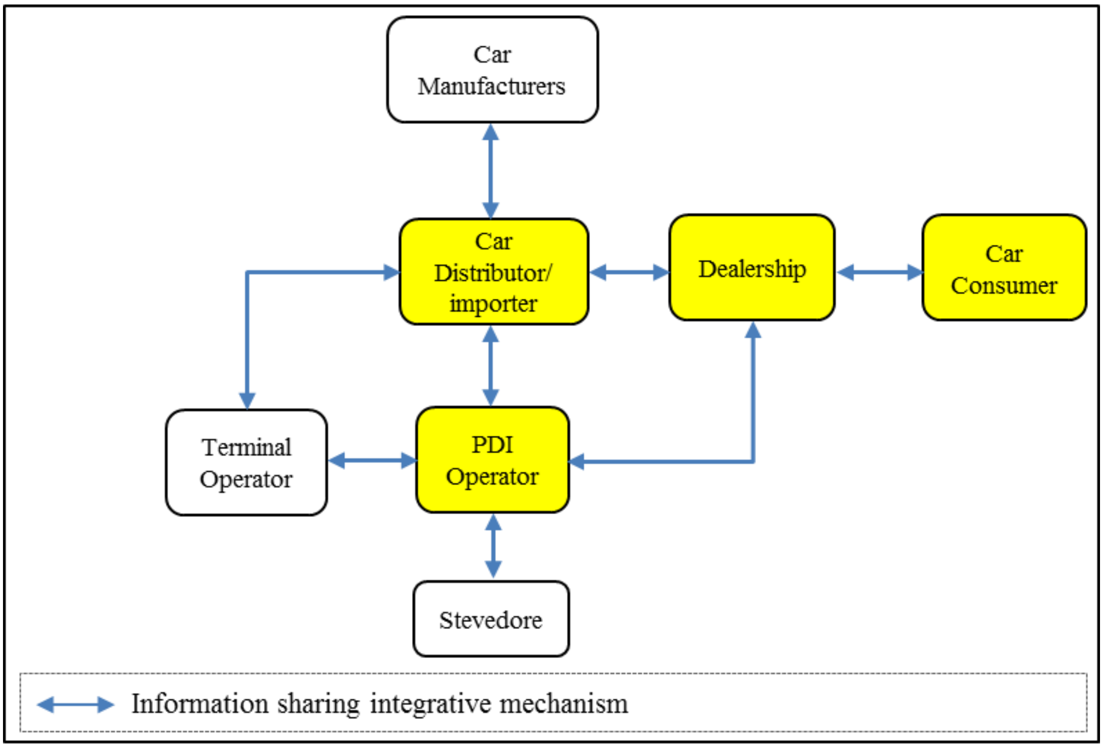

Figure 7.7. Information sharing integrative mechanisms in the landside section of the auto chain.
Note: The blue arrows represent these mechanisms applied by different entities.

Due to their high-level involvement in the preparation, processing and storage of the imported vehicles, a PDI company requires an integrated and smooth flow of information to and from major players in the landside section of the chain. As such, each of the PDI companies uses its own custom-designed IT system to support the processing operations and management of the activities in different stages of inland vehicle processing and distribution. Some of these IT systems are accessible by the PDI companies' clients (car importers and car dealerships) to allow them to monitor and receive the latest updates about the status of their orders on-line.

In the next section, the design and platform of one of these IT systems will be investigated[10].

7.8 IT system of a PDI company

The role of the PDI companies in the landside of the chain is a service provider and end-to-end logistic solution provider for car importers and dealerships. For a PDI company, IT is fundamental and the integration engine of the PDI business. It flows through the operational procedures from the time that the vehicle arrives at the port to the time that the vehicle is invoiced out for sale.

The IT system of the PDI company enables the company to offer its clients (car importers and car dealerships) a seamless logistics flow and high visibility on status and movement of their vehicles. This IT system is capable of Electronic Data Interchange (EDI) and File Transport Protocol (FTP) transaction messaging with other chain players, and provides their clients a web portal access. EDI is a type of standard electronic message format for exchange of business documents between business partners directly through their computer systems (computer-to-computer). FPT is a client-server network protocol for transferring electronic files between a client and server on a computer network. Clients interact by using FTP with the server and are able to download, upload, delete, rename, move and copy files on the server. As a result, the clients can interact with the web portal, update their requirements, track the location of their vehicles, and receive updates about their stage of processing and their prospective delivery time.

The IT system uses Vehicle Identification Numbers (VINs). The VIN is a unique number with 17 digits used by the automotive industry to identify individual motor vehicles globally.

In order to manage PDI work, everything that is done on the vehicle has a code which is attached to its VIN electronically. When a PDI company takes a vehicle into its PDI centre, the services required for that vehicle are known to the PDI company under their

[10] Due to the confidentiality of the commercial contents, the name of the PDI company and its IT system is not revealed in this section.

clients' contract. On completion of the required services, the vehicle is invoiced at the correct amount to their owners (car dealers).

Figure 7.8 describes the IT system of the PDI company as an integrating engine that can manage inland activities and increase the operational efficiency of the chain. EDI/FTP messaging systems increase the visibility of the chain, helping each company obtain constant updates about the activities in the chain. When the IT systems of all the service providers are connected, the constant electronic computer-to-computer messaging between all service providers will be possible. This access to real-time information increases the speed and accuracy of the information flow because no human is needed to deliver this information.

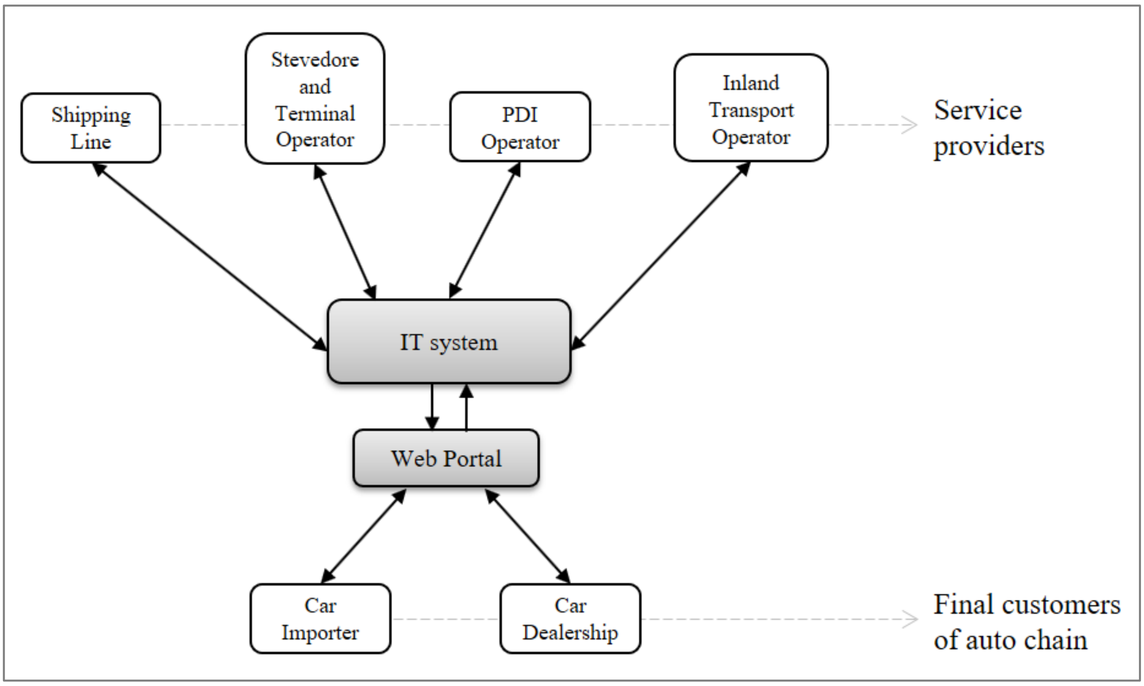

Figure 7.8. PDI IT system as an integrative engine for the auto chain.

In addition, real-time access to the information increases the flexibility and agility of the chain in terms of unforeseen situations, and increases the speed of the chain's players in order for them to react and rearrange their operations and planning in a timely manner.

A further important benefit of this IT system is providing the chain's clients (car importers and car dealerships) with a more comprehensive experience through the importing, processing and transportation of their vehicles. The IT system allows the clients to monitor milestones and receive updates about what is happening in the interface, ensuring that the status of the vehicle is at the right level to allow additional work. For example, in the case of damage to a vehicle, the car owner will be informed and the web portal has the capability to store photos taken at inspection which can be shown to the car owner to help make a decision regarding repairing the vehicle. Prior to having this IT system, the management of customers' vehicles (vehicles of car importers) would have been undertaken by the PDI client liaison officer, which could cause delays and errors in the processing of the imported vehicle.

The PDI companies are endeavouring to improve and integrate their IT systems with their other business partners to increase their efficiency and effectiveness across the whole chain and allow their clients to manage their company cars more effectively for themselves. For example, when one of the PDI companies in Melbourne acquired a line-haul transport company, the IT system of the transport company was merged into the IT system of the PDI company as part of the acquisition to enhance effectiveness and efficiency over their logistic system. This merging was undertaken through the interaction between two IT systems in order to exchange and update data in the respective management systems. After integrating the IT systems, the PDI company was likely to achieve greater effectiveness as an outcome of this integration (information obtained via confidential interviews). The cohesiveness of the system supports guaranteed the time of arrival from receipt into Australia to delivery to the dealership.

The PDI companies know that time is important for car importers and their dealership network. As such, they endeavour to become more time and cost effective within their organisation, and with their interactions with other logistic service providers. For instance, one of the PDI companies is improving its IT system to provide a build date (the date that the PDI processing on the vehicle is expected to finish) against the vehicle. As such, 48 hours before the expected arrival time of a ship, the IT system transacts the priority status of the vehicles to the stevedore's system and prioritises the status accordingly. The stevedore takes this information, which is then utilised to prioritise the vehicles into set locations at the laydown area on the port-terminal. The PDI reviews the information and the vehicles priority status, and identifies the vehicle sequence to align the build date and transporter load plan and delivery location for each vehicle. This is an algorithm that is applied to ensure that vehicles priority is processed, the transporter is fully loaded, and deliveries meet the timing requested by the customer.

However, the above example shows an ideal situation where all service providers in this chain (shipping line, stevedore, terminal operator, and inland transport company) are not only the business partners of the PDI company, but also have an integrated IT system. If that is not the case, the real-time exchange of information (through EDI/FTP format) cannot happen properly. For instance, when the shipping company is not related to the PDI company, the PDI might not be able to receive the cargo manifest[11] from the shipping line directly. Consequently, they must try other methods such as communicating with car owners (importers) to obtain information about cargo manifests. In addition, there are situations in which the customer chooses an external truck operator or transport company for the transportation of their vehicles. In such situations, the real-time flow of the information is disconnected when the transporter loads the vehicle because the PDI doesn't have any EDI/FTP communication with them.

Another example involves communication between the PDI and the stevedore company to specify the laydown plan of the coming vehicles based on their priorities. Such pre-arrangements through EDI/FTP communication are only possible when the stevedore and the PDI company have close business partnerships that allow them to communicate constantly. As a result, the integration of logistic service providers through corporate ownership links is a prerequisite for integration of the IT systems of the associated companies, and for providing a seamless end-to-end logistic flow. Such IT capabilities can significantly improve the efficiency and effectiveness of operations across the chain.

In the current chain of importing vehicles through the PoM, the major PDI companies (PrixCar and Patrick Autocare) are capable of providing a seamless supply chain experience to their clients through their associations and corporate ownership links, with some other logistic service providers of the chain such as the shipping lines, stevedore and inland transport companies. However, since they are not linked with all the service providers, some of their customers might not receive the same end-to-end service.

[11] Cargo manifest is a list that contains the details of the cargo on a vessel, including, nature, quantity, types and numbers, consignee, consignor, destination, and information for customs declaration of the goods.

A closer relationship developed by a PDI with all of those key stakeholders (including shipping line, stevedore, dealerships and importers) leads to improved information being provided to their customers (car importers), as well as an increase in capability for car importers to serve their dealership network and final vehicle consumers.

7.9 Conclusion

The landside operation of the auto chain, the links between different service providers, and the integrative mechanisms used by them were discussed in this chapter. The content of this chapter shows the important role of PDI companies in the new automobiles import destinations such as Australia as a delayed customisation platform for the overseas car manufacturers.

Chapter 8 Analysis and Discussion

In previous empirical chapters, the role of the individual players of the auto chain, their functions within the auto chain, and their dyadic relationships with other chain players were investigated. The findings in these chapters recognised the degree and depth of involvement of each chain player in the integrative mechanisms to contribute/increase operational efficiency and coordination of the auto chain. These findings, however, could partly answer the research questions of this study because the focus in the empirical chapters was on individual chain members, and their individual contribution to the efficiency and integration of the chain, and the integration and efficiency issues from their perspective.

In this chapter, the focus is on the entire chain as a whole (Figure 8.1), and its integration and efficiency to address the research questions by testing the applicability of the principles that were presented in the conceptual framework on the auto chain. The principles that were developed were based on the comprehensive literature review and the two real case studies of SCI in the coal export chains in Australia.

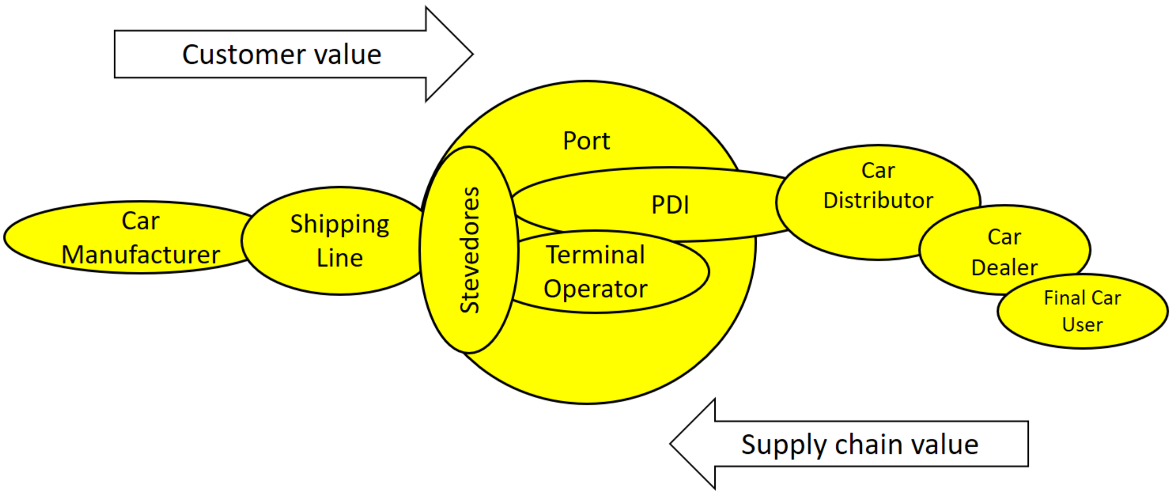

Figure 8.1.The schematic diagram of the new vehicle import chain through the port of Melbourne.

This chapter is divided into two parts. Part A focuses on auto chain as a whole system and attempts to recognise the auto chain construct, its underlying operational model, architecture, dynamics, integration level and efficiency dimensions. Part B focuses on responding to the research questions, and the applicability of the conceptual framework on the auto chain.

PART A

8.1 Auto chain construct

A chain in the context of supply chain is a concept that refers to a chain of organisations or entities that are involved in linking the producer at the beginning of the chain to the consumer at the end of the chain. Based on this perspective, a chain is an end-to-end sequence of interdependent functions and responsibilities that delivers a product or service in exchange of the final customer's value. Firms in chains exist to deliver value to the chain and capture revenues from the chain on a sustainable basis. Since firms in the chain are supposed to deliver a sustainable outcome that must be socially equitable and economically efficient, a supply chain system might involve legislations, public policies and regulatory frameworks; and thus, a supply chain system effectively can be a construct, and theoretically can involve many elements and concepts. Elements include different organisations such as suppliers, customers, logistic service providers, and statutory organisations. Concepts include the chain's objectives and functions, different types of interfirm relationships within the chain, as well as the regulatory constraints.

Every chain has a construct with these generic attributes, but also has some unique features dependent upon its industry background, the type of good or service that it delivers, and the logistic paths that it uses. As such, a chain construct of different chains, such as manufacturing chains, port-oriented chains, coal chain and automotive chain, might have some generic attributes and some unique characteristics. This section attempts to recognise the chain construct of the auto chain to investigate the integration and efficiency of the whole chain to address the remaining research questions.

8.1.1 Auto chain structure

The first step in the chain construct is to recognise its chain structure. The structure of the auto chain was described in detail in the empirical chapters by zooming in on the main auto chain players, their duties and their dyadic relationships. Figure 8.2 provides a summary of the sequential key activities which need to be performed by auto chain members to bring a new car from car manufacturers overseas to the dealership showroom in Australia.

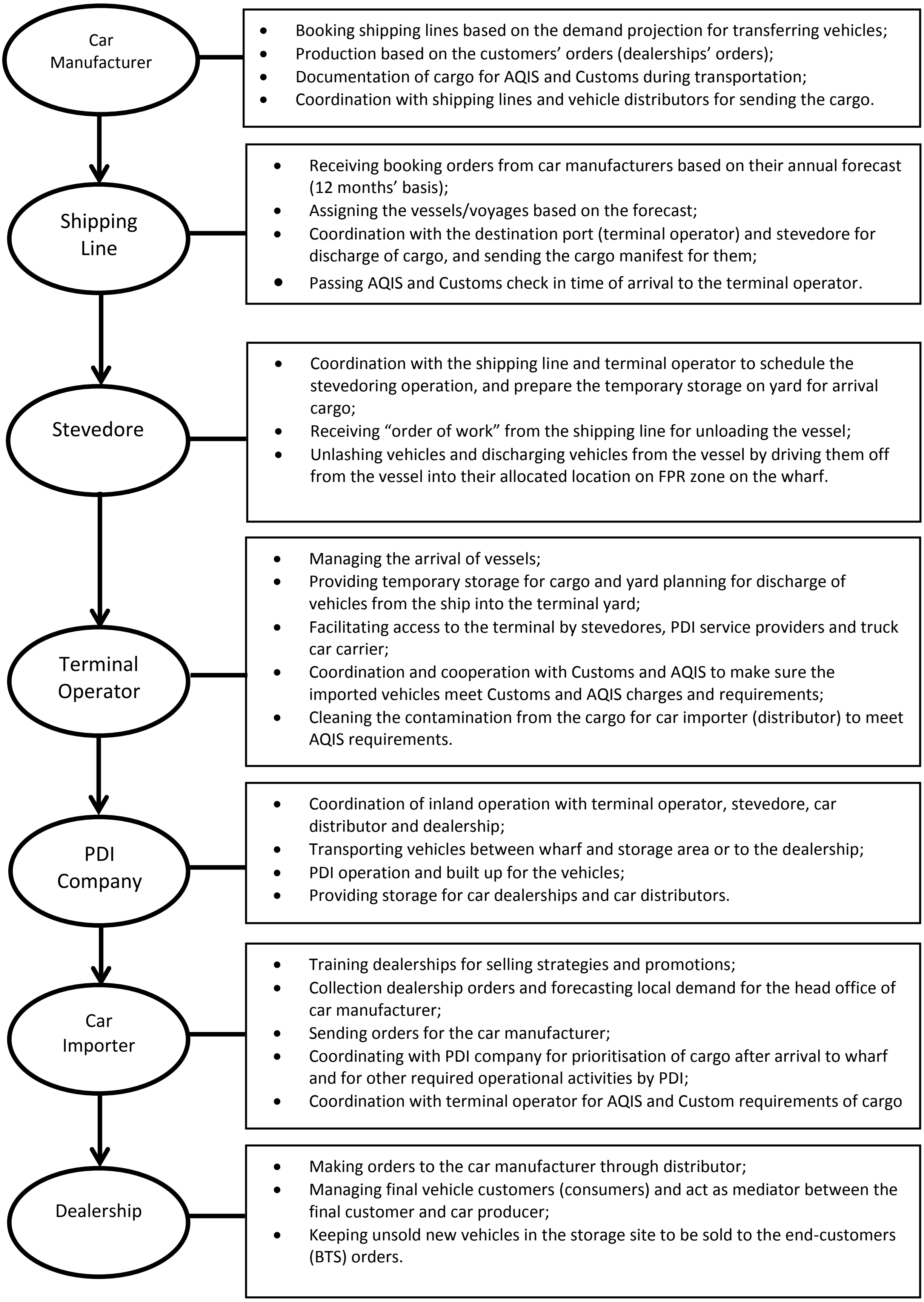

Figure 8.2. The functional structure of the auto chain and the sequence of operational activities in the chain.

8.1.2 Auto chain operational model

One of the important parts of a chain construct is recognising its underlying operational model which determines the chain architecture and dynamics. The first step for the recognition of the auto chain operational model is to find out what triggered the supply of the new cars in the auto chain. Was the supply of the new car triggered by the car manufacturer forecast and thus the car was pushed to the market, or was it triggered by a customer demand at the end of the auto chain?

As noted in chapter four, in recent decades, the operational model of automotive supply chain has shifted from supply-push to demand-pull. Although part of the production plan of car manufacturers still relies on market forecast and trends, in practice, new cars are produced based on the dealership orders. As such, the car movement is triggered by the demand from the customer (Figure 8.3), and its supply chain model is demand-pull. According to this figure, at the first stage the car dealership orders a new car from the car importer. At the second stage, the car importer purchases the new car from the car manufacturers and this transaction triggers the production of the car and its movement from the production site toward the dealership showroom.

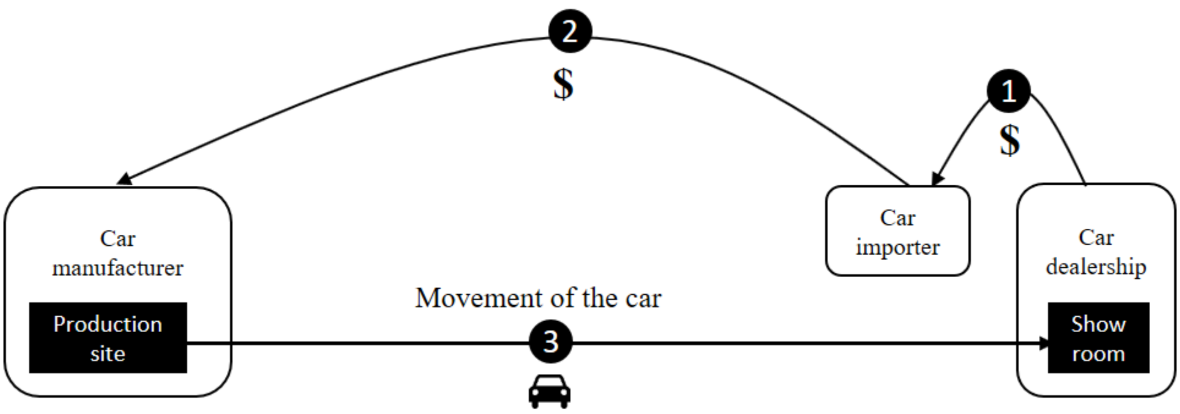

Figure 8.3. Demand-pull as operational model of the auto chain.

Since the auto chain has a demand-pull operating model, the auto chain architecture is not characterised with multiple buffer stocks as is common in supply-push operating models. However, since part of the dealership orders are based on the market demand forecast and not the actual end-customers, there are cars in stock in the dealerships for a few months until sold to the end-customers. In some unusual circumstances, such as a sudden drop in the demand due to an economic crisis, the number of unsold new cars might increase in the dealership's inventory which may create buffers in the auto chain.

Another aspect of the chain construct that defines the chain underlying architecture is the flow of money between the main supplier and the main customer and their subcontractor logistic service providers. Figure 8.4 provides an example of the flow of money and the contractual relationships in the chain. It also indicates where the responsibility of cargo switches from car manufacturer to the local car importer. According to this figure, a transaction occurs between a car manufacturer (as the main supplier) and a car retailer (as the main customer) with liaison of the car manufacturer's local agent (car distributor) to purchase a car. A major portion of the price that the car dealership pays for the car is returned to the main supplier (car manufacturers overseas) for producing the vehicle, and a portion of it is taken by the local car distributor for importing the vehicle, and the rest is distributed between different logistic service providers for transporting the vehicle from its overseas production sites to the dealership showrooms in Australia. When the responsibility of delivering the car (from its manufacturing site to the car importer) is by the car manufacturer, the logistic service providers are chosen and paid by the car manufacturer. Otherwise if the responsibility of the car transportation belongs to the car importer, the logistic service providers are chosen and paid by the car importer.

In the chain of importing vehicles through PoM, in most cases, as shown in Figure 8.4, the car manufacturer is responsible for the delivery of vehicle to the port of discharge, and from the FPR zone at the PoM terminal, the car importer is responsible for the other tasks and related charges for clearance, preparation and delivery of the vehicle to the local dealership. According to this figure, the car manufacturer choses the shipping line for delivering the cargo to the port of discharge, and other contracts are set in place by the shipping line and its direct service provider (stevedore) and their dyadic partners (terminal operator). In the landside operation of the chain, the car importer employs the PDI company, and inland car transportation providers are employed either directly by the car importer or by its PDI.

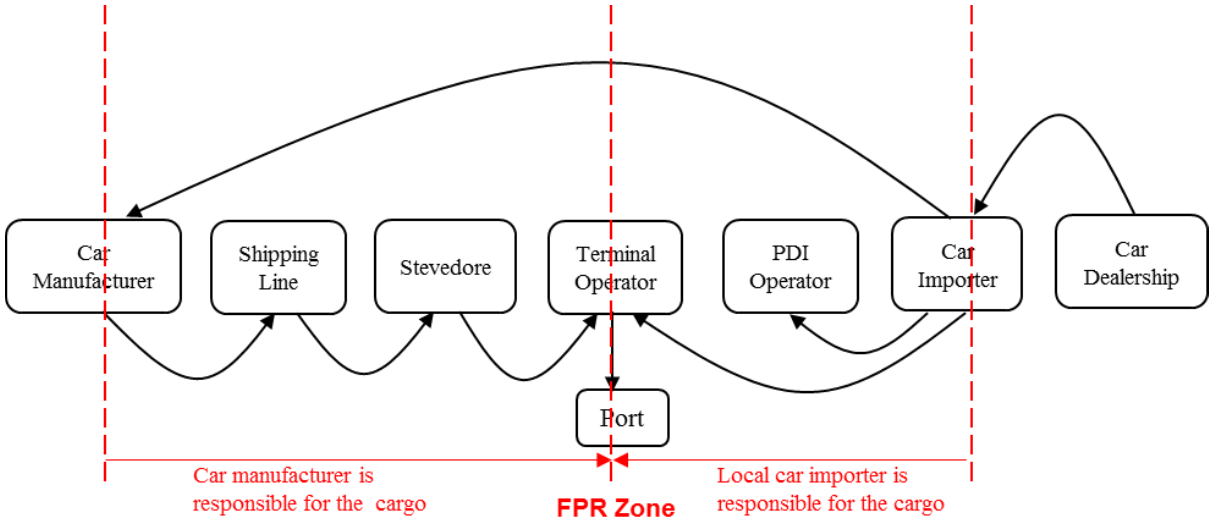

Figure 8.4. The flow of money in the auto chain when the responsibility of the cargo switched from car manufacturer to car importer in the port of unloading the vehicles.

Whilst Figure 8.4 shows the generic flow of money and transactions in the auto chain, Figure 8.5 provides an example of actual contractual relationships in the auto chain in March 2014. In Figure 8.5, grey arrows represent these relationships among different auto chain players. In this figure 'i' represents the number of car dealerships and 'n' represents the number of car manufacturers. There are seven shipping lines, two stevedore companies, one terminal operator, and two PDI companies in this figure.

As seen in this figure, some shipping lines such as K-line, WWL and Glovis are in a contractual relationship with Qube for their required stevedoring services in PoM, whilst shipping lines such as MOL, NYK, Höegh and Toyofuji are in a contractual relationship with Asciano.

In the landside part of the chain, there are two main PDI companies including PrixCar, and Patrick Autocare. Each of these PDI companies have their own customers (car importers) on a contractual basis. The car importers in group A of this figure have contracts with PrixCar, whilst the companies in group B are customers of Patrick Autocare (Patrick Autocare n.d.-a; PrixCar 2016).

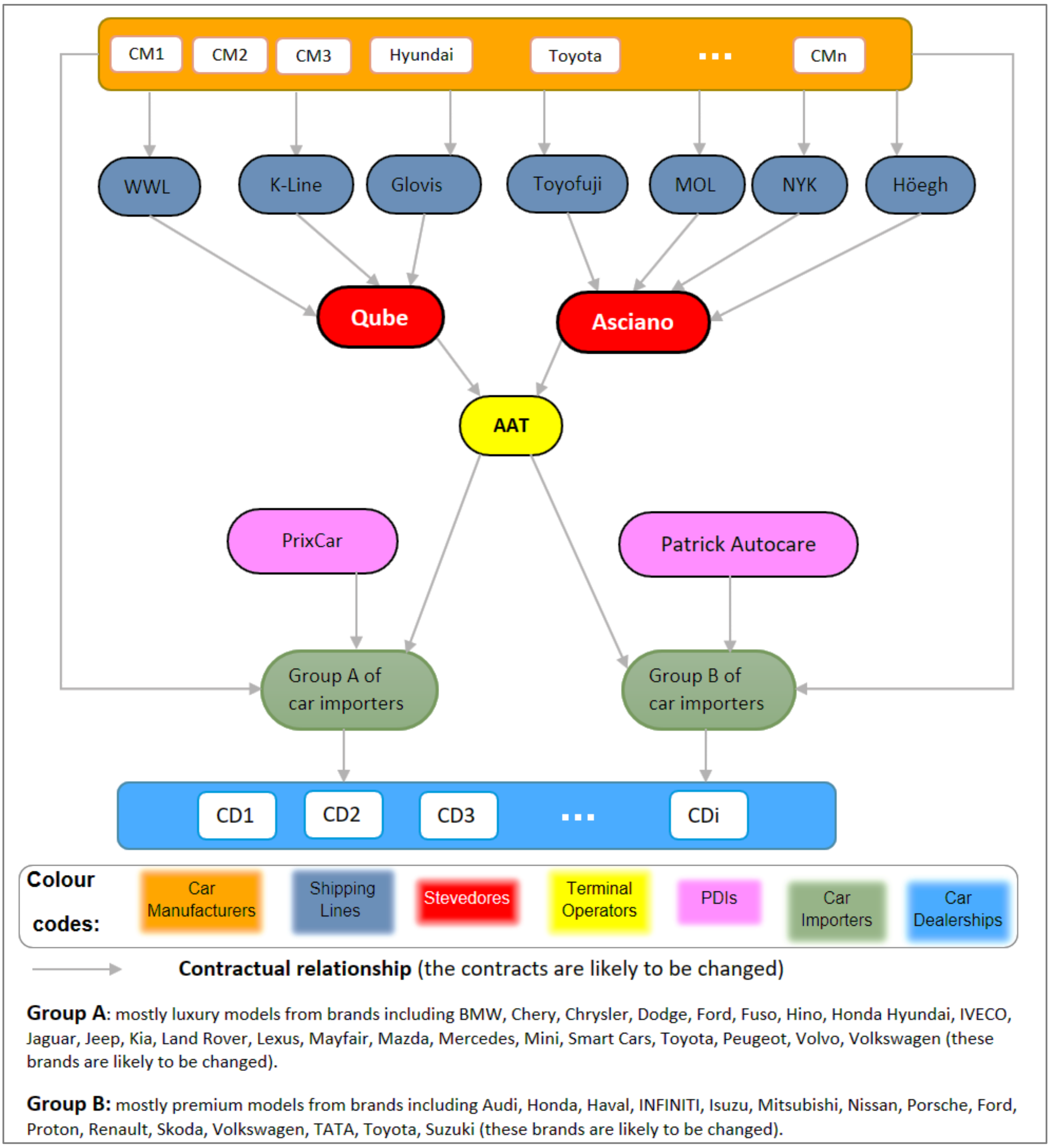

Figure 8.5. Example of the actual contractual agreements amongst different firms of the auto chain in March 2014.
Note: 'i' represents the number of car dealerships and 'n' represents the number of car manufacturers.

Besides these contractual arrangements which are normally set for a duration of one to three years, there are other corporate ownership relationships between the different auto chain players which are valid long-term (as long as the involved parties are interested in maintaining the ownership links). Some of these players are linked vertically, and some are linked horizontally through corporate ownership relationships (Figure 8.6). The black arrows in this figure indicate the corporate ownership links between different chain participants from 2014 to August 2016. These corporate ownership relationships will be discussed in further detail in Part B of this chapter.

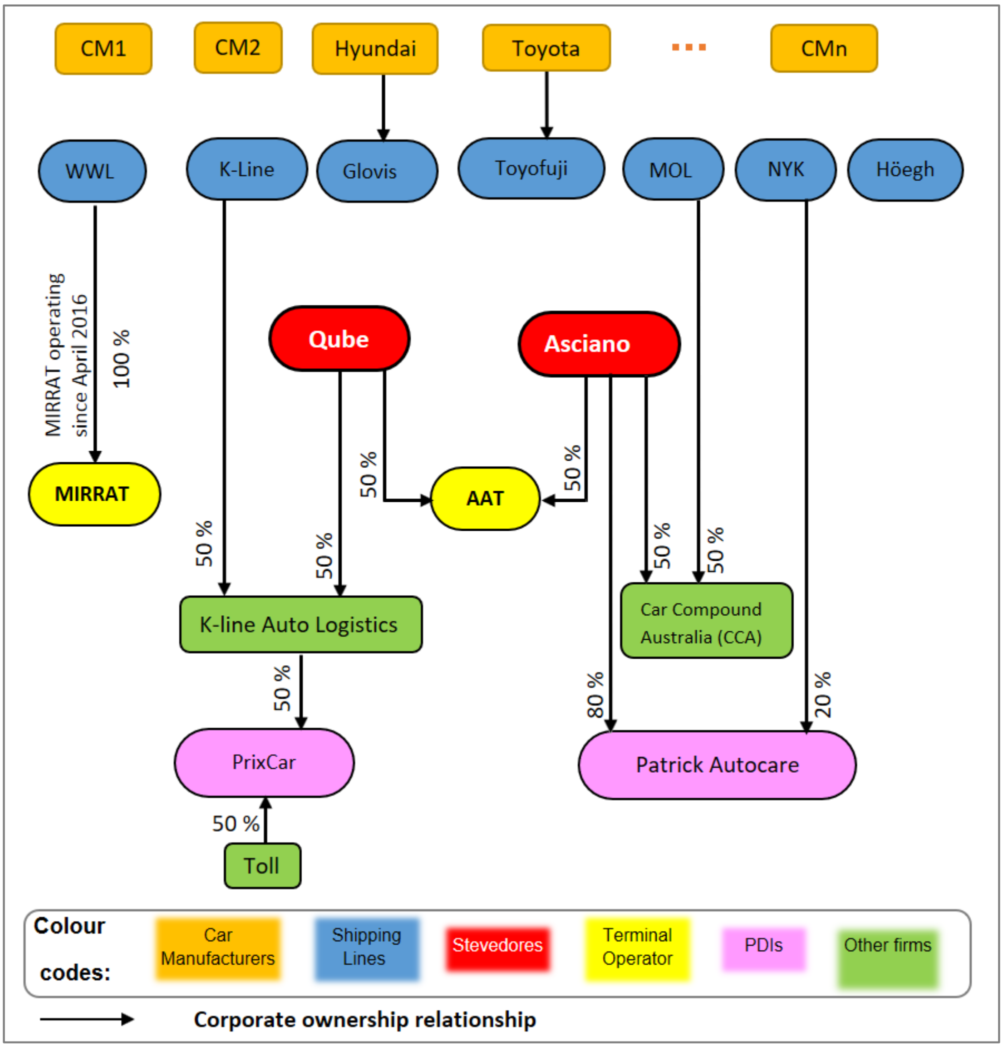

Figure 8.6. Corporate ownership links in the auto chain from 2014 to August 2016.

8.1.3 Auto chain integration and efficiency levels

As noted at the beginning of this thesis, this research is not designed to measure or provide a quantitative scale for the integration and efficiency of a chain. However, it attempts to understand the concept of integration, its relationships with efficiency, and the practical models, mechanisms and strategies that have been used in real case studies of port-oriented freight chains to achieve greater efficiency. It was also noted that what we mean by integration in this thesis is inter-firm integration, and what we investigate in relation to the chain efficiency is macro efficiency factors of the whole chain and not micro efficiency factors that are related to the efficiency of individual firms. Considering these conditions and recognising the underlying architecture and dynamics of the auto chain, the integration and efficiency of the auto chain is analysed in this section.

As discussed in chapter two, there is much anecdotal evidence that suggests an integrated chain is more efficient. In an integrated chain, functions are controlled by fewer participants, reducing the chances of incompatibility, bottlenecks and congestion in the chain, enhancing efficiency for the whole chain.

In addition, integration is a multi-dimension concept, with different depths, levels, timeframes and lengths. These different levels for integration and their resultant effects on the efficiency of the auto chain are listed in Table 8.1.

Table 8.1. Different levels and scope of integration in the auto chain and their relevant resulting efficiency.

Timeframe	**Integration levels**	**Resultant effects on the auto chain efficiency**	**Depth of information exchange/sharing**
Daily basis	Operational links	Defining the chain	Low level of info sharing
One to three years	Operational links + Contractual links	Operational efficiency	High level of info sharing
More than three years	Operational links + Contractual links + Corporate ownership links	Operational efficiency + Investment efficiency	Integrated/connected IT systems + Efficient information flow

The first row of this table refers to daily operational transactions between different firms in the auto chain with the purpose of delivering a new car from one end of the chain to the other end of the chain. This refers to the concept of defining the auto chain as an initial stage of chain integration. At this level, since every element of the auto chain works and pairs with other dyadic chain members on a short-term basis, the level of information sharing is limited to basic business information required for having a temporary operational business relationship. Under these circumstances, there is a great potential for mismatch of operational functions and incompatibility between dyadic business partners across the auto chain, which can result in inefficiencies and high cost operations.

The second row of the table refers to a continuous act of operational cooperation between members of the auto chain that have decided to extend and secure their daily business relationship for a longer period of time (between six months and three years) under contractual arrangements. As such, the contractual arrangement among auto chain players adds to the stability of the chain's functions, operational adjustments and medium term-capacity alignment between the dyadic chain partners. The information sharing at this stage among two chain members that have contractual relationships is continued for a longer period, and the amount of information that is shared is vaster and more dynamic compared with the previous stage. As a result, a higher level of operational integration and efficiency is expected for the whole chain due to the contractual arrangements between the auto chain members that smooth the operational bottlenecks in the chain and reduce erosion of value within the chain.

In the third row of the table, the level of sequential arrangements between different auto chain members is extended beyond the contractual arrangements by engaging different chain members in a long-term partnership and commitment through corporate ownership links. The corporate ownership links bring further control, arrangement and collaboration amongst auto chain players to secure a long-term commitment, by aligning their business interests, investment plans and collaborations to maximise the chain efficiency and gained value from the chain. The amount, depth and frequency of information exchange is at the highest level in these situations amongst business partners because the purpose is not only to exchange the critical business information, but also to share information about future investment, capacity planning and developments with other business partners. The integration of the IT systems of the engaged companies, depending on the type of their corporate alliances, can boost the efficiency of the chain system by use of real time information flow that can improve the effectiveness and efficiency of operational arrangements in the auto chain. The increase of operational efficiency as well as investment efficiency are the results of higher levels of integration, stability, harmony and operational capacity arrangements between business partners to avoid bottlenecks, enabling the smooth flow of material and information across the chain.

Now that the auto chain construct has been recognised, we can answer the research questions in the next part.

Part B

8.2 The test of conceptual framework on the auto chain and case study questions

This thesis deals with the issues of integration and efficiency in the chains and particularly in the port-oriented chain networks. A conceptual framework was developed based on a comprehensive literature review in the production based chain networks and maritime-related chains, as well as real-world case studies in coal export chains in Australia.

Based on this conceptual framework shown in Figure 8.7, two models are recognised in real-world port-oriented supply chains to achieve an integrated chain. One model is achieved by voluntary efforts of individual players of SCN by applying integrative strategies in the chain. The other model is achieved by imposing control over the supply chain by an external regulatory authority, firm or organisation.

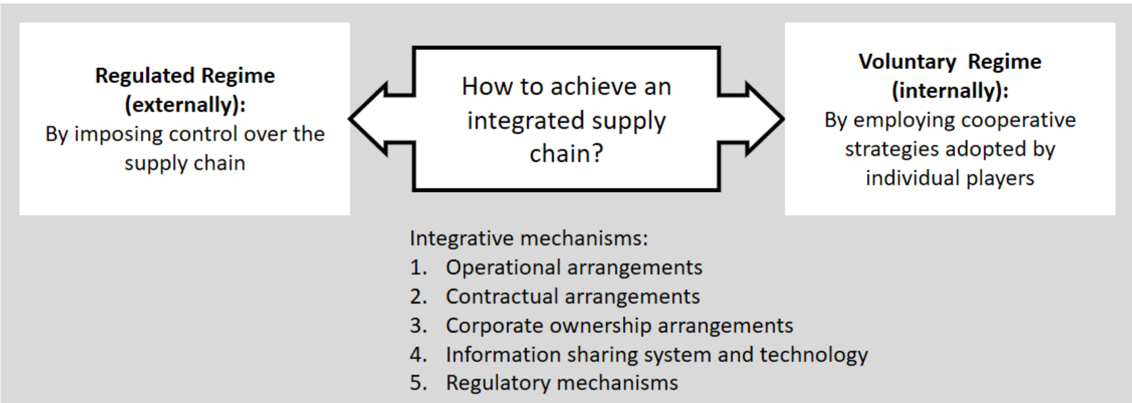

Figure 8.7. Possible models for achieving an integrated supply chain network and the integrative mechanisms that are used to make an integrated SCN.

This conceptual framework also suggests some integrative mechanisms that can be practiced by firms in this class of supply chain networks to increase the efficiency and integration of the whole chain network.

The conceptual framework that was developed within the context of two recent case studies of bulk coal export chains in Australia (the Goonyella coal chain in Queensland and the HVCC in New South Wales) raised the problem of applicability to other port-dependent freight chains. Hence, a case study approach was designed to test this conceptual framework in the vehicle import chain through PoM in Australia.

The result of testing the proposed conceptual framework is discussed below by responding to the research questions.

8.2.1 To what extent is the auto chain efficient and integrated?

The definition that was used for 'efficiency' in this research is an interpretation of the term 'efficiency' that is the result of an integrated system/SCN and is associated with integrative mechanisms, such as operational, contractual and corporate ownership integrative mechanisms.

The root of the word 'integration' arises from the Latin word 'integrare' which means 'to make whole' or 'to combine into a whole' (Robinson 2013). According to Robinson (2013, p.2):

> In the context of chain and supply chain systems, it underlines the essential integrity of the system as a set of interdependent functions performed by a single, vertically integrated firm or many firms and agencies that link the production or supply of a good to the buyer or customer of that good. If integrare is to make whole and integration is a condition of wholeness then it is axiomatic that the chain system is a perfectly equilibrated system - it is a system performing optimally, though the precise meaning of the word is not always clear.

The ideal status for an integrated chain is described when all the chain participants are either vertically integrated by corporate ownership links, or when all these functions are performed by individual firms that are working together seamlessly under the control of a single intelligence in order to maximise the efficiency and captured value of the chain.

To find out any similarities with the auto chain and the ideal status for an integrated chain, we need to look at the auto chain underlying architecture model designed in Part A of this chapter. As shown in Figure 8.8, the auto chain consists of many individual players, each performing a function, and some are linked by corporate ownership. The dashed ovals determine what members of the chain are linked by corporate ownership. It is evident that not all chain members are linked by corporate ownership. In addition, there is no firm operating as a single intelligence to control all auto chain functions.

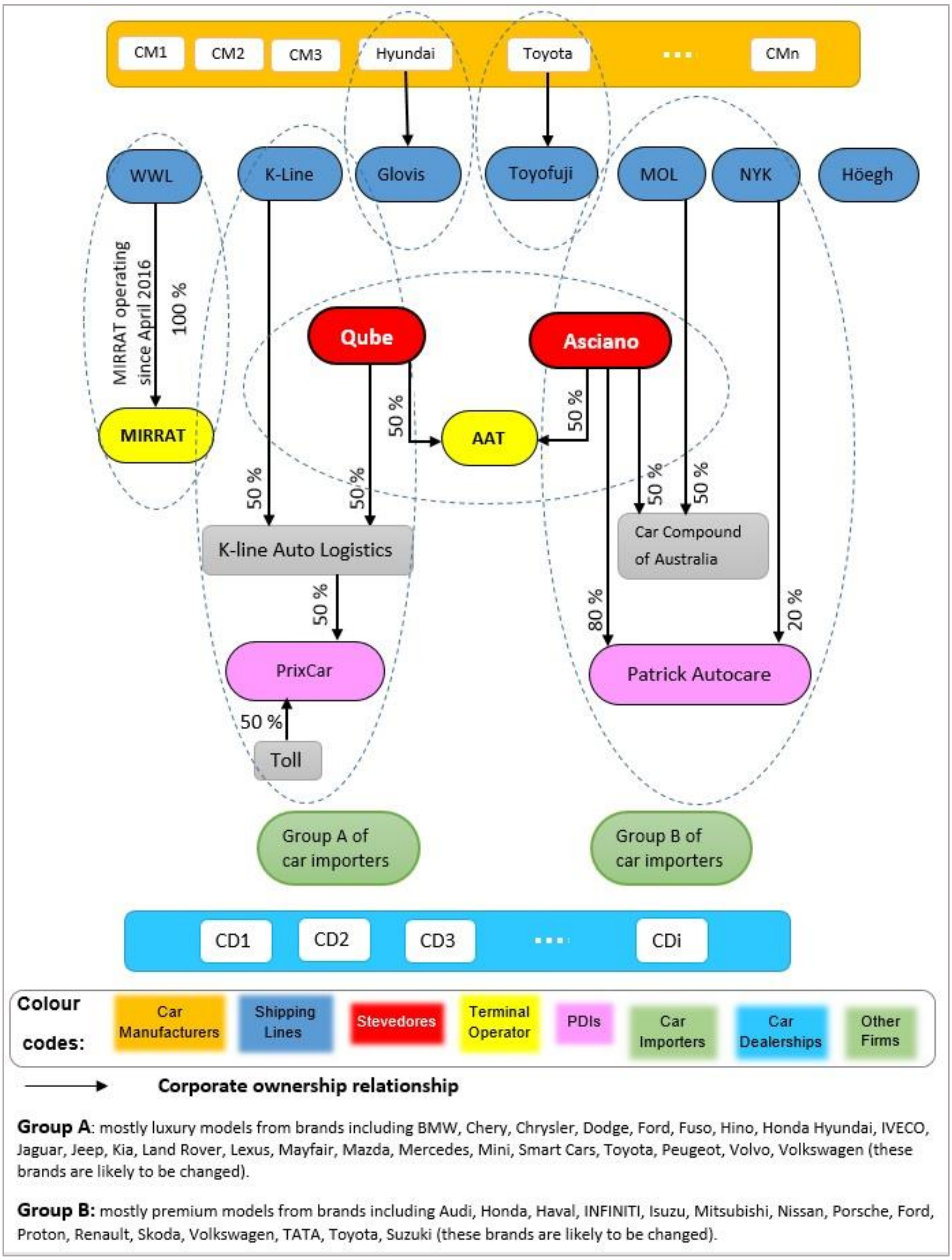

Figure 8.8. Patterns of integration in the auto chain network.
Note1: The corporate ownership relationships are valid from 2014 to August 2016.
Note2: 'i' represents the number of car dealerships and 'n' represents the number of car manufacturers.

As such, the auto chain does not represent an ideal status of a fully integrated end-to-end chain such as the C4 model in Figure 8.9 where all chain functions are undertaken and controlled by a single entity.

However, and in contrast to the C4 model in Figure 8.9, the auto chain is not fragmented or disintegrated as depicted in C1. In fact, the dashed ovals in Figure 8.8 suggest that the auto chain in recent years represents a partially integrated chain similar to the C2 model in which some of the chain participants have taken some functions of the chain under their own control by engaging in corporate ownership relationships.

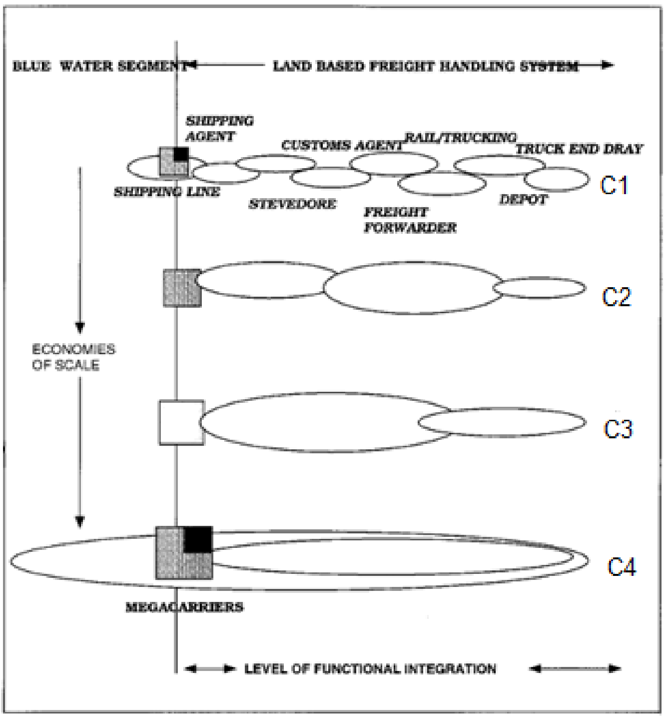

Figure 8.9. Level of integration in port-oriented supply chain.
Source: Robinson (2002, p.249)

Table 8.2 shows different types of these links in the auto chain. The purposes of these corporate ownership links are different, depending on the type and the position of the companies in the auto chain. Some chain members are vertically linked (whether directly or indirectly) with other members of the chain in order to increase economies of scope and gain more value from the chain, while others are horizontally linked to increase their economies of scale and improve their market share and business operation.

An example of a horizontal corporate ownership link in the auto chain is the establishment of AAT. In 2002 Qube and Asciano (Patrick) jointly established AAT in order to expand their economies of scale in serving their customers with the charter to control, operate and develop automotive terminal facilities in different Australian ports.

In 2006, AAT became the sole operator of all three automotive terminals in the PoM for the exclusive benefit of its parent companies, Qube and Patrick.

Table 8.2. Different corporate ownership links among auto chain players.

	Horizontal corporate ownership links	Vertical corporate ownership links
Directly	---	Hyundai with Glovis Toyota with Toyofuji WWL with MIRRAT Asciano with Patrick Autocare NYK with Patrick Autocare
Indirectly	Qube with Asciano via AAT	Qube with PrixCar via K-line Auto Logistics K-line with Qube via K-line Auto Logistics MoL with Asciano via Car Compound Australia Asciano with NYK via Patrick Autocare

There are many examples of vertical integrating strategies of different auto chain players and their purposes of such engagements. These include the following:

- Some car manufacturers, such as Toyota and Hyundai, have extended their operations in the auto chain into the shipping business by establishing their own RoRo shipping line. Toyota owns Toyofuji in order to ensure control over the ocean transportation of its vehicles from Japan to Australia and New Zealand. The Korean logistic company Hyundai Glovis (part of the Hyundai Motor Group) established Hyundai Glovis Australia in 2005 (Hyndai Glovis 2014a), providing space charter for vehicle cargo on the RoRo shipping services from Korea to Australia (Hyndai Glovis 2014b).

- WWL as a leading global ocean shipping company has expanded its traditional RoRo shipping operation to cover much of the supply chain, from the factory gate to the dealership, and is now significantly involved in RoRo terminal operations in at least 13 ports worldwide, including the newly developed consolidated terminal, MIRRAT, in the PoM, as well as providing 67 vehicle processing centres around the world (WWL 2017).

- Asciano (Patrick), a major stevedoring company in the PoM as well as other major Australian ports, established its own PDI company, Patrick Autocare, expanding its vehicle stevedoring business to include PDI operations.

- NYK, which holds 'the world's largest car carrier fleets and shipping-route networks' (NYK Group 2016, p.32), is also vertically integrated with Patrick Autocare, having acquired 20 percent equity in this company. The remaining 80 percent of Patrick Autocare belongs to Patrick's parent company, Asciano (Patrick).

Besides these direct corporate ownership relationships, there are indirect corporate relationships between different auto chain members through joint venture companies such as K-line Auto Logistics and Car Compound of Australia. This way, different companies with independent identities, functions and profiles align their interest with other service providers in the chain, expanding their economies of scope, as well as harvesting the benefits of long-term partnerships without changing their own identity or company profile.

- K-line Auto Logistics was formed in 2009 as a joint venture company of Qube and K-Line. This company further expanded its supply chain control by entering the landside operations of the chain by acquiring 50 percent equity in PrixCar. As a result of these corporate ownership links, K-line, Qube and PrixCar indirectly became business partners, extended their operations and control across the auto chain, providing a seamless end-to-end logistic service.

- The joint venture of Asciano (Patrick) with MOL to create Car Compound Australia also indirectly linked Asciano (Patrick) as a stevedoring company and MOL as a major shipping line in the auto chain beyond their contractual relationships.

Although the auto chain is not a fully integrated chain, the direct and indirect corporate ownership arrangements mentioned above indicate that different logistic service providers within the chain, such as shipping lines, stevedores and PDIs, have tried to increase their economies of scope, gaining more value from the chain by aligning their interests to provide a more vertically integrated and efficient service to their clients.

8.2.2 How was integration achieved in the auto chain? What integrating mechanisms were used by chain members?

Even though the auto chain is only partially integrated in some sections, there are logistic service providers within the auto chain, such as PrixCar and Patrick Autocare, that are able to provide an integrated shore to door service for importing vehicles to their clients (car importers). These logistic service providers have attained this ability by applying higher levels of integrative mechanisms in their relationships with other service providers in stevedoring and shipping line sections. As shown in Figure 8.10, PrixCar can provide an integrated service through its associations and corporate ownership links with K-line and Qube. Patrick Autocare can also provide a seamless supply chain experience to its clients through its corporate ownership links with Asciano (Patrick), NYK and MOL. In addition to these corporate ownership links, they have contractual and operational links, and their information sharing is at a high-level, enabling access to the real-time information through an integrated IT system that allows the clients to monitor the status and movement of the car during its transportation and processing.

However, using such integrated shore to door services also depends on the logistic service providers that are contracted by the car manufacturers and car importers for the shipment of the car. For example, not all cars that proceed through PrixCar have arrived through Qube and its contracted shipping lines (K-line, Glovis and WWL). Some of these cars might have come to PoM through other shipping lines such as NYK and its associate stevedoring Asciano (Patrick), and after arrival to the FPR zone at PoM they proceed through PrixCar (Figure 8.10). It is evident that because of the lack of long-term integrative mechanisms, such as contractual and corporate ownership links, and real-time information exchange between PrixCar with Asciano and its associates (NYK), the cars that come through these paths will not go through a completely seamless transportation operation and the auto chain is partly integrated.

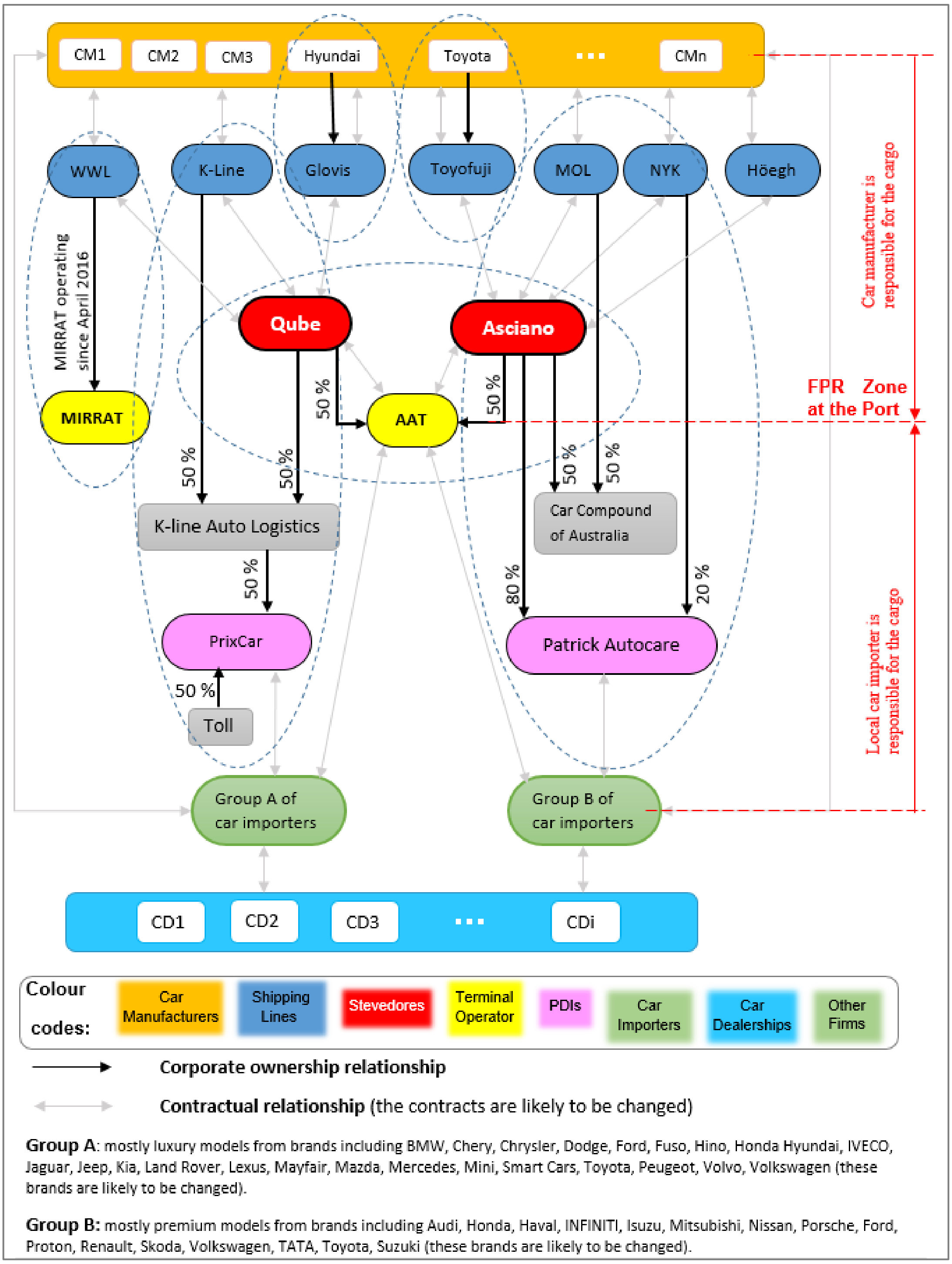

Figure 8.10. Auto chain underlying architecture model including corporate ownership and contractual relationships.
Note 1: The corporate ownership relationships are valid from 2014 to August 2016.
Note 2: 'i' represents the number of car dealerships and 'n' represents the number of car manufacturers.
Note 3: FPR zone is the place in the automotive port-terminal where the responsibility of the cargo changes from car manufacturer to the car importer.

The conceptual framework of this study suggested there are five different types of integrative mechanisms used by firms. Although the auto chain is not a completely integrated chain, the research findings show that different levels and mechanisms of integration, including operational, contractual, corporate ownership, and information sharing, have been used in the auto chain. The details of these integrative mechanisms were explained in earlier empirical chapters.

Those firms that have used more integrative mechanisms in the auto chain have better integration and competitiveness compared with those participants that have applied less integrative mechanisms.

In addition to the abovementioned mechanisms and as explained in chapter six, a regulatory mechanism was applied by the regulator in the port section of the auto chain to prevent the fragmentation of the automotive terminal operations at PoM. Consolidation of automotive terminal operations at PoM was essential for operational efficiency whilst protecting and ensuring access to the terminal. This model was later repeated after the management and development of the WDW terminal was given to another company (MIRRAT) until 2040 under a strict regulatory framework and open access regime.

8.2.3 Does the dynamics of the auto chain follow a voluntary integrating regime (internally) or a regulated integrating regime (externally)?

The conceptual framework (Figure 8.7) represented possible models for achieving an integrated supply chain network. According to this conceptual framework, a whole-of-chain integration is either imposed on the chain by an external firm such as a regulator (as occurred in both coal export chains over a short period by giving authorisation to the coal terminal operator to act as a channel master), or adopted voluntarily through the internal cooperation of all chain members (as occurred in the HVCC after authorisation to the coal terminal operator was expired and participants continued the CDS voluntarily).

This research in the auto chain could not find any single entity such as the terminal operator controlling the whole chain. Although the authorisation was given to AAT and later to MIRRAT as the automotive terminal operator in the auto chain, the purpose of their authorisation was not to impose control and management over the whole chain as occurred in the coal chains. In fact, the purpose of authorisation was to grant immunity from legal action for breaching the Trade Practices Act 1974, by engaging in anti-competitive conduct such as consolidating the automotive terminals at PoM and acting as a sole terminal operator. As noted in chapter six, the reason authorisations were granted was because the regulator (ACCC) reached the conclusion that the public benefit from this conduct outweighed any public detriment.

As noted above, the partial level of integration evident in the auto chain has been achieved by voluntary efforts of different chain components, such as car manufacturers, shipping lines, stevedores and PDI companies, to increase their competitive position within the chain, and to increase their captured value from the chain by improving operational efficiency of the chain.

8.3 Discussion

In this section, the similarities and differences of coal chains and the auto chain will be discussed to establish consistency and applicability of the conceptual framework into the auto chain.

8.3.1 How was integration achieved in the coal chains compared with the auto chain?

In the coal chain, the integration was achieved through a single intelligence model imposed by the regulator (ACCC) to transform the operational system of the coal chain from a supply-push model to a demand-pull model, which reduced ship queues. By linking coal and ship arrival at the terminal, the bottleneck in the system (that is, long ship queues) was eliminated, smoothing the operation of coal arrival from the mine, rail and stockpile to the terminal and ship arrival. Linking these elements improved the efficiency of the whole chain.

The coal chain case studies indicated greater efficiency when the chain was under the control of a single operator; in both cases the controlling mechanism was initially the terminal operators.

While there is no evidence of a single operator in control of the auto chain, there is an abundance of evidence indicating that alliances and control over parts of the chain is becoming increasingly the business strategy and objective of many operators. Car manufacturers, for example, are extending their operations into shipping and stevedoring, and shipping lines are seeking long-term business links with landside logistic providers in the auto chain.

8.3.2 The role of the regulator in coal chains and auto chain

One of the important issues that has been neglected in many chain analyses was the role of policy makers and regulations on the integration and efficiency level of the chain systems.

> A chain system is a set of interdependent functions delivered by firms or agencies; firms exist to derive revenues and ideally profits and rents on a sustainable basis; and sustainability may require outcomes that are socially equitable and efficient - which may involve legislation, public policy and regulatory oversight (Robinson 2013, p.2).

That is why supply chain operations may require regulatory supervision and control. The role of such regulatory organisations was one of the investigating issues in this study because the regulator had a significant role in both coal and auto chains.

In the coal chains, the change of operational models from supply-push to demand-pull was not possible without regulatory approval as it contravened trade practices legislation. In both coal chains, authorisation was granted by the regulator (ACCC) to the terminal operator to act as the channel master and match the arrival of the ships with the availability of the coal at the port, eliminating the chain's bottleneck and integrating and smoothing the chain operations and functions. These authorisations to improve chain efficiency were conditional on regulatory approval and ongoing oversight.

The involvement of the regulator in the coal chains was significant as it could impose efficiency over the chain. However, although the regulator's involvement was critical in the auto chain, its function was different, seeking to prevent the abuse of monopoly power. As discussed in chapter six, AAT was the facility manager of three automotive terminals at PoM for the exclusive use of its shareholders (Patrick and Qube). Following the ACCC-initiated legal action in the Federal Court against AAT and its shareholders, the exclusivity of the AAT access was abolished and the terminals transformed into common user operation, while remaining consolidated terminals operated by AAT. In this case, the regulator found that a consolidated automotive terminal model could yield efficient outcomes, capturing economies of scale by efficient utilisation of the available terminal space and assets. A major difference in the revised AAT model from the earlier AAT model was the fact that it was not exclusively for the use of its owners. This model was later repeated by ACCC after the management and development of the only automotive terminal at PoM was given to another company (MIRRAT) until 2040 under a strict regulatory framework and open access regime.

8.3.3 The extent of consistency and applicability of the conceptual framework into the auto chain

The conceptual framework presents possible models for integration of a chain. Some of the principles for integration in the conceptual framework have been consistent and applicable with the auto chain case study. For example, although the auto chain compared with the HVCC is a partially integrated chain, voluntary based integrative mechanisms have been recognised in both chains. Furthermore, various levels of integrative mechanisms (from information sharing links to corporate ownership links) have been used by different players in the auto chain which are similar to the voluntary based integrative mechanisms used in the HVCC.

In the coal chains, the bottleneck was at the port-terminal which was unable to coincide coal and ship arrival, creating congestion at the terminal. In the auto chain, the problem was not congestion at the terminal, but rather the poor utilisation and management of the limited automotive terminal space that was not able to provide a single on-wharf value-added and processing platform for the increasing number of imported motor vehicles. As such, the inefficiency at the port-terminals in PoM at some stages caused inefficiency in the delivery time, adding to the delivery cost of importing vehicles from the port-terminals to the dealerships and preventing a seamless logistic experience for the arrival of motor vehicles.

A regulatory integrative mechanism was used and set in place in all cases (both coal and auto chains) by the ACCC to the port-terminal operator. Although the purpose of authorisation in the coal chains was different with the auto chain, authorisation helped in improving efficiency of the port-terminal function and meant fewer bottlenecks in the chains.

In addition, in all three chains the principles of the rationalisation diagram (Figure 8.9) are applicable, and the degree of rationalisation in both landslide and seaside corporate structures increases as firms seek to achieve economies of scale, scope and network density and integrity.

8.4 Findings

The findings of this research confirm the results of other researchers in the context of SCI and particularly in port-oriented supply chains. The findings are as follows:

8.4.1 An integrated chain tends to be more efficient regardless of how the integration is achieved

As discussed in the literature review, the relationship between 'chain integration' and 'chain efficiency' has been investigated in many studies. The majority of the research supports the positive correlation between the 'chain integration' and its 'efficiency'. This positive correlation for the bulk freight chains has been demonstrated by Robinson (2002) in Figure 8.9. According to this figure, as freight volume increases, the level of rationalisation and functional integration in both landside and seaside sections of the chain increases, as chain participants seek economies of scale as well as economies of scope (Robinson 2002, p.249). As a result of significant rationalisation and underlying modification of different functions across the chain, the efficiency of the chain tends to increase. The findings of this research support this fact as well. For example, in the HVCC (before imposing the regulatory control to integrate the chain), the available coal at the terminal was not necessarily linked with ship arrival. The mismatch of functions and timings of chain players caused a long queue of ships waiting to load coal at the port-terminal which resulted in major delays in the chain operation and high demurrage costs. However, later and as a result of the internal cooperation of all mining companies and other chain players, the HVCC coordinator was established to control all of the individual chain functions in order to increase the integration and efficiency across the whole chain. As a result, the coal chain became efficient when the coal and ship arrival coincided. Such an arrangement resembles a chain model in which the wider scope of chain functions is performed and controlled by one player.

Although having a single organisation in charge of all chain functions might not be a realistic model for every chain, a similar concept can be recognised in chains with a high level of cross-functional integration, such as corporate alliances, contractual or joint ventures, to smooth or eliminate bottlenecks within the chain. These joint ventures and collaborations are important mechanisms controlling significant areas of the chain and enhancing efficiency with the likely reduction or abolition of bottlenecks. Similar patterns of cross-functional integration can be recognised in the auto chain. Although the auto chain does not resemble a fully integrated chain since no integrated direct link between a car manufacturer and the local dealerships can be found, there is a distinct indirect link between manufacturers, PDIs and land based operators with the dealerships.

These indirect links reflect partial integration in the form of corporate ownership links between different logistic service providers within the chain, such as shipping lines, stevedores and PDIs, to expand their control of the chain under their own control in order to achieve enhanced efficiency.

8.4.2 Chains with demand-pull operational models are inherently more integrated

Previous research by Robinson (2010) in the context of port-oriented freight chains suggested that chains with a demand-pull operational model are inherently more integrated and efficient compared with chains with supply-push models. According to this view, the operational model of a chain not only influences the business strategies of individual chain members, but will also impact on the underlying architecture and dynamics of a chain, as well as integrative or disintegrative strategies within the chain.

The finding of this research confirms this recognition. In both coal chains and the auto chain, the shift to the demand-pull operational model resulted in greater efficiency. In a chain under a demand-pull model, functions and capacity will match the actual demand, and there will be less potential for bottlenecks in the system compared with the supply-push model.

In both coal chains, after the authorisation was granted to the terminal operators, the operational model of the chain changed from supply-push to demand-pull, which resulted in the elimination of bottlenecks and congestion in the chain, as coal was sent to the port to coincide with ship arrival. Consequently, under this new chain model, a wider scope of operational functions was being controlled and coordinated by a single entity which resulted in a more integrated and efficient chain.

The automotive manufacturing chain, like the earlier coal chain, was initially a supply-push model. The change from supply-push to demand-pull, despite happening gradually over the last 50 years as explained in chapter four, improved the efficiency of the car manufacturing supply chain, avoiding high inventory cost, overcapacity, and inefficient utilisation of resources.

8.4.3 Consistency and applicability of the conceptual framework into other port-oriented chains

The conceptual framework was based on the two coal case studies, claiming two models for achieving an integrated chain in a port-oriented chain (voluntary based or externally imposed). As discussed above, testing the proposed conceptual framework on the auto chain reveals that the principles of integration and efficiencies are similar in the auto chain to those of the coal chains, despite the differences that exist between these two freight chains in terms of the nature of the commodity they deliver, their chain construct, and parties that are involved.

In addition, one of the motivations of this research was to provide an applicable solution for making chains more integrated and efficient by investigating the real-world case studies (coal chains and auto chains) and the strategies and mechanisms that are used by different firms in these chains for achieving better integration and efficiency. The investigations recognised five integrating mechanisms that were used in these chains in different levels and scopes. These mechanisms might be applicable in other port-oriented chains, depending on the underlying business dynamics and construct of those chains.

8.5 Conclusion

This research has focused on integrated supply chains for automobile imports through the port of Melbourne. It has argued that integrated chains tend to be efficient chains because fewer companies or conglomerates operate the chain and there is less likelihood of functional mismatch between chain members and the development of bottlenecks.

This research adopted two coal chain models in which integration was initially imposed by the Australian government regulator. In one instance, integration was continued voluntarily by the operators once the regulatory constraints were removed, whilst in the other case, chain disintegration resumed once regulatory oversight was lifted. This thesis has adopted the principles of the two coal chain case studies and has applied those principles to the automotive import chain.

Chapter 9 Conclusion

Over the last 50 years, the car manufacturing industry and the automotive markets have been impacted by various issues. The car production industry that used to be in the hands of certain countries and brands is now a global industry. The traditional mass production strategy and supply-push operational model of car manufacturers have been replaced with mass customisation and a change to the demand-pull model. New opportunities due to free trade agreements and globalisation of trade, enabled car manufacturers to not only expand and penetrate new markets, but also to move their production sites to those regions with lower labour costs and emerging markets. However, besides the mass customisation strategies, these opportunities have made today's automotive market one of the most customer oriented markets in the lifetime of this industry, and has led to the migration of value to the downstream of the automotive supply chain. For these reasons, today's car manufacturers have a greater tendency to control the distribution side of their supply chain, in order to gain more value from the chain by increasing the efficiency and integration of the demand side of the auto chain.

For the car manufacturers in the Australian market, these issues are critical as the current automotive market is one of the most open and competitive markets in the world. Despite its relatively small size, it includes many varieties of passenger car brands and models. The competition between car manufacturers in Australia has intensified during the last three decades as federal government policy throughout these years has encouraged free competition between domestically produced vehicles and imported vehicles in order to improve their competitiveness in global markets. This competition reached its peak in the last couple of years, forcing Australian domestic car producers to cease production and close their production plants in Australia by the end of 2017, thus making Australia completely dependent on vehicle imports. The increasing volume of imported vehicles into Australia, in addition to the fierce competition in the domestic automotive market, has put additional pressure on the existing logistic infrastructure to efficiently handle, process and transport these excessive volumes. As a result, the car manufacturers and their agents (car importers) in Australia are demanding more efficient and cost-effective vehicle processing and transportation from the different logistic service providers in this chain. The ports and automotive RoRo terminals as a strategic point between water and land transportation, and a logistic support platform for processing and value-added activities on imported vehicles, have come under significant pressure to improve their services and reduce costs by increasing their efficiency and competitiveness. Car dealerships, as the end customer of this chain, are also demanding a seamless logistic service and processing experience with the possibility of an online trace and track system for the vehicles from the PDI companies and other inland service providers. These issues, in addition to the pressure from statutory organisations to accept further social and environmental responsibilities in their operations, have created more challenges for the different participants in the auto import chain to Australia to look for solutions to overcome these challenges by making an integrated and efficient chain.

This research found the necessity to investigate the auto import chain through the PoM in terms of its efficiency and integration as a subset of auto import chains to Australia. Despite the importance of the automotive trade to the Australian economy and the fact that motor vehicles are the largest non-containerised commodities handled in Australian ports, no major study of the automobile import trade has been completed in Australia in terms of its integration and efficiency within a whole-of-chain context. Selecting this case study is expected to provide a useful contribution to the automotive industry in Australia and particularly the state of Victoria. This case study also aimed to identify the most effective integrating practices and strategies for chain members, influential policy makers, decision makers and regulators, in order to increase the integrative efficiency of the auto chain.

The comprehensive literature review in the context of SCI in the mainstream production based literature, as well as maritime research, indicated that despite the importance of increasing efficiency and a seamless transition between the place of production and the place of consumption, not many firms in different supply chains have been successful in achieving an efficient and integrated supply chain. In fact, research showed that many companies are failing to create integrated efficient chains and a whole chain integration is exceptional rather than routine. This research was particularly concerned, however, with finding examples of chain integration and efficiency in real-world port-oriented chains to investigate their related shipping linkages and the landside modal networks and operations that link suppliers and customers in these chains. In Australia, some of the bulk chains for natural resources, such as iron ore and coal, have been leaders in reaching and implementing an integrated chain.

This research examined the integration and efficiency of the auto chain against the conceptualisation that was extracted from the successful models/case studies of integrated coal export chains in eastern Australia (the Goonyella coal chain in Queensland and the HVCC in New South Wales), and a comprehensive literature review in production based chains as well as maritime-related chains. According to this conceptual framework, the integration of a whole-of-chain is either imposed externally by a regulator as it was the case in both coal export chains over a short period, or adopted voluntarily through the internal cooperation of all chain members, as occurred in the HVCC in order to maximise efficiency and increase value captured by the chain.

Three questions were designed to test the auto chain against this conceptualisation. The first question aimed to analyse the auto chain in terms of its efficiency and its levels of integration. The second question aimed to identify the integrating strategies adopted by different firms in an endeavour to seek increased control over the auto chain. The third question designed to find out whether these integrative strategies were adopted voluntarily or imposed by either the regulator or another external body.

The whole-of-chain construct analysis methodology developed by Robinson (2009) was used for detailed empirical work on the auto chain, including discussions with firms and key players in this chain.

The result of testing the auto chain against the conceptualisation extracted from the coal chains illustrated that the auto chain represents a partially integrated chain, and that the principles and integrating mechanisms recognised in the coal chain were to some extent applicable to the auto chain. In addition, the partial level of integration evident in the auto chain achieved by voluntary efforts of different chain players such as car manufacturers, shipping lines, stevedoring and PDI companies, to achieve economies of scope in order to gain more value from the chain.

The findings of the research provided suggestions about the efficient utilisation of available infrastructure to handle the increasing volume of imported vehicles. In addition, it highlighted the need for proper planning and investment to cope with the future volume of auto trade import to Australia, and to Melbourne in particular.

As discussed above, testing the conceptual framework on the auto chain revealed that the principles of integration and efficiencies are similar in the auto chain to those of the coal chains, despite the differences that exist between these two freight chains in terms of the nature of the commodity that they deliver, their chain construct, and the parties involved. Further research will demonstrate to what extent these conceptualisations are consistent with other port-oriented chains, and whether similar models for achieving an integrated chain can be recognised in other port-oriented chains.

This research also found five types of integrating strategies that are attractive to the players in auto chain and coal chains. The patterns and practises of these integrating mechanisms are similar in both coal and auto chain case studies. Further research and evidence is required to realise whether these principles and mechanisms are applicable to other port-oriented chains.

This research underlined the notion of whole-of-chain integration and the concept of the 'integrative efficiency' in port-oriented chains, and suggested applicable strategies and models for firms and policy makers participating in auto chain to improve the efficiency and integration of their chain system.

It also pointed to the critical need to understand the dynamics, principles and drivers that impact on the integration, efficiency and behaviour of the participants in different port-oriented chains. In addition, it reminded us that different port-oriented chains dependent on their functional structure, their operational model, the commodity or service that they deliver, the position of their firms within the market and within the chain, and their expected outcomes, need different sets of concepts about chain integration and efficiency compared with what has emerged from the mainstream logistics and supply chain literature for production based chains.

Another important implication of this research is the rich framework that it provides for chain analysis by revealing the underlying complexities, dynamics and architecture of relationships, market conditions and behaviours of players in an auto import chain. The construct analysis also demonstrated the unique position and role of statutory organisations, regulators and policy makers on the integration and efficiency of chains. As discussed in chapter six, some regulations can increase the integration and efficiency of a chain, while some other regulations can limit the extent of integration and efficiency within a chain.

Finally, it is expected that the results of this empirical case study will help to understand and develop the concept of chain integration and efficiency relationships with deeper insight, and will provide more applicable solutions to achieve SCI in other contexts.

References

"K" Line 2012, *Bridge to the future_"K" Line annual report 2012*, Kawasaki Kisen Kaisha, Ltd., viewed 15 May 2016, https://www.kline.co.jp/en/ir/library/annual/__icsFiles/afieldfile/2013/07/30/annual_2012_e.pdf.

"K" Line 2015, *Value for our next century_"K" Line report 2015*, Kawasaki Kisen Kaisha, Ltd., viewed 15 May 2016, http://www.kline.com/Corporate-Info/K-Line-2015-Annual-And-Social-And-Environmental-Report.pdf.

"K" Line (Australia) 2015, *Car Carriers Schedules*, K" Line (Australia) Pty. Ltd., viewed 2 February 2017, http://www.kline.com.au/schedules/car-schedules.

AAT 2009, *Australian Amalgamated Terminals Pty Limited (AAT) submission to Australian Competition and Consumer Commission: application for authorisation of AAT*, Australian Amalgamated Terminals Pty. Ltd., viewed September 2016, http://registers.accc.gov.au/content/trimFile.phtml?trimFileTitle=D09+61315.pdf&trimFileFromVersionId=1194138&trimFileName=D09+61315.pdf.

AAT 2014a, *AAT commences management of Appleton Dock – Port of Melbourne* Australian Amalgamated Terminals Pty. Ltd., Melbourne, 01 April, http://www.aat.auz.biz/News/AATRelease%20-%20Appleton%20April%201%202014.pdf.

AAT 2014b, *Welcome to Appleton Dock*, Australian Amalgamated Terminals Pty. Ltd., viewed 5 December 2014, http://www.aat.auz.biz/pages/location-appleton.aspx.

ACCC 2007, *ACCC institutes legal proceedings against stevedores and senior executives for alleged collusion*, Australian Competition and Consumer Commission, viewed 10 March 2013, https://www.accc.gov.au/media-release/accc-institutes-legal-proceedings-against-stevedores-and-senior-executives-for-alleged.

ACCC 2009, *Determination A91141-42, A91181-82 ii. The ACCC grants conditional authorisation to Australian Amalgamated Terminals Pty Limited (AAT).* Australian Competition and Consumer Commission, viewed November 2016, http://registers.accc.gov.au/content/trimFile.phtml?trimFileTitle=D09+191733.pdf&trimFileFromVersionId=1194138&trimFileName=D09+191733.pdf

ACCC 2014a, *ACCC will not oppose MIRRAT proposed acquisition of lease to operate automotive terminal at Port of Melbourne*, Australian Competition and Consumer

Commission, viewed 7 May 2015, https://www.accc.gov.au/media-release/accc-will-not-oppose-mirrat-proposed-acquisition-of-lease-to-operate-automotive-terminal-at-port-of-melbourne.

ACCC 2014b, *Public competition assessment: Melbourne International RoRo & Auto Terminal Pty Ltd proposed acquisition of a long term lease to operate the Webb Dock West automotive terminal at the Port of Melbourne*, Australian Competition and Consumer Commission, viewed October 2016, Retrived file no.MER14+7895 from http://registers.accc.gov.au/content/index.phtml/itemId/1160755/fromItemId/751046.

ACCC 2014c, *Section 87B of the Competition & Consumer Act*, Australian Competition and Consumer Commission, viewed 20 December 2016, https://www.accc.gov.au/publications/section-87b-of-the-competition-consumer-act.

Alfalla-Luque, R, Medina-Lopez, C & Dey, PK 2012, 'Supply chain integration framework using literature review', *Production Planning & Control*, pp. 1-18.

Alfalla-Luque, R, Medina-Lopez, C & Schrage, H 2012, 'A study of supply chain integration in the aeronautics sector', *Production Planning & Control*, pp. 1-16.

Almotairi, B & Lumsden, K 2009, 'Port logistics platform integration in supply chain management', *International Journal of Shipping and Transport Logistics*, vol. 1, no. 2, pp. 194-210.

Asciano 2015, *Annual report 2015*, Asciano, viewed January 2016, http://asciano2015.reportonline.com.au/annual-report-2015/operating-and-financial-review/divisional-performance/patrick-bulk-and-automative.

Asciano 2016, *Welcome*, Asciano, viewed 14 November 2016, https://asciano.com.au/.

Australian Bureau of Statistics 2016a, *International trade in goods and services, Australia, 'Table 34. merchandise imports, balance of payments broad economic category, customs value', Excel time series spreadsheet, cat. no. 5368.0, Passenger motor vehicles, Seried ID. A1829736F*, ABS, viewed November 2016, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5368.0Nov%202016?OpenDocument#Data.

Australian Bureau of Statistics 2016b, *Sales of new motor vehicles, Australia, Excel time series spreadsheet, cat no. 9314.0, Series ID. A367304A*, ABS, viewed August 2016, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/9314.0November%202016?OpenDocument.

Australian Department of Industry 2012, *Key automotive statistics 2012*, Australian Government, viewed February 2017, http://www.industry.gov.au/industry/IndustrySectors/automotive/Statistics/Documents/KeyAutomotiveStatistics2012.pdf.

Australian Science and Technology Heritage Centre 1988, *Technology in Australia, 1788-1988 : a condensed history of Australian technological innovation and adaptation during the first two hundred years*, Online 2000 edn, Australian Science and Technology Heritage Centre, Melbourne.

Berger, AJ & Gattorna, J 2001, *Supply chain cybermastery: building high performance supply chains of the future*, Gower Publishing, Ltd.

Brooks, MR, Schellinck, T & Pallis, AA 2011, 'A systematic approach for evaluating port effectiveness', *Maritime Policy & Management*, vol. 38, no. 3, pp. 315-34.

Butler, J 2016, *Ford has made its last car in Australia after a legendary 91-year run*, Huffington Post Australia, viewed 15 October 2016, http://www.huffingtonpost.com.au/2016/10/06/ford-has-made-its-last-car-in-australia-after-a-legendary-91-yea/.

Carbone, V & De Martino, M 2003b, 'LSPs in the automotive supply chain: a case study', *NOFOMA*, pp. 416-31.

Carbone, V & Martino, MD 2003a, 'The changing role of ports in supply-chain management: an empirical analysis', *Maritime Policy & Management*, vol. 30, no. 4, pp. 305-20.

Chandra, C & Kumar, S 2001, 'Enterprise architectural framework for supply- chain integration', *Industrial Management & Data Systems*, vol. 101, no. 6, pp. 290-304.

Chen, I, Paulraj, A & Lado, A 2004, 'Strategic purchasing, supply management, and firm performance', *Journal of Operations Management*, vol. 22, no. 5, pp. 505-23.

Childerhouse, P, Deakins, E, Böhme, T, Towill, DR, Disney, SM & Banomyong, R 2011, 'Supply chain integration: an international comparison of maturity', *Asia Pacific Journal of Marketing and Logistics*, vol. 23, no. 4, pp. 531-52.

Childerhouse, P, Disney, SM & Towill, DR 2004, 'Tailored toolkit to enable seamless supply chains', *International Journal of Production Research*, vol. 42, no. 17, pp. 3627-46.

Childerhouse, P & Towill, DR 2011, 'Arcs of supply chain integration', *International Journal of Production Research*, vol. 49, no. 24, pp. 7441-68.

Christopher, M & Ryals, LJ 2014, 'The supply chain becomes the demand chain', *Journal of business logistics*, vol. 35, no. 1, pp. 29-35.

Coia, A 2014, *Shipping focus: Capacity in the balance*, Ultima Media, viewed 13 April 2015, http://automotivelogistics.media/intelligence/shipping-focus-capacity-in-the-balance.

Cox, A, Ireland, P, Lonsdale, C, Sanderson, J & Watson, G 2002, *Supply chains, markets and power: mapping buyer and supplier power regimes*, Routledge, London.

Das, A, Narasimhan, R & Talluri, S 2006, 'Supplier integration- finding an optimal configuration', *Journal of Operations Management*, vol. 24, no. 5, pp. 563-82.

Department of Agriculture 2013, *New vehicle offshore pre-loading biosecurity risk guide* Australian Government, viewed 15 October 2015, http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/import/vehicles-machinery/newvehicle.pdf.

Department of Agriculture and Water Resources 2017, *Pratique*, Australian Government, viewed 13 March 2017, http://www.agriculture.gov.au/biosecurity/avm/vessels/human_health/vessel-pratique#what-time-periods-are-pratique--inspections-able-to-be-performed-eg-24-x-7-working-hours-other.

Department of Foreign Affairs and Trade 2016, *DFAT STARS Database/Australia's Total Vehicle Imports (2005 _ 2015)*, based on ABS Cat No. 5368.0 (unpublished), February 2016.

Dias, JQ, Calado, J & Mendonça, M 2010, 'The role of European «ro-ro» port terminals in the automotive supply chain management', *Journal of Transport Geography*, vol. 18, no. 1, pp. 116-24.

Ding, Q 2011, 'Interfirm alliance linkages and knowledge transfer: an exploratory analysis of mutual cooperative learning in an international joint venture in the Chinese automotive industry', Doctor of Philosophy (PhD) thesis, University of Waikato, http://hdl.handle.net/10289/5234.

Dowling, J 2017, *Holden last to turn out the lights on Australian car manufacturing after Toyota announces October 3 shutdown*, viewed 3 March 2017, http://www.news.com.au/finance/business/manufacturing/holden-last-to-turn-out-the-lights-on-australian-car-manufacturing-after-toyota-announces-october-3-shutdown/news-story/0f2e2b73bdb63064b7545a23ea037dbb.

Eisenhardt, KM 2002, 'Building theories from case study research', in MA Huberman & MB Miles (eds), *The qualitative researcher's companion*, SAGE Publications, Inc., Thousand Oaks, CA, pp. 4-36.

Eisenhardt, KM & Graebner, ME 2007, 'Theory building from cases: opportunities and challenges', *The Academy of Management Journal*, vol. 50, no. 1, pp. 25-32.

Ellram, LM 1996, 'The use of the case study method in logistics research', *Journal of business logistics*, vol. 17, no. 2, pp. 93-138.

Everett, S 2003, 'Corporatization: a legislative framework for port inefficiencies', *Maritime Policy & Management*, vol. 30, no. 3, pp. 211-9.

Everett, S 2005, 'Policy making and planning for the port sector: paradigms in conflict', *Maritime Policy & Management*, vol. 32, no. 4, pp. 347-62.

Everett, S 2007, 'Port reform in Australia: regulation constraints on efficiency', *Maritime Policy & Management*, vol. 34, no. 2, pp. 107-19.

Everett, S 2008, 'Public sector deregulation: a paradigm in conflict', *Maritime Policy & Management*, vol. 35, no. 4, pp. 341-51.

Everett, S & Pettitt, T 2006, 'Effective corporatization of ports is a function of effective legislation: legal issues in the existing paradigm', *Maritime Policy & Management*, vol. 33, no. 3, pp. 219-32.

Everett, S & Robinson, R 1998, 'Port reform in Australia: issues in the ownership debate', *Maritime Policy and Management*, vol. 25, no. 1, pp. 41-62.

Everett, S & Robinson, R 2006, 'Port reform: the Australian experience', *Research in Transportation Economics*, vol. 17, pp. 259-84.

Everett, S & Robinson, R 2007, 'Supply chain inefficiencies: regulation misdirected? an examination of Queensland's Dalrymple Bay Coal Terminal', *Public Infrastructure Bulletin*, vol. 1, no. 6.

Everett, S & Weston, R 2011, 'Ownership equity and efficiency: the case of Australian bulk ports', in *Handbook of Maritime Business*, Edward Elgar Publishers, pp. 305-30.

Fabbe-Costes, N & Jahre, M 2007, 'Supply chain integration improves performance: the Emperor's new suit?', *International Journal of Physical Distribution & Logistics Management*, vol. 37, no. 10, pp. 835-55.

Fabbe-Costes, N & Jahre, M 2008, 'Supply chain integration and performance: a review of the evidence', *The International Journal of Logistics Management*, vol. 19, no. 2, pp. 130-54.

Fawcett, SE & Magnan, GM 2002, 'The rhetoric and reality of supply chain integration', *International Journal of Physical Distribution & Logistics Management*, vol. 32, no. 5, pp. 339-61.

Federal Chamber of Automotive Industries 2009, *Submission to the inquiry into manufacturing in Victoria* Federal Chamber of Automotive Industries viewed September 2014, https://www.parliament.vic.gov.au/images/stories/committees/edic/submissions/VMI_Sub_58_FCAI.pdf.

Federal Chamber of Automotive Industries 2014a, *Annual report*, Federal Chamber of Automotive Industries, viewed July 2015, https://www.fcai.com.au/library/publication/2014_fcai_annual_report.pdf.

Federal Chamber of Automotive Industries 2014b, *Submission to the Productivity Commission's_Review of the Australian Automotive Manufacturing Industry*, Canberra, Australia, http://www.fcai.com.au/library/publication/FCAI%20submission%20to%20the%20PC's%20review%20of%20the%20Australian%20automotive%20manufact....pdf.

Federal Chamber of Automotive Industries 2016, *Vehicle price and specification comparison*, Federal Chamber of Automotive Industries, viewed 30 September 2016, http://www.fcai.com.au/specification.

Flynn, BB, Huo, B & Zhao, X 2010, 'The impact of supply chain integration on performance: A contingency and configuration approach', *Journal of Operations Management*, vol. 28, no. 1, pp. 58-71.

Frohlich, MT & Westbrook, R 2001, 'Arcs of integration: an international study of supply chain strategies', *Journal of Operations Management*, vol. 19, no. 2, pp. 185-200.

Fujimoto, T 2014, 'The long tail of the auto industry life cycle', *Journal of Product Innovation Management*, vol. 31, no. 1, pp. 8-16.

Fuller, G 2012, '" V8's 'til '98" The V8 engine, Australian nationalism and automobility', *Global Media Journal: Australian Edition*, vol. 6, no. 1.

Gerring, J 2004, 'What is a case study and what is it good for?', *American political science review*, vol. 98, no. 02, pp. 341-54.

Gerring, J 2006, *Case study research: Principles and practices*, Cambridge University Press.

Gibbert, M, Ruigrok, W & Wicki, B 2008, 'What passes as a rigorous case study?', *Strategic Management Journal*, vol. 29, no. 13, pp. 1465-74.

Golicic, SL & Mentzer, JT 2005, 'Exploring the drivers of interorganizational relationship magnitude', *Journal of business logistics*, vol. 26, no. 2, pp. 47-71.

Greenwald, BC & Kahn, J 2005, *Competition demystified: a radically simplified approach to business strategy*, Penguin.

Griffiths, E 2013, *Holden to cease manufacturing operations in Australia in 2017*, ABC News, viewed 2 February 2014, http://www.abc.net.au/news/2013-12-11/holden-to-cease-manufacturing-operations-in-australia-by-2017/5150034.

Güttner, A & Sommer-Dittrich, T 2008, 'Current issues at OEMs and suppliers', in *Build To Order*, Springer, pp. 55-73.

Hall , PV & Olivier, D 2005, 'Inter-firm relationships and shipping services: the case of car carriers and automobile importers to the United States', *Maritime Policy & Management*, vol. 32, no. 3, pp. 279-95.

Hancock, DR & Algozzine, B 2006, *Doing case study research: A practical guide for beginning researchers*, Teachers College Press.

Hass, DC 2013, *Protectionism and the Australian automotive industry 1896 to 2012 - a timeline*, viewed 4 January 2017, http://onfourwheels.blogspot.com.au/2013/02/protectionism-and-australian-automotive.html.

Hawthrone, M 2014, *Toyota to exit Australia, 30,000 jobs could go*, The Sydney Morning Herald, viewed 15 February 2014, http://www.smh.com.au/business/toyota-to-exit-australia-30000-jobs-could-go-20140210-32cl3.html.

Höegh Autoliners 2017, *Trade routes*, Höegh Autoliners, viewed 2 February 2017, http://www.hoeghautoliners.com./site/0/trade-routes.

Holsti, OR 1969, 'Content analysis for the social sciences and humanities'.

Holweg, M 2008, 'The evolution of competition in the automotive industry', in G Parry & A Graves (eds), *Build To Order*, Springer, pp. 13-34.

Holweg, M & Pil, FK 2004, *The second century : reconnecting customer and value chain through build-to-order: Moving beyond mass and lean production in the auto industry*, The MIT Press, Cambridge, Mass.

Hosoda, T & Disney, SM 2006, 'The governing dynamics of supply chains: The impact of altruistic behaviour', *Automatica*, vol. 42, no. 8, pp. 1301-9.

Huang, M-C, Yen, G-F & Liu, T-C 2014, 'Reexamining supply chain integration and the supplier's performance relationships under uncertainty', *Supply Chain Management: An International Journal*, vol. 19, no. 1, pp. 64-78.

Huo, B, Qi, Y, Wang, Z & Zhao, X 2014, 'The impact of supply chain integration on firm performance: The moderating role of competitive strategy', *Supply Chain Management: An International Journal*, vol. 19, no. 4, pp. 369-84.

Hyndai Glovis 2014a, *History*, Hyndai Glovis Co., Ltd., viewed 25 February 2017, http://www.glovis.net/Eng/AboutGLOVIS/CorporateHistory/History.aspx?year=2005.

Hyndai Glovis 2014b, *Shipping*, Hyndai Glovis Co. Ltd., viewed 2 February 2017, http://www.glovis.net/eng/aboutbusiness/businessscope/Shipping-FinishedVehicle-ServiceRoutes.aspx#nationinfo07.

Industry Commission 1990, *The automotive industry, report no.5*, Australian Government, viewed January 2014, http://www.pc.gov.au/inquiries/completed/automotive-1990/05automotive.pdf.

Jayaram, J & Tan, K-C 2010, 'Supply chain integration with third-party logistics providers', *International Journal of Production Economics*, vol. 125, no. 2, pp. 262-71.

Jayaram, J, Tan, K-C & Nachiappan, S 2010, 'Examining the interrelationships between supply chain integration scope and supply chain management efforts', *International Journal of Production Research*, vol. 48, no. 22, pp. 6837-57.

Krippendorff, K 2004, *Content analysis: an introduction to its methodology*, Sage.

Lai, K-H, Ngai, E & Cheng, T 2004, 'An empirical study of supply chain performance in transport logistics', *International Journal of Production Economics*, vol. 87, no. 3, pp. 321-31.

Lam, JSL 2010, 'Synchronisation of seaborne cold chains', *International handbook of maritime business*, p. 68.

Lam, JSL & van de Voorde, E 2011, 'Scenario analysis for supply chain integration in container shipping', *Maritime Policy & Management*, vol. 38, no. 7, pp. 705-25.

Lambert, DM 2001, 'The supply chain management and logistics controversy', in Ann M. Brewer, Kenneth J. Button & David A. Hensher (eds), *Handbook of logistics and supply-chain management*, 1st edn, Amsterdam ; London : Pergamon, pp. 99-126.

Li, L, Zhang, L & Willamowska-Korsak, M 2014, 'The effects of collaboration on build-to-order supply chains: with a comparison of BTO, MTO, and MTS', *Information Technology and Management*, vol. 15, no. 2, pp. 69-79.

M. Beheshti, H, Oghazi, P, Mostaghel, R & Hultman, M 2014, 'Supply chain integration and firm performance: An empirical study of Swedish manufacturing firms', *Competitiveness Review*, vol. 24, no. 1, pp. 20-31.

Magala, M & Sammons, A 2008, 'A new approach to port choice modelling', *Maritime Economics & Logistics*, vol. 10, no. 1, pp. 9-34.

Maggi, E & Mariotti, I 2010, 'Logistics FDI in Italy: integration strategies and motivations', *European Transport Research Review*, vol. 2, no. 1, pp. 13-24.

Maloni, MJ & Carter, CR 2006, 'Opportunities for research in third-party logistics', *Transportation Journal*, pp. 23-38.

Marasco, A 2008, 'Third-party logistics: a literature review', *International Journal of Production Economics*, vol. 113, no. 1, pp. 127-47.

Maxton, GP & Wormald, J 2004, *Time for a model change : re-engineering the global automotive industry*, Cambridge University Press, Cambridge, GBR.

Mellat-Parast, M & E. Spillan, J 2014, 'Logistics and supply chain process integration as a source of competitive advantage: An empirical analysis', *The International Journal of Logistics Management*, vol. 25, no. 2, pp. 289-314.

Mendonça, MC & Dias, JQ 2007, '‘Postponement’ in the logistical systems of new automobiles marketed in Portugal: the brands and quality', *Total Quality Management*, vol. 18, no. 6, pp. 681-96.

Mentzer, JT & Flint, DJ 1997, 'Validity in logistics research', *Journal of business logistics*, vol. 18, no. 1, p. 199.

Merriam, SB 2009, 'Qualitative research: a guide to design and implementation: revised and expanded from qualitative research and case study applications in education', *San Francisco: Jossey-Bass*.

Meyr, H 2004, 'Supply chain planning in the German automotive industry', *OR Spectrum*, vol. 26, no. 4.

MIRRAT 2017a, *MIRRAT's site map*, Melbourne International RORO & Auto Terminal Pty Ltd, viewed 14 January 2017, http://www.mirrat.com.au/notice-board/mirrat-site-map/#.WLD1_jt95PZ.

MIRRAT 2017b, *MIRRAT announced as winner of bid to operate Melbourne Auto Terminal*, Melbourne International RORO & Auto Terminal Pty Ltd, viewed 14 January 2017, http://www.mirrat.com.au/notice-board/mirrat-announced-as-winner-of-bid-to-operate-melbourne-auto-terminal/#.WLDw6zt95PZ.

MIRRAT 2017c, *On site: MIRRAT*, Melbourne International RORO & Auto Terminal Pty Ltd, viewed 14 January 2017, http://www.mirrat.com.au/notice-board/one-top-notch-terminal/#.WLDxsDt95PY.

MIRRAT 2017d, *Seeing the whole picture*, Melbourne International RORO & Auto Terminal Pty Ltd, viewed 14 January 2017, http://www.mirrat.com.au/notice-board/seeing-the-whole-picture/#.WLDsITt95PZ.

Mitsui O.S.K. Lines 2017, *MOL ACE_Auto Carrier Express*, Mitsui O.S.K. Lines, viewed 2 February 2017, http://www.molroro.com/DisplayRouteMapDetails.aspx.

Mortensen, O & Lemoine, OW 2008, 'Integration between manufacturers and third party logistics providers?', *International Journal of Operations and Production Management*, vol. 28, no. 4, pp. 331-59.

Mustafa Kamal, M & Irani, Z 2014, 'Analysing supply chain integration through a systematic literature review: A normative perspective', *Supply Chain Management: An International Journal*, vol. 19, no. 5/6, pp. 523-57.

Narasimhan, R & Das, A 2001, 'The impact of purchasing integration and practices on manufacturing performance', *Journal of Operations Management*, vol. 19, no. 5, pp. 593-609.

Näslund, D 2002, 'Logistics needs qualitative research-especially action research', *International Journal of Physical Distribution & Logistics Management*, vol. 32, no. 5, pp. 321-38.

Näslund, D, Kale, R & Paulraj, A 2010, 'Action research in supply chain management—a framework for relevant and rigorous research', *Journal of business logistics*, vol. 31, no. 2, pp. 331-55.

Nassirnia, P & Robinson, R 2013, 'Supply chain integration and chain efficiency: the importance of changing perspective toward whole chain integration', *Journal of Applied Sciences and Engineering Management*, vol. 1, no. 1, pp. 13-23.

Notteboom, TE & Rodrigue, J-P 2005, 'Port regionalization: towards a new phase in port development', *Maritime Policy & Management*, vol. 32, no. 3, pp. 297-313.

Nuttall, S 2016, *2015 vehicle sales – trends in the Australian automotive market*, ACA Research, viewed 10 October 2016, http://www.acaresearch.com.au/australian-market-research-blog/2015-vehicle-sales-trends-in-the-australian-automotive-market.

NYK Group 2012, *NYK annual report 2012*, Nippon Yusen Kabushiki Kaisha viewed 8 September 2015, https://www.nyk.com/english/ir/library/nyk/pdf/2012.pdf.

NYK Group 2013, *NYK report 2013, financial, social and environmental performance*, Nippon Yusen Kabushiki Kaisha viewed 12 May 2016, https://www.nyk.com/english/ir/library/nyk/pdf/2015_nykreport_all.pdf.

NYK Group 2014, *NYK report 2014, financial, social and environmental performance*, Nippon Yusen Kabushiki Kaisha viewed 12 May 2016, https://www.nyk.com/english/ir/library/nyk/pdf/2014_nykreport_all.pdf.

NYK Group 2015, *NYK report 2015, financial, social and environmental performance*, Nippon Yusen Kabushiki Kaisha viewed 12 May 2016, https://www.nyk.com/english/ir/library/nyk/pdf/2015_nykreport_all.pdf.

NYK Group 2016, *NYK report 2016, financial, social and environmental performance*, Nippon Yusen Kabushiki Kaisha, viewed 27 February 2017, http://www.nyk.com/english/ir/library/nyk/pdf/2016_nykreport_all.pdf.

NYK RoRo 2016a, *From Europe & Mediterranean to south east Asia and Japan*, NYK Group, viewed 2 February 2017, http://www.nykroro.com/esea-service/esea-service.html.

NYK RoRo 2016b, *Trade maps*, NYK Group, viewed 2 February 2017, http://www.nykroro.com/customer/trade-maps.html.

O'Leary-Kelly, SW & Flores, BE 2002, 'The integration of manufacturing and marketing/sales decisions: impact on organizational performance', *Journal of Operations Management*, vol. 20, no. 3, pp. 221-40.

OICA 2004, *Statistics* The International Organization of Motor Vehicle Manufacturers, viewed 10 April 2016, http://www.oica.net/category/production-statistics/2004-statistics/.

OICA 2016, *2015 Production Statistics* International Organization of Motor Vehicle Manufacturers, viewed 10 October 2016, http://www.oica.net/category/production-statistics/.

Øvstebø, BO, Hvattum, LM & Fagerholt, K 2011, 'Optimization of stowage plans for RoRo ships', *Computers & Operations Research*, vol. 38, no. 10, pp. 1425-34.

Pacific National 2017, *Pacific national key milestones*, Pacific National, viewed 6 February 2017, https://pacificnational.com.au/p/history.

Pagell, M 2004, 'Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics', *Journal of Operations Management*, vol. 22, no. 5, pp. 459-87.

Palomero, S & Chalmeta, R 2014, 'A guide for supply chain integration in SMEs', *Production Planning & Control*, vol. 25, no. 5, pp. 372-400.

Parry, G & Graves, A 2008, *Build to order*, vol. 1, Springer.

Patrick Autocare n.d, *Australia's #1 choice*, Patrick Autocare, viewed 7 March 2017, http://www.patrickautocare.com.au/about-us/index.html.

Patrick Autocare n.d.-a, *About us: customers*, Patrick Autocare, viewed 10 May 2016, http://www.patrickautocare.com.au/about-us/customers.html.

Patrick Autocare n.d.-b, *Patrick Autocare*, Patrick Autocare, viewed 14 January 2017, http://www.patrickautocare.com.au/.

Patrick Autocare n.d.-c, *Patrick Autocare depot locations*, Patrick Autocare, viewed 14 January 2017, http://www.patrickautocare.com.au/move-my-car/depot-locations.html.

Poirier, CC 1999, *Advanced supply chain management: how to build a sustained competitive advantage*, Berrett-Koehler Publishers.

Port of Melbourne Corporation 2009, *Port development strategy 2035 vision*, Port of Melbourne Corporation, viewed December 2016, https://www.parliament.vic.gov.au/images/stories/committees/pomsc/Transcripts/port-devt-strategy-2035-vision.pdf.

Port of Melbourne Corporation 2011, *Automotive snapshot: expanding Melbourne's automotive capacity*, Port of Melbourne Corporation, viewed November 2015, retrieved from http://portcapacity.portofmelbourne.com/facilities-and-development/port-capacity-project/publications.

Port of Melbourne Corporation 2013, *Expanding Australia's economic gateway*, Port of Melbourne Corporation, Melbourne.

Port of Melbourne Corporation 2014a, *2013-14 Annual report*, Port of Melbourne Corporation, viewed March 2017, https://www.parliament.vic.gov.au/file_uploads/Port_of_Melbourne_CorporationAnnual_Report_2013-2014_h66GswKm.pdf.

Port of Melbourne Corporation 2014b, *Safety and environment management plan*, Port of Melbourne Corporation Melbourne http://www.youblisher.com/p/1311650-Port-of-Melb/.

Port of Melbourne Corporation 2015a, *2014-2015 Annual report*, Port of Melbourne Corporation, viewed October 2016, http://www.parliament.vic.gov.au/file_uploads/POMC_-_Annual_Report_2014-2015_LOW_RES_ZNfG7Cpn.pdf.

Port of Melbourne Corporation 2015b, *Port Information Guide* Port of Melbourne Corporation, viewed December 2015, http://www.portofmelbourne.com.au/publications/hmd-and-port-information-guide.

Ports Australia 2013a, *Commercial vessel calls: car carriers for 2012/2013*, Ports Australia, viewed November 2016, http://www.portsaustralia.com.au/aus-ports-industry/trade-statistics/?id=65&period=13.

Ports Australia 2013b, *Ports of Australia*, Ports Australia, viewed 16 June 2014, http://www.portsaustralia.com.au/assets/Uploads/Ports-Australia-map-Current-Web-PDF.pdf.

Prajogo, D & Olhager, J 2012, 'Supply chain integration and performance: the effects of long-term relationships, information technology and sharing, and logistics integration', *International Journal of Production Economics*, vol. 135, no. 1, pp. 514-22.

PrixCar 2016, *Our clients*, viewed 10 May 2016, http://www.prixcar.com.au/our-clients/.

PrixCar Transport Services Pty. Ltd. 2016a, *A brief history of Autotrans Express*, PrixCar Transport Services Pty. Ltd., viewed 13 January 2017, http://www.prixcartransport.com.au/company-news/prixcar-transport-services-pty-ltd-acquires-toll-autologistics-autotrans-express/.

PrixCar Transport Services Pty. Ltd. 2016b, *Shareholders of PrixCar*, PrixCar Transport Services Pty. Ltd., viewed 13 January 2017, http://www.prixcar.com.au/shareholders/.

PrixCar Transport Services Pty. Ltd. n.d.-a, *About PrixCar Transport*, PrixCar Transport Services Pty. Ltd., viewed 13 January 2017, http://www.prixcartransport.com.au/about-prixcar-transport/.

PrixCar Transport Services Pty. Ltd. n.d.-b, *Autotrans Express becomes PrixCar Transport*, PrixCar Transport Services Pty. Ltd., viewed 13 January 2017, http://www.prixcartransport.com.au/about-prixcar-transport/autotrans-express/.

PrixCar Transport Services Pty. Ltd. n.d.-c, *Getting to the PrixCar Transport Melbourne Depot*, PrixCar Transport Services Pty. Ltd., viewed 13 January 2017, http://www.prixcartransport.com.au/getting-to-the-prix-car-transport-melbourne-depot/.

Productivity Commission 2014, *Australia's automotive manufacturing industry- Inquiry report no.70*, Australian Government, viewed February 2015, http://www.pc.gov.au/inquiries/completed/automotive/report/automotive.pdf.

Qube 2016, *Qube annual report 2016*, Qube Holding Limited, viewed 6 September 2016, http://www.qube.com.au/downloads/announcements/Qube_Annual_Report_2016.pdf.

Qube 2017a, *About Qube*, Qube Holding Limited, viewed 15 January 2017, http://www.qube.com.au/about.

Qube 2017b, *About Qube history*, Qube Holding Limited, viewed 15 January 2017, http://www.qube.com.au/about/history.

Qube Logistics 2012, *Qube extends capability across automotive logistics supply chain*, Qube Logistics Holdings Ltd., Melbourne, 16 May 2012, http://www.qube.com.au/downloads/announcements/16_05_12_11_03_33_Qube_extends_capability_across_automotive_logistics_supply_chain.pdf.

Ramdas, K & Spekman, RE 2000, 'Chain or shackles: understanding what drives supply-chain performance', *Interfaces*, vol. 30, no. 4, pp. 3-21.

Reddy, R & Reddy, S 2001, *Supply chains to virtual integration*, McGraw Hill Professional.

Renault-Nissan Alliance Communications 2012, *Beyond platform sharing: the alliance's new approach to commonization*, 13 September, http://blog.alliance-renault-nissan.com/blog/beyond-platform-sharing-alliances-new-approach-commonization.

Renault-Nissan Alliance Communications 2016, *Timeline | The alliance case study*, Renault-Nissan Alliance Communications, viewed 13 September 2016, http://blog.alliance-renault-nissan.com/page/timeline.

Renault Nissan Alliance Facts and Figures 2013, viewed 11 September 2016, https://group.renault.com/wp-content/uploads/2014/05/bookletalliance2013_gb.pdf.

Reuters 2013, *Ford plans to shut its 2 plants in Australia*, The New York Times, http://www.nytimes.com/2013/05/24/business/global/ford-plans-to-shut-its-2-plants-in-australia.html.

Reve, T 1990, 'The firm as a nexus of internal and external contracts', in *The Theory of the Firm: Critical Perspectives on Business and Management*, pp. 310-34.

Robinson, R 2001, 'A third container terminal in the port of Melbourne: Critical issues'.

Robinson, R 2002, 'Ports as elements in value-driven chain systems: the new paradigm', *Maritime Policy & Management*, vol. 29, no. 3, pp. 241-55.

Robinson, R 2003, 'Port authorities: defining functionality within a value-driven chain paradigm', paper presented to IAME Conference, Busan.

Robinson, R 2004, 'Shipping networks, liner shipping strategies and competitive advantage: An analytical framework', paper presented to IAME Conference, Izmir.

Robinson, R 2006, 'Port-oriented landside logistics in Australian ports: a strategic framework', *Maritime Economics & Logistics*, vol. 8, no. 1, pp. 40-59.

Robinson, R 2007a, 'Efficiency in port-oriented supply chains: insight from Australia', paper presented to Global maritime and intermodal logistics conference, Singapore, December 2007.

Robinson, R 2007b, 'Regulating efficiency into port-oriented chain systems: export coal through the Dalrymple Bay Terminal, Australia', *Maritime Policy & Management*, vol. 34, no. 2, pp. 89-106.

Robinson, R 2008, 'Cooperative strategies and supply chain efficiency: export coal chain through Australian ports', paper presented to IAME Conference, Dalian.

Robinson, R 2009, *Chain system analysis: new thinking about supply chain efficiency*, Monograph Series in Chain System Analysis, Monograph 1, University of Melbourne Press, Melbourne.

Robinson, R 2010, 'Business models, supply chain efficiency and port efficiency: new strategic imperative', in K Cullinane (ed.), *Handbook of Maritime Business*, Edward Elgar Publishers, pp. 13-37.

Robinson, R 2013, 'Integration and efficiency in port-dependent supply chains: rethinking the fundamentals', paper presented to IAME Conference, Marseille, 3-5 July.

Robinson, R 2015, 'Cooperation strategies in port-oriented bulk supply chains: aligning concept and practice', *International Journal of Logistics Research and Applications*, vol. 18, no. 3, pp. 193-206.

Robinson, R, Weston, R & Everett, S 2012, 'Port-oriented supply chain integration : critical efficiency issues,' paper presented to IAME.

Romano, P 2003, 'Co-ordination and integration mechanisms to manage logistics processes across supply networks', *Journal of Purchasing and Supply Management*, vol. 9, no. 3, pp. 119-34.

Sehgal, B & Gorai, P 2012, *Platform strategy will shape future of OEMs: flexibility to drive growth*, Evalueserve

Singh, P, Smith, A & Sohal, A 2005, 'Strategic supply chain management issues in the automotive industry: an Australian perspective', *International Journal of Production Research*, vol. 43, no. 16, pp. 3375-99.

Smyrk, LV 2000, 'The political economy of, and modelling the demand for, Australian passenger motor vehicles', Doctor of Philosophy thesis, Victoria University of Technology.

Song, D-W & Panayides, PM 2008, 'Global supply chain and port/terminal: integration and competitiveness', *Maritime Policy & Management*, vol. 35, no. 1, pp. 73-87.

Statista 2016, *Number of cars produced worldwide 2015* Statista, viewed October 2016, https://www.statista.com/statistics/262747/worldwide-automobile-production-since-2000/.

Stevens, GC & Johnson, M 2016, 'Integrating the supply chain … 25 years on', *International Journal of Physical Distribution & Logistics Management*, vol. 46, no. 1, pp. 19-42.

Stevens, LCE & Vis, IFA 2016, 'Port supply chain integration: analyzing biofuel supply chains', *Maritime Policy & Management*, vol. 43, no. 3, pp. 261-79.

Stopford, M 2003, *Maritime economics*, Second Edition edn, Routledge.

Sweeney, E 2011, 'Supply chain integration: challenges and solutions'.

Swink, M, Narasimhan, R & Wang, C 2007, 'Managing beyond the factory walls: Effects of four types of strategic integration on manufacturing plant performance', *Journal of Operations Management*, vol. 25, no. 1, pp. 148-64.

Taylor, L 2016, *Australians to bypass car dealers and import directly from Japan and UK*, Guardian News and Media Limited, viewed 15 December 2016, https://www.theguardian.com/business/2016/feb/10/australians-to-bypass-car-dealers-and-import-directly-from-japan-and-uk.

Terjesen, S, Patel, PC & Sanders, NR 2012, 'Managing differentiation-integration duality in supply chain integration', *Decision Sciences*, vol. 43, no. 2, pp. 303-39.

The Allen Consulting Group 2013, *The strategic role of the Australian automotive manufacturing industry (prepared for the Federal Chamber of Automotive Industries)*, http://www.acilallen.com.au/cms_files/ACILAllen_FCAI_September2013.pdf.

The European Automobile Manufacturers' Association 2014, *The automobile industry pocket guide 2014-2015*, viewed March 2016, http://www.acea.be/uploads/publications/POCKET_GUIDE_2014-1.pdf.

The Sydney Morning Herald 3 July 2009, *Court fines Patrick, DP World $1.9m each*, The Sydney Morning Herald, viewed December 2016, http://www.smh.com.au//breaking-news-business/court-fines-patrick-dp-world-19m-each-20090703-d7e7.html.

Toll Group 2012a, *Completion of sale of vehicle distribution business*, Toll Holdings Limited., viewed 10 May 2016, http://www.tollgroup.com/asx-announcement/completion-of-sale-of-vehicle-distribution-business.

Toll group 2012b, *Toll restructure to combine vehicle distribution service with JV partner PrixCar*, Melbourne, 16 May 2012, http://www.qube.com.au/downloads/announcements/16_05_12_11_03_33_Qube_extends_capability_across_automotive_logistics_supply_chain.pdf.

Toll Holdings Limited 2017a, *Acquisitions*, Toll Holdings Limited, viewed 28 February 2017, http://www.tollgroup.com/acquisitions.

Toll Holdings Limited 2017b, *Milestones*, Toll Holdings Limited, viewed 20 January 2017, http://www.tollgroup.com/milestones.

Towill, DR 1997, 'The seamless supply chain-the predator's strategic advantage', *International Journal of Technology Management*, vol. 13, no. 1, pp. 37-56.

Toyofuji Shipping Co. n.d, *Oceania regular service*, Toyofuji Shipping Co. Ltd., viewed 25 February 2017, http://www.toyofuji.co.jp/english/works/kaigai/oceania.html.

Trace, K 2008, *Transport/ Port of Melbourne Authority*, The School of Historical & Philosophical Studies of Melbourne University, viewed May 2016, http://www.emelbourne.net.au/biogs/EM01163b.htm.

Trading Economics 2016, *Australia Imports*, Trading Economics, viewed October 2016, http://www.tradingeconomics.com/australia/imports.

Universal Cargo 2013, *Auto shipping: RoRo vs. Container - which is better?*, Universal Cargo Management., viewed 4 July 2016, http://www.universalcargo.com/auto-shipping-roro-vs-container-which-is-better/.

Van der Vaart, T & Van Donk, DP 2008, 'A critical review of survey-based research in supply chain integration', *International Journal of Production Economics*, vol. 111, no. 1, pp. 42-55.

Victoria Department of Environment, Land, Water and Planning, 2016, *Port of Melbourne Planning Scheme*, State Government of Victoria, viewed 6 November 2016, http://planningschemes.dpcd.vic.gov.au/schemes/combined-ordinances/PortOfMelbourne_PS_Ordinance.pdf.

Victoria Department of Transport 2011, *Relocating motor vehicle importing and exporting to the Port of Geelong*, State Government of Victoria, viewed July 2014, http://www.g21.com.au/sites/default/files/dmdocuments/PortofGeelong-FeasibilityDiscussionPaper.pdf.

Victoria Department of Treasury and Finance 2016, *Leasing the Port of Melbourne*, State Government of Victoria, viewed 23 November 2016, http://www.dtf.vic.gov.au/Infrastructure-Delivery/Leasing-the-Port-of-Melbourne.

Vijayasarathy, LR 2010, 'Supply integration: An investigation of its multi-dimensionality and relational antecedents', *International Journal of Production Economics*, vol. 124, no. 2, pp. 489-505.

Volkswagen 2015, 'Annual report 2015'.

Wallenius Wilhelmsen Logistics n.d, *Route maps*, Wallenius Wilhelmsen Logistics, viewed 2 February 2016, http://www.2wglobal.com/global-network/route-maps/route-maps-list/.

Wang, B, Childerhouse, P, Kang, Y, Huo, B & Mathrani, S 2016, 'Enablers of supply chain integration: Interpersonal and interorganizational relationship perspectives', *Industrial Management & Data Systems*, vol. 116, no. 4, pp. 838-55.

Wathne, E 2012, 'Cargo stowage planning in RoRo shipping: optimisation based naval architecture', Master degree thesis, Norwegian University of Science and Technology, http://www.diva-portal.org/smash/get/diva2:566111/FULLTEXT01.pdf.

Weston, R & Robinson, R 2008, 'Value migration and profit pools in port-oriented freight systems: the implications for new patterns of efficiency', *Maritime Policy & Management*, vol. 35, no. 3, pp. 253-70.

Whytcross, D 2015, *Automotive industry in Australia- IbisWorld industry report X0014*, viewed September 2015, retrieved from IbisWorld database.

Williams, M 2014a, *Ro-ro lines "living in denial since 2008"*, viewed 5 July 2016, http://automotivelogistics.media/news/ro-ro-lines-living-in-denial-since-2008.

Williams, M 2014b, *WWL wins bid to operate Webb Dock auto terminal*, Automotive Logistics, viewed 15 January 2016 2016, http://automotivelogistics.media/news/wwl-wins-bid-to-operate-webb-dock-auto-terminal.

Woo, S-H, Pettit, S & Beresford, AK 2011, 'Port evolution and performance in changing logistics environments', *Maritime Economics & Logistics*, vol. 13, no. 3, pp. 250-77.

Wu, T 2016, *Motor vehicle manufacturing in Australia- IbisWorld industry report C2311*, viewed January 2017, retrieved from IbisWorld database.

WWL 2017, *Company profile*, Wallenius Wilhelmsen Logistics, viewed 26 February 2017, http://www.2wglobal.com/about-us/wwl/company-profile/.

Xuan, X 2014, 'Evaluation of shipping finished automotive in multimodal containers: a marketing plan for shipping company', Master degree thesis, World Maritime University, http://commons.wmu.se/all_dissertations.

Yin, RK 1993, *Applications of case study research*, Applied social research methods, Sage Publication.

Yin, RK 2009, *Case study research: design and methods*, Fourth edn, Sage Publications.

Yu, W, Jacobs, MA, Salisbury, WD & Enns, H 2013, 'The effects of supply chain integration on customer satisfaction and financial performance: An organizational learning perspective', *International Journal of Production Economics*, vol. 146, no. 1, pp. 346-58.

Yunus, EN & Tadisina, SK 2016, 'Drivers of supply chain integration and the role of organizational culture: Empirical evidence from Indonesia', *Business Process Management Journal*, vol. 22, no. 1, pp. 89-115.

Zhao, X, Huo, B, Flynn, BB & Yeung, JHY 2008, 'The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain', *Journal of Operations Management*, vol. 26, no. 3, pp. 368-88.

Zikmund, WG 2003, *Business research methods*, Cincinnati, OH : Thomson/South-Western

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Appendix A

Please tick and explain the type of relationship between your company and the other players listed in the first column of this form.									
Chain Participants	**Name of the Firm**	Corporate ownership	Contractual	Operational	Statutory	Information sharing	Other relationships	No relation	Comment
Car Manufacturers									
Shipping Lines	WWL								
	Höegh								
	K-line								
	NYK								
	MOL								
	Toyofuji								
	Glovis								
Stevedores	Asciano (Patrick)								
	Qube								
PoM Authority									
Terminal Operator	AAT								
Customs									
AQIS									
PDI	PrixCar								
	Patrick Autocare								
Car Distributor									
Car Dealership									
Final Car User									

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Appendix B

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate

You are invited to participate in a research project entitled **Integration and Efficiency in Port Oriented Supply Chains: The Dynamics of the Automotive Import Chains through the Port of Melbourne.**

This project is being conducted by the student researcher Parisima Nassirnia as part of a PhD study at Victoria University under the supervision of Professor Ross Robinson from Victoria University.

Project explanation

This study is about the ways in which different firms participate in the automobile import chains through the port of Melbourne. In general, we are interested in the efficiency and integration of the finished Automobile import chain through the port of Melbourne. Therefore, the study will focus on integrating mechanisms; the importance of a cohesive statement of chain efficiency and its drivers; and a framework for defining, implementing and evaluating of integration for the whole of finished automobile chain through the port of Melbourne.

Basically, what we will be trying to do is to get some information from key informants involved in the Auto import chain about the role that their company plays in this chain, the functional procedures that they follow, the operational, contractual and corporate ownership relationships between their company and other different players in this chain such as manufacturers, shipping lines, importers and terminal operators.

What will I be asked to do?

The researcher would like to request an interview with you to find out answers to a series of semi-structured and open-ended descriptive questions basically associated with the Automobile import chains through the port of Melbourne, its operational structure, its corporate linkages and its contractual relationships. In addition, the researcher would like to view non-confidential brochures and reports in order to support the interview process. The interview will have duration of approximately one hour and researcher would like to audio-record the interview if you agree with that.

What will I gain from participating?

Your participation will greatly contribute to the existing body of academic knowledge about whole of chain integration and efficiency. More importantly, the emphasis on the whole-of-chain efficiency and the interdependencies between and among different components of the Automobile import chain will underline exceptional insights into the chain operational strengths and weaknesses that will be useful for the chain members to better manage their individual businesses within the chain.

Moreover, the ongoing discussion with the key players in the chain will ensure the transfer of ideas and the thesis findings will be made available to the industry to assist in their planning and operations.

How will the information I give be used?

Your involvement in the project is entirely voluntary and you are free to discontinue at any time, without any need to provide any reason or explanation. Any information or personal details gathered in the course of the study are confidential. No individual or organization will be identified to anyone other than the research team. Participants will be assigned a code that will be kept separate. All of the codes will be kept confidential and stored at Victoria University in a locked filing cabinet and/or password protected computer.

What are the potential risks of participating in this project?

There is no intention to reveal either the company name or the names of the particular individuals obtained from any interviews unless explicit approval is obtained. In addition, no information will be used that could be construed as negative toward any particular individual or company. Therefore, it is believed that there is no risk associated with your involvement in this study.

How will this project be conducted?

In this research context an empirical case study approach with conducting interview as a data gathering technique will be used to provide an appropriate and necessary format for detailed investigation of complex chain processes and chain relationships.

Prior to the interview, an email will be sent to you indicating the outline with the major questions to allow you time to reflect on the answers and to maximise the duration and the outcomes resulting from it. Once the interview is conducted and if you are willing to receive feedback, the transcription of the interview will be sent for your approval to avoid any misunderstanding or errors in the interview transcription.

Who is conducting the study?

Chief investigator contact details:

Professor Ross Robinson
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Contact number: 03 9919 7743

Any queries about your participation in this project may be directed to the Chief Investigator listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4781.

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CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study exploring the dynamics of the automobile import chain through the Port of Melbourne. This research is an in depth case study which involves the detailed process mapping of finished automobile import chain through the port of Melbourne; its operational, corporate and contract ownership structure and the role of power in driving integration in the chain. Your participation will greatly contribute to enhance the integration and efficiency of chains passing through the ports, particularly finished automotive logistics through the port of Melbourne.

CERTIFICATION BY SUBJECT

I, of

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study **Integration and Efficiency in Port Oriented Supply Chains: The Dynamics of the Automotive Import Chains through the Port of Melbourne**; being conducted at Victoria University by **Professor Ross Robinson**.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by **Ms. Parisima Nassirnia** and that I freely consent to participation involving the below mentioned procedures:

- The researcher would like to request an interview with a participant to find out answers to a series of semi-structured and open-ended descriptive questions basically associated with Automobile import chains through the port of Melbourne, its operational structure, its corporate linkages and its contractual relationships.
- In addition, the researcher would like to view the non-confidential company brochures and reports in order to support the interview process.
- This interview will have duration of approximately one hour and researcher would like to audio-record it if you agree to it.
- Any information that you provide during the interview will be treated as confidential and no individual person will be identified within the report. Records of participants' interviews will be assigned a code that will be kept separately. All of the codes will be kept confidential and stored at Victoria University in a locked filing cabinet and/or password protected computer.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

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I consent to:

• Audio-recording	YES	☐	NO	☐
• Receiving feedback	YES	☐	NO	☐

Signed: Date:

Any queries about your participation in this project may be directed to the researcher Professor Ross Robinson, email: ross.robinson@vu.edu.au, phone (3) 9919 7243. If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428