Impacts of Information Technology (IT) Systems on the Efficiency of Empty-Container Park Operations for the Port of Melbourne

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ABSTRACT

As disclosed by the Port of Melbourne Corporation in 2015, full import containers significantly outnumber full export containers in the port of Melbourne, indicating that the port has become a major import container location experiencing acute pressures to manage the disequilibrium in trade flows. The report further points to increased container volumes through the port of Melbourne over the decade 2005-2015 – an increase of 650,000 twenty-foot containers. This growth in port-related containerised volumes creates capacity constraints in landside transport infrastructures and container parks' facilities resulting from increased truck movements in and around the port of Melbourne.

As specified by the Australian Competition and Consumer Commission in 2011, these capacity constraints at container parks resulted from random truck arrivals patterns, which caused depots to alternate periods of low truck traffic activity with periods of excess demand that generated major delays. Also, transport carriers often arrived at container parks to be notified of the unavailability of stocks to attend to empty collections, that is, futile trips occurred on a regular basis.

In this line, previous industry studies had noted in as early as 2004 and 2005 the need to implement a vehicle booking system with a view to deliver superior visibility and thus operational gains for the empty-container supply chain in an effort to address the capacity challenges already experienced in and around the port of Melbourne.

This thesis examines the proposition that the adoption of information technology is central in integrating and thus streamlining container chain operations resulting in superior supply chain efficiency. For this purpose this research will explore, in a detailed case study, the adoption of the Containerchain portal by some of the empty-container parks in the port of Melbourne. In particular, this thesis seeks to shed light on the impacts this web-based application is having on the integration of chain activities and operational chain efficiency given differentiated empty-container parks and empty-container chains.

In this study we examine operational efficiency within the framework of the level of supply chain integration that varies between disintegration and high integration – in simple

terms, the greater the degree of supply chain integration, the greater the operational gains obtained across the chain. For the purpose of this study, operational efficiency is characterised by three attributes. Capacity management or the ability to allocate slots in the system so that truck moves are evenly distributed across the operating day is regarded to be the basic capability. A second level attribute is to effectively manage empty collections and returns in a paperless environment – which leads to reduced truck turnaround times by way of streamlining the gate-in and gate-out processes. And third and highest-level attribute identifies the ability to manage stocks – stock management, so as to ensure the availability of empty containers for collecting trucks – and by so doing, to eliminate futile trips.

A major conclusion of this study is that the proactive participation of the container park in the management of stocks, the provision of a setting free of paperwork as well as the introduction of capacity disciplines so as to regulate truck moves is key in achieving whole-of-chain operational efficiency. And this calls for the implementation of disciplined management measures by the container park in engaging chain members to exhibit integrative endeavours so that operational benefits are derived by way of effectively utilising the tools provided by this technology solution. This technology solution, thus, provides the platform for enhanced operational linkages between trading partners in terms of superior capacity and stock management practices as well as the provision of a paperless environment.

The results of this study suggest that this web-based software – the Containerchain portal – offers the means and capabilities to deliver integrated chains and streamlined operational efficiency across the chain; yet, reactive management behaviours by way of deficient forward operational planning, lax introduction of parameters in the system and over-tolerant approaches towards inefficient attitudes and expressions of self-interest seriously hinder higher levels of integration and integrative efficiency across the whole range of chain participants, giving rise to silo-oriented supply chains.

Student Declaration

"I, Teresa Lucia Gil-Campos, declare that the Master by Research thesis entitled Impacts of Information Technology (IT) Systems on the Efficiency of Empty-Container Park Operations for the Port of Melbourne is no more than 60,000 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".

[redacted]

Teresa Lucia Gil-Campos

November 2015

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX 1

LIST OF ABBREVIATIONS

AB	Assembly Bill
ACCC	Australian Competition and Consumer Commission
AQIS	Australian Quarantine and Inspection Service
BAHS	Business Activity Harmonisation Study
BITRE	Bureau of Infrastructure, Transport and Regional Economics
CAA	Carrier Access Arrangements
CBFCA	Customs Brokers & Forwarders Council of Australia
CPIS	Container Park Information System
CRA	Container Return Advice
CTO	Carrier Transport Operator
DAFF	Department of Agriculture, Fisheries and Forestry
ECP	Empty-Container Park
ECPWG	Empty-Container Park Working Group
EDI	Electronic Data Interchange
EDO	Electronic Delivery Order
EIDO	Electronic Import Delivery Order
EIR	Equipment Interchange Receipt
ELC	Enforcement Liaison Committee
ETA	Estimated Time of Arrival

FIFO	First In First Out
FMT	Forklift Mounted Terminal
GFC	Global Financial Crisis
ISO	International Standards Organisation
IT	Information Technology
IV&EWG	Information Visibility & Exchange Working Group
KPI	Key Performance Indicator
MCP	Melbourne Container Park
MoU	Memorandum of Understanding
MRS	Melbourne Reefer Services
MSIC	Maritime Security Identification Card
MT	Empty Container
OCS	Oceania Container Services
OH&S	Occupational Health and Safety
PCS	Port Community System
PDA	Personal Digital Assistant
PMC	Port Melbourne Containers
PoMC	Port of Melbourne Corporation
POWG	Container Park Operations Working Group
PRA	Pre-Receival Advice
SaaS	Software as a Service

SAL	Shipping Australia Limited
SMS	Short Message Service
SOH	Stock On Hand
TEU	Twenty-Foot Equivalent Unit
TOP	Truck Optimisation Plan
TWU	Transport Workers Union
UR	Under Repair
VBS	Vehicle Booking System
VCM	Victorian Container Management
VCY	Virtual Container Yard
VICTL	Victorian International Container Terminal Ltd
VKT	Vehicle Kilometres Travelled
VRFAC	Victorian Road Freight Advisory Council
VTA	Victorian Transport Association
WSC	Waiting Steam Clean

CHAPTER 1: INTRODUCTION

In view of the growth in port-related trade an increasing number of firms are seeking not only to integrate their internal operations but also to integrate with other supply chain members in an effort to generate performance gains. Information technology (IT) systems facilitate collaboration and the exchange of data that lead to operational and strategic efficiencies across the supply chain. Consequently, IT has acquired a leading role in orchestrating and integrating channel members in a supply chain network (Frohlich & Westbrook 2001; Gunasekaran & Ngai 2004).

Recent studies show that integrated IT (Vickery et al. 2003) and IT integration capabilities (Rai, Patnayakuni & Seth 2006) enhance supply chain integration which leads to superior firm performance. Consistent with these findings, Li et al. (2009), Dehning, Richardson and Zmud (2007) and Wamba (2012) added to previous knowledge by examining performance benefits derived from the adoption of technological solutions at the aggregate level of the entire supply chain. They found that IT acts as an enabler in achieving improved supply chain performance by coordinating organisations across the supply chain.

To date there have been a number of initiatives that have demonstrated the importance of introducing IT systems in order to streamline the operations of container parks and container terminals. The study conducted by Giuliano and O'Brien (2007) supports the notion that IT solutions can restructure and modernise container chain operations and deliver supply chain efficiency.

In an effort to test the proposition that the adoption of IT solutions can result in efficiency gains for the focal firm as well as for the entire supply chain this research will focus, in a detailed case study, on the recent implementation of the web-based Containerchain[1] IT application implemented by some of Melbourne's Empty-Container Parks (ECP). The following paragraphs note the context of, and the reasons for, this decision.

[1] Containerchain is a web-based application designed for the management of empty containers.

1.1 Trade imbalances in the port of Melbourne

The Port of Melbourne Corporation's *Annual Report 2013-2014* noted that the overall containerised freight task through the port of Melbourne for the financial year 2013-14 amounted to 2.53 million containers (Twenty-Foot Equivalent Units, TEUs), up 0.8% on the 2012-13 financial year. Further, full container exports increased 1.8% in 2013-2014 and full container imports showed a moderate decline of 0.2% while empty container volumes increased 1.4%. Also, the *Historical trade data* report issued by the Port of Melbourne Corporation (PoMC) further points to increased container volumes through the port of Melbourne over the decade 2005-2015 – an increase of 650,000 TEUs, which translates into a 34% growth in containerised trade traffic (Table 1.1).

Table 1.1 Container Traffic (TEUs) through the port of Melbourne 2006/2015

Total TEUs	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015
Loaded Import	872,665	948,783	1,050,504	980,415	1,034,743	1,090,222	1,167,132	1,134,667	1,132,789	1,171,645
Loaded Export	670,017	698,523	727,513	712,539	766,627	806,301	885,143	863,471	879,344	852,542
Empty Import	111,791	110,386	98,791	108,174	98,314	112,590	131,330	133,010	135,140	123,323
Empty Export	275,605	335,688	380,176	356,230	336,953	383,851	395,477	380,983	386,106	431,704
Total	1,930,078	2,093,380	2,256,984	2,157,358	2,236,637	2,392,964	2,579,082	2,512,131	2,533,379	2,579,214

Source: ***Historical trade data*, Port of Melbourne Corporation (2015)**

Note also that total empty containers (export plus import TEUs) increased from approximately 387,000 TEUs in 2006 to over 521,000 TEUs in 2015 – representing about 25% and 26% respectively of the annual containerised trade volumes. In effect, about one in four TEUs handled in the port was empty; and empty export containers outnumbered empty import containers by a factor, though variable of at least 2 or 3 to one.

Over a longer term of 20 years to 2032/33 the Bureau of Infrastructure, Transport and Regional Economics (BITRE) has predicted the port would handle total empty containers of 1.4 million TEUs – about 22% of the port's 6.4 million TEUs handled (Table 1.2).

Importantly, however, empty export containers would account for 1.18 million TEUs, five times the number of empty import containers (243,000 TEUs).

Clearly, the management of empty container flows is likely to be an ongoing problem for some time to come.

Table 1.2 Project Containerised Trade : port of Melbourne (BITRE 2014)

Year	EXPORTS			IMPORTS			TOTAL
	Full	Empty	Total	Full	Empty	Total	Trade
				('OOO EUs)			
1998–99	437	117	554	497	75	572	1126
2008–09	713	356	1069	980	108	1089	2157
2009–10	767	337	1104	1035	98	1133	2237
2010–11	806	384	1190	1090	113	1203	2393
2011–12	885	395	1281	1167	131	1298	2579
2012–13	863	381	1244	1135	133	1268	2512
2013–14	*879*	*386*	*1265*	*1132*	*135*	*1267*	*2533*
2014–15	*892*	*461*	*1352*	*1241*	*135*	*1377*	*2729*
2015–16	*934*	*486*	*1420*	*1310*	*136*	*1446*	*2866*
2016–17	*990*	*557*	*1547*	*1439*	*137*	*1576*	*3122*
2017–18	*1036*	*593*	*1629*	*1521*	*140*	*1660*	*3289*
2018–19	*1097*	*635*	*1732*	*1619*	*146*	*1765*	*3497*
2019–20	*1161*	*681*	*1842*	*1725*	*153*	*1878*	*3720*
2020–21	*1200*	*735*	*1936*	*1822*	*153*	*1974*	*3910*
2021–22	*1266*	*779*	*2045*	*1925*	*161*	*2086*	*4131*
2022–23	*1331*	*807*	*2138*	*2012*	*169*	*2181*	*4319*
2023–24	*1400*	*858*	*2258*	*2129*	*175*	*2304*	*4562*
2024–25	*1469*	*898*	*2367*	*2231*	*183*	*2414*	*4781*
2025–26	*1537*	*938*	*2475*	*2331*	*193*	*2524*	*4998*
2026–07	*1606*	*970*	*2575*	*2425*	*201*	*2626*	*5201*
2027–28	*1675*	*994*	*2669*	*2510*	*211*	*2721*	*5391*
2028–29	*1749*	*1019*	*2768*	*2600*	*221*	*2821*	*5589*
2029–30	*1824*	*1040*	*2865*	*2687*	*232*	*2919*	*5784*
2030–31	*1900*	*1071*	*2971*	*2785*	*242*	*3027*	*5997*
2031–32	*1979*	*1093*	*3072*	*2888*	*242*	*3130*	*6202*
2032–33	*1996*	*1180*	*3176*	*2995*	*243*	*3238*	*6415*

1.2 Capacity constraints in the port of Melbourne

In its *2012-2013 Containerised Trade (in TEU)* Statistics report, Ports Australia (2015) disclosed that in the port of Melbourne, full import containers totalled 1.13 TEUs while full export containers had a much lower total of 863,473 containers (TEUs). Additionally, the number of empty containers repositioned to overseas locations totalled 380,983 TEUs indicating that the port had become a major import container location experiencing acute pressures to manage the disequilibrium in trade flows. This has translated into inadequate depot capacities and inefficient freight transport movements linked to increased truck traffic in and around the port of Melbourne – and to delays, congestion, high vehicle emissions into the atmosphere and loss of operational efficiency.

These capacity challenges were made potentially more serious by the closure of a number of container parks in the past twenty years. The Port of Melbourne Corporation (2010) indicated that the number of container parks in 1992 reached twenty-eight while the current total is twelve – indicating significant changes in the industry and probably the critical importance of need for economies of scale.

Nonetheless, the entry of a new international container terminal at Webb Dock East by the end of 2016 will, in all likelihood, stimulate the competitiveness between stevedores, which, in turn, will give rise to enhanced port-related operational efficiency and, by extension, streamlined economic efficiency. The supply chain participants that will immediately benefit from this greater competition amongst stevedores are anticipated to be the shipping lines as they will be provided with greater bargaining power in the negotiations with the stevedores; however, these benefits are expected to flow through to cargo owners and the wider port-hinterland community by way of less costly imports and more competitive exports (ACCC 2014).

In May 2014, Victorian International Container Terminal Ltd (VICTL) was announced as the third stevedoring service in Melbourne. VICTL is a consortium comprising the Philippines-based International Container Terminal Services Inc. and Anglo Ports Pty Ltd. This new introduction will be crucial in delivering the much sought-after additional capacity so as to provide the port of Melbourne with the required infrastructure to handle the increased volumes of freight. This new terminal will be equipped to manage over 1 million TEUs annually; in addition, it will boost off-peak truck moves with the purpose of streamlining Victoria’s transport supply chain efficiency (PoMC 2015a).

1.3 Challenges faced in the empty-container supply chain

Empty-container parks play a critical role in ports with an imbalance of trade, as is the case for the port of Melbourne and all other metropolitan ports in Australia; and in 2011, the Australian Competition and Consumer Commission (ACCC 2011) underlined the challenges that container parks faced. It noted first, that trucks arrived at irregular intervals, which caused container parks to alternate periods of no activity with periods of excess demand that generated queues. These lengthy truck queues at container parks’ gates and operational delays generated congestion which, in turn, posed a serious problem for container parks as it hindered their obligation as ‘loading managers’ to manage heavy vehicle driver fatigue in accordance with the Chain of Responsibility Legislation which stipulates that truck turnaround times cannot exceed a thirty-minute time window. Second, drivers often arrived at the wrong container park to pick-up or dehire a container as a result of incorrect information leading to the so called futile trips. Third, the ACCC pointed to a disconnect between commercial and operational relationships. A container park's revenue comes mainly from shipping lines, however, empty-container parks interact with container transport operators and the operational inefficiencies to which transport operators were subject at container park gates did not directly affect container park's main customers, the shipping lines. Similarly, container parks did not have incentives to invest in new labour and equipment on the basis that investment would only increase costs without attracting any revenue. The final point made by the ACCC noted the information mismatch between container parks and transport operators stemmed from the lack of knowledge on transport operators arrival times at depots for collection or return of containers.

Thus, prior to the implementation of Containerchain, the lack of visibility across the empty-container supply chain negatively impacted, in particular, on both transport companies and container parks. On the one hand, container parks were uninformed of the actual transport companies' demand levels as well as their arrival times so that they were not able to pre-plan to deploy their resources accordingly – which inevitably led, in some instances, to undesired delays at the container park. Similarly, transport companies showed random arrival patterns resulting from their lack of knowledge of the actual capabilities of a container park at a given point in time as well as the demand from other transport operators.

These challenges reflect the lack of coordination among chain members, particularly the inadequacy and unavailability of real time information. For these reasons, twelve container parks in Melbourne have progressively implemented Containerchain throughout 2011, 2012 and 2013.

Containerchain is a privately owned, easily navigated web portal, which provides stakeholders with information visibility regarding empty container management. Its purpose is to confer enhanced information transparency and consistency of data. This IT solution has the potential to obtain operational efficiencies across the empty-container chain by allowing container parks to regulate transport operators' demand by means of allocating slots per half an hour time windows across the operating day and, hence, plan their workload ahead and utilise resources more effectively. Thus, the purpose is to reduce truck queuing by smoothing the traffic of trucks across the day so that high demand periods can be apportioned more evenly throughout the day. Further, Containerchain also allows transport companies to better forward plan their labour and equipment, which gives rise to streamlined decision-making on the utilisation of their assets.

1.4 The research problem

This thesis focuses on the proposition that IT has a central role in streamlining container chain operations leading to superior supply chain efficiency. It does so particularly, but not only, through ensuring the provision of superior operational and chain systems information providing transparency to appropriate chain participants – in this context, through the application of a purpose-designed portal marketed under the name of Containerchain.

In effect, the key research questions will focus on:

- What has the Containerchain IT solution been designed to do? What operations does it monitor and what parameters does it use in so doing? What integration measures does it employ?

- In what ways, and to what extent, are container parks differentiated? How can operational procedures differ?

- What effects is this innovative web-based portal having on the efficiency and synchronisation of chain activities – and more precisely of container chains which are concerned with the movement and storage of empty containers in the port of Melbourne and which are served by a number of container parks – given differentiated empty-container parks and empty-container chains?

Ideally, we would have sought to conduct a before/after study to evaluate the efficiencies arising from the adoption of the Containerchain portal. However, this approach was not feasible since there are no available records pertaining to the pre Containerchain period.

Conceptually, this study focuses not simply on an information technology solution *per se* or on operational efficiency of the empty-container park as an entity. Rather, it attempts to underline the critical importance of the relationships among chain players – and, in this context, among chain players in those chains which are focused on 'efficiency' and integration of 'empty-container chains'. It takes the view that it is 'the chain’, not individual firms in the chain, which deliver the value which customers want; and that the value delivered reflects the degree of integration of the chain.

1.5 Outline of the thesis

The thesis is composed of six chapters. The introductory chapter lays the foundations for the research study. It underscores the background of the research problem, which leads to the formulation of the research questions. In chapter 2, the context of the study within the academic discussion, the conceptual and research frameworks and the practical and academic contributions are examined. Also, an empirical case study approach is presented as the most appropriate method to uncover the critical proposition of how IT integrates the operations of empty-container parks with that of transport operators' and shipping lines'. Chapter 3, on the one hand, presents a background note to Containerchain and, on the other hand, allows for the effective quantification of operational efficiency subject to the three integrative mechanisms. In Chapters 4 and 5 the empirical findings are revealed by way of testing the proposition that IT delivers superior chain efficiency. More specifically, the various levels of operational efficiency found in supply chains subject to their level of integration are presented and analysed in a thorough case study. Throughout these chapters findings are cross-referenced for increased internal validity. Last, Chapter 6 reviews the results of the study and evaluates its implications. Also, future avenues for research are discussed.

CHAPTER 2: LITERATURE REVIEW AND METHODOLOGY

2.1 Introduction

Much, if not most, of the literature addressing the challenge of empty containers (Hanh 2003) and container scheduling (Ngai et al. 2007) is limited to production and process engineering and is almost invariably model-based and theoretical. Even in the logistics and supply chain literature optimisation, simulation and statistical modelling have been the tools used to evaluate hypothetical but viable gains for the successful flow of goods. Additionally, the published work on container pick-up/return operations at container terminal gates is rare (Guan & Liu 2009).

The aim of this study is to test the conceptually important proposition that purpose-designed IT packages can positively impact on chain efficiency by integrating partnering firms and the business-related practices across the supply chain. In particular, the thesis critically assesses the effects of a purpose-designed IT portal, the Containerchain web-based platform, on the operations of empty-container parks and related key chain players. It is a 'real-world' study that seeks to assess the real-world operations and impacts on chains and chain players – on businesses in chains. Rigorous, empirical testing of concept and principles adds to our body of knowledge about chain integration and chain efficiency.

Integrated and efficient container chains deliver value – to customers, to chain firms, to the wider economy. IT solutions enable the creation of value. This research will demonstrate whether Containerchain creates value for chain firms; or whether it actually erodes value. This research, both rigorous and independent, will have direct commercial and dollar spinoffs for chain players; and it will point to possible problem areas in the IT package that must be addressed in order to deliver maximum value impacts to the empty-container parks, to key chain players and to the wider economy and community.

2.2 An overview of relevant literature

In light of the continuous growth in international trade volumes and in times of globalisation, it is becoming important to integrate firms internally and externally to obtain performance gains. This requires that all the firms within the supply chain operate in unison as if they were a single entity (Frohlich & Westbrook 2001) or as a single intelligence (Robinson 2015). This harmonisation is enabled by integrated technological solutions, which facilitate cooperation and information sharing on value-added activities, and key business processes across the supply chain. This underscores the importance of IT in synchronising partnering organisations in supply chains (Frohlich & Westbrook 2001; Gunasekaran & Ngai 2004). Successful integration requires a smooth flow of accurate and timely information across the supply chain and the ability to control and manage information flows has become a key tool in today’s cutting edge organisations (Li et al. 2009). Conversely, disjointed IT systems hinder the timely flow of information and cooperation across the entire value chain (Sambamurthy, Bharadwaj & Grover 2003).

Wu et al. (2006) noted that by incorporating IT into an organisation’s supply chain network the firm was able to enhance operational efficiencies through effective information exchange and effective coordination with supply chain members. The rationale behind this notion is that IT has enabled real time collaboration among channel members through transparency of data, resulting in improved manufacturing and distribution planning and enhanced inventory management (Li et al. 2009). Frohlich and Westbrook (2001) claimed that the Internet is extending the types of information shared and collaboration may grow in range and intensity leading to a broader arc of integration with both customers and suppliers. They argued further that the higher degree of integration and the broader arc of integration between suppliers and customers were directly associated with the highest performance outcomes across the supply chain.

Some researchers argue strongly that IT is an important enabler of supply chain management. This realisation arises from the formulation that integrating supply chains results from the need for streamlining operations so as to achieve high quality customer service (Gunasekaran & Ngai 2004; Gunasekaran, Patel & McGaughey 2004; Simchi-Levi, Kaminsky & Simchi-Levi 2008).

The literature uncovers mixed results relative to the IT/Performance relationship. In the early 1990's, researchers made attempts to unveil the "IT productivity paradox", in which there did not appear to be a positive relation between IT investment and firm performance or productivity. A decade later, several studies found positive links between IT investment and performance (Dehning & Richardson 2002). In similar fashion, integrated IT is positively related to supply chain integration which has a direct and positive effect on firm performance. Hence, supply chain integration fully mediates the relationship between IT implementation and firm performance (Jin 2006; Rai, Patnayakuni & Seth 2006; Vickery et al. 2003). Similar findings were also reported by Li et al. (2009), Dehning, Richardson and Zmud (2007) and Wamba (2012) who extended the previous work by exploring performance outcomes of IT implementation at a supply chain level. They found that IT enables supply chain performance by means of integrating supply chain partners and, consequently, allows for improved business processes and operational efficiency across the supply chain. This enhanced state of affairs stems from the extended visibility across the supply chain and inter and intra firm collaboration.

Over a decade ago, Jays Corporate Services Pty Ltd (2004) identified in their *NSW Import Export Container Mapping Study* several issues affecting landside container movements in New South Wales which, if not addressed, would become more serious as the trade imbalance between imports and exports would increase in favour of imports. Additionally, they claimed that the container chain was disjointed as a result of the lack of information on container movements and, in order to achieve the required level of chain efficiency, a significantly higher degree of cooperation and information exchange would be required. Accordingly, a vehicle booking system (VBS) was proposed as one of the viable measures to improve these inefficiencies.

One year later, the Victorian Freight and Logistics Council (2005) issued the *Business Activity Harmonisation Study (BAHS),* which acknowledged that 'supply chain visibility, transparency of information and the adoption of common standards were highlighted across the board as being a fundamental component to delivering efficiency gains for the industry'. Pursuant to this view, IT adoption is seen as a way of capturing value for the individual firms as well as for the supply chain as a whole with a view to deliver superior value to customers (Robinson 2002). Similarly, the management of empty-container parks was identified as crucial in the import/export process and for the smooth operation of the port and its hinterland links.

A particularly relevant study that underscores the benefits of implementing IT systems in container operations undertaken by Ngai et al. (2007) discussed the development of a Radio-Frequency Identification (RFID) system embedded in a container depot. The system yields several advantages such as savings in operating costs and greater visibility to operations data allowing depot companies to quickly track the locations of containers and enhance the control processes and improved truck turnaround times in container depots.

The literature in the field of container scheduling is largely theoretical (Ngai et al. 2007) in that most of these studies have used optimisation algorithms and simulation modelling as methodologies to assess the potential benefits derived from the implementation of a system for more efficient cargo movement. Chang et al. (2006) and Theofanis et al. (2007), for example, investigated the Virtual Container Yard (VCY) which is a virtual platform that facilitates the direct exchange of empty containers from consignee to shipper without the need to transport the empty container to the container park or port terminal. Thus, reductions in empty truck kilometers are achieved, in addition to reductions in truck emissions. This notion is also known as 'triangulation' or 'street runs'.

In relation to booking systems, Huynh and Walton (2005) analysed the two measures that terminal operators are using to reduce truck turnaround times. The first measure uses yard cranes to provide insights to terminal operators on whether it is the right investment to make. The second measure introduces a truck appointment system to rationalise the number of truck arrivals into the terminal across the operating day. For this purpose, the authors developed a simulation model evaluating impacts on truck turnaround times and the utilisation of cranes. The ultimate objective is to assist terminal operators in assessing the impacts of limiting truck arrivals into the terminals. Comparably, Namboothiri and Erera (2008) used an approach that explicitly models a port appointment system with minimum transportation cost. The main purpose of this study was to develop an understanding of the potential efficiency gains derived from a VBS on trucking operations.

Research undertaken by Giuliano and O'Brien (2007) and Giuliano et al. (2008) in assessing the outcomes of the California Assembly Bill (AB) 2650 at the ports of Los Angeles and Long Beach is of particular interest. Such a measure was imposed on port operations in an effort to mitigate truck emissions resulting from the increased containerised freight traffic. This state regulation allowed terminals to adopt either a VBS or longer operating hours as viable options to reduce truck idling time at terminal gates and, consequently, air pollution. Results from the study did not substantiate the turnaround time savings associated with the gate access system since queues were simply shifted to inside the terminal to avoid fines and, in so doing, comply with the regulation! But it did support the proposition that the appointment system offered potential reductions in truck turnaround times.

In Melbourne and other Australian ports, Containerchain is an easily navigated web-based platform that provides an effective interface between transport companies and container parks. Containerchain Pty Ltd (2011a) noted that the most significant anticipated benefits derived from the implementation of this IT application are the elimination of lengthy truck queues; reduction in truck turnaround times; the elimination of futile trips to container parks; reduction in phone calls; reduction in paperwork at the depot leading to paperless transactions; the monitoring of container park performance; an enhanced container survey process resulting from the reduction of paperwork and automation of internal tasks at the depot; and display of real time container status.

Clearly, extensive research has been undertaken into the importance of IT in the logistics and supply chain-related literature and this review has noted a wide range of approaches. For the most part IT has been instrumental in synchronising activities and promoting integration and collaboration among chain players. IT has also been important in ensuring the operating efficiency of container parks as functional elements or entities.

Our review has revealed, however, that the literature has paid little attention to the empty-container park's critical function in integrating the needs of shipping lines with that of cargo owners in ports characterised by severe imbalances in the containerised flows of import and export chains. In particular, container parks have been conceptualised simply as locations for the storage (and ancillary services) of containers. Arguably, however, container parks must also be regarded as key elements in managing the supply of empty containers generated by import flows and the demand for empty containers from export shippers on a sustainable basis.

Further, and critically, container parks are highly differentiated businesses – in terms of ownership, functionality, business models, operational procedures and interactions with transport operators and customer base (shipping lines mainly). Not surprisingly, then, some container parks will operate more effectively than others and their relative impacts on chain integration and efficiency will differ. There has been little, if any, attention in the literature to these insights.

2.3 The conceptual framework and research problem

This research focuses on the importance of IT for the operation of container parks but it does so within the wider conceptual framework of the chain structures within which the container parks operate. Figure 2.1 suggests that Containerchain's IT solution directly addresses operational efficiency issues, but in so doing, it indicates the potential for impacting the efficiency of container trucking, the wharf/terminal and truck haulage interface, the shipping lines and their container asset/space utilisation practices and cargo owner operations – in short, the levels and effectiveness of the relevant chain operations.

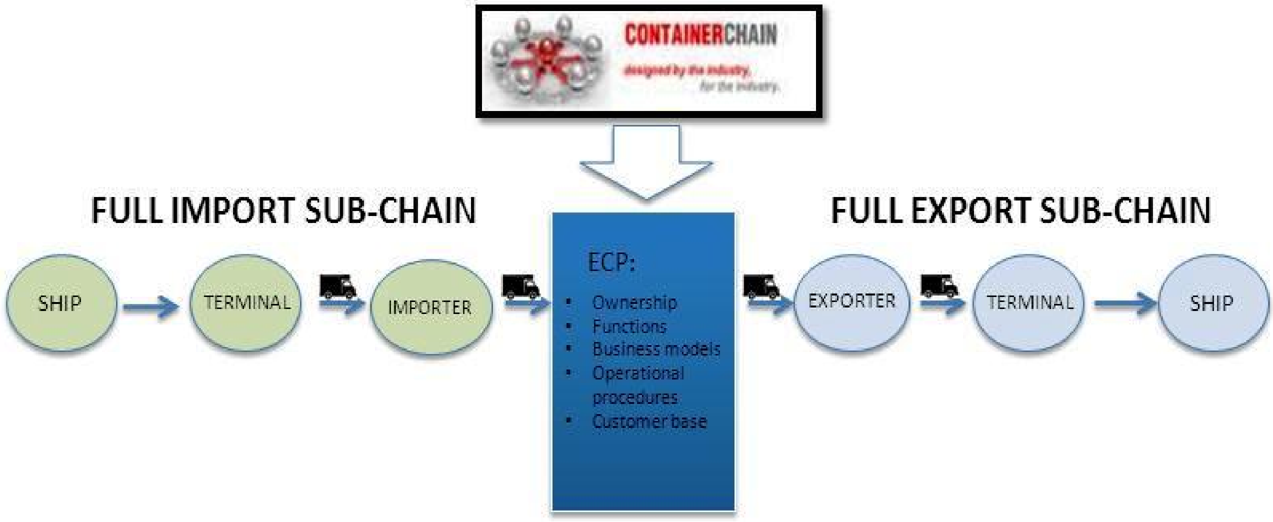

Figure 2.1 A conceptual framework (after Robinson R 2009)

Clearly, this conceptualisation could support a major and ongoing study; but in the context of a master's degree with its focus on independent research, given strict time limits, there is a need to focus and limit the study. The overriding proposition is that IT is a critical factor in achieving the integration of chain players and chain efficiency in the empty-container chains focused on the port of Melbourne. More particularly, the key research questions that will guide the study are as follows:

- What is the structure and purpose of the Containerchain portal? What does it set out to do? What operations does it monitor and what measures are defined? What chain integration mechanisms does it promote?
- To what extent and on what basis are empty-container parks differentiated? How can operational procedures differ?
- In what ways and to what extent has Containerchain, as an innovative technology application, impacted on integration and efficiency of chain activities in the port of Melbourne, more specifically, empty-container chains, given significantly differentiated empty-container parks?

Thus, the aim of this study is to explore the effects of this IT application on the integrative measures that may provide the means for a seamless integration of partnering firms and streamlined operational efficiency across the full range of supply chain participants.

In this study we examine operational efficiency within the framework of the level of supply chain integration that varies between disintegration and high integration – in simple terms, the greater the degree of supply chain integration, the greater the operational gains obtained across the chain. For the purpose of this study, operational efficiency is characterised by three criteria – the first relates to the ability to manage capacity. It identifies the means, as well as the disciplines put in place by the container parks, to regulate transport operators' demand for slots in the system so that truck arrivals are uniformly apportioned across the operating day, preventing queues and congestion at the container park. The second criterion relates to the ability to manage transactions in the container park in a paperless environment – which reduces truck turnaround times by way of streamlining the gate-in and gate-out processes. The third criterion relates to the ability of the container park, together with the shipping line to manage stocks so as to ensure the availability of empty containers for collecting trucks – and by so doing, to avoid futile trips.

A full evaluation of the Containerchain IT solution would include a before and after analysis of the short term and long-term efficiency measures before and after its implementation. This present analysis, however, only relates to the period after Containerchain was adopted – that is, we will focus on the efficiencies that have resulted from enhanced operational visibility and transparency of data among participants of the empty-container chain in the port of Melbourne since the adoption of Containerchain. The simple fact is that there is no comparable data prior to the adoption of this web-based solution. (This challenge was also faced by Giuliano and O'Brien (2007) in their research study on the impacts of various VBSs on the truck turnaround times in California.).

2.4 The elements of a case study approach

In order to assess the research proposition that IT is positively linked to chain efficiency by synchronising trading firms this study focuses, as noted above, particularly on the effects of a purpose-designed IT package, the Containerchain software application, on the operational efficiency of empty-container parks and associated key empty-container chain players. It aims to clarify whether this web-based solution creates or erodes value for the chain and its members.

An empirical case study approach has been adopted to provide insights into, and to fully understand, the causal and complex effects of this IT web-based solution on the operational performance and chain efficiency of empty-container parks. The literature review has demonstrated that there has been little academic discussion about how container parks integrate the supply of empty containers derived from import flows with the demand for empty containers originated by shippers. Importantly, however, this study is focusing not only on the question of 'how' but also on the more critical proposition of how IT integrates the operations of empty-container parks with that of transport operators' and shipping lines', leading to superior supply chain operational efficiency.

As claimed by Yin (2009), a case study approach is the most appropriate method in problems in which 'how' and 'why' research questions are being posed in the context of a contemporary set of real-life events over which the researcher has little control. The case study method is a research method that extends our understanding of the dynamics and idiosyncrasies present within single or multiple settings (Eisenhardt 1989). The defining characteristic of a case study is its holistic approach – it captures as much detail as possible in real-life situations and presents the findings in a logical and clear way. A case study is a comprehensive research strategy comprising qualitative and quantitative methods guided by a distinct theoretical framework (Kyburz- Graber 2004), thereby avoiding excessive dependability on a single approach (Bryman & Bell 2011).

Given the time constraints of this research it is not feasible or necessary to examine the implications arising from Containerchain implementation in every container park in Melbourne. Consequently, we have selected a sample of container parks that are representative of the industry on the basis of a number of selection criteria including ownership, size, location, carrier access arrangements (operational procedures) and extended gate hours. First, ownership is significant from the standpoint of how the container parks integrate business processes. There are four different types of ownership structures for container parks in Melbourne – stand alone, aligned to stevedores, aligned to shipping lines by way of ownership, equity or alliance and operated by integrated service providers; thus, we have selected one of each kind. Second, size and capacity relate to the ability to manage trade volumes in specific land areas. As a result, we explore the impact on truck queuing and truck turnaround times. Third, there are four container parks – CC Containers, Victorian Container Management, Patrick Port Logistics Coode Road and ANL Container Park – that have stricter carrier access arrangements than the remaining container parks. We will investigate this impact on container parks' operations. Finally, there is only one container park at present that is offering extended gate hours for specified shipping lines. How is this fact smoothing truck arrivals throughout the day? Should it be implemented in other container parks?

This study will use a stratified random sampling procedure which entails partitioning the population into distinct groups (strata) according to stated principles. The advantage of the technique is that it ensures that the industry is accurately represented on the basis that the resulting distribution mirrors the industry in terms of the selected criteria (Bryman & Bell 2011). This rigour in the sampling procedures will add to the validity of the sampling and ensuing findings of the present study.

The research design of the study comprises a mixed methods strategy that integrates quantitative and qualitative approaches. The purpose of using a combined approach is to provide greater importance to the strengths with which quantitative and qualitative research methods are associated which responds to the technical version on the nature of research methods (Bryman & Bell 2011). Kellehear (1993) indeed pointed out that combining methods may increase the validity of the findings since one method may yield results that may be further examined by the other. It also generates a broader and in-depth analysis of the major problem areas under study.

The study has placed considerable emphasis on understanding and interpreting primary, computer-generated real-time data available as screen dumps and files of actual operations. These primary sources provide exceptional insights into key operating principles and provide managers with real-time information to enable better efficiency outcomes.

The study is also able to draw on a large amount of secondary data, which provides the basis for in-depth understanding of the Containerchain IT package – its functions, the activities it supervises and the parameters used to fulfil this supervision. We also aim at extending existing insights into the taxonomy of container parks according to specified variables and how this affects the efficiency within the focal firm (container park) and across the chain. To this end, we will employ in-house container park documents and container park performance reports generated by Containerchain. Government reports, information from industry associations such as the Victorian Transport Association (VTA), Shipping Australia Limited (SAL) or PoMC, in addition to accounts from regulatory bodies provide further basis for analysis.

Bryman and Bell (2011) identified a number of advantages in the use of secondary data. It is a cost-effective way of accessing and utilising information; and it provides significant savings in time since data collection has already been carried out by other researchers, leaving more time for the detailed analysis of data. Further, secondary data may be of extremely high quality providing it has been generated by a trustworthy and reliable source.

The study also rests on a range of semi-structured interviews. Unlike other methods, interviews allow participants to offer their personal views and to articulate reflections to support these views, experiences or attitudes. Semi-structured interviews are a set of prearranged open-ended questions, with other questions arising as the conversation evolves (Dicicco-Bloom & Crabtree 2006). These semi-structured interviews will be tailor-made to obtain the opinions and perceptions of container park managers, transport operators and shipping line managers on the effects of the IT web-based package on container park operational activities and how this, in turn, impacts on other players and the commercial practices across the empty-container chain.

In these semi-structured interviews, we will focus key research issues including, for example, the integration mechanisms that Containerchain employs to integrate with other industry players such as transport operators or shipping lines; features that differentiate container parks in Melbourne; and the implications of the introduction of this web-based solution on the efficiency and integration of empty-container chain activities in the port of Melbourne.

These various mixed-method strategies, used also to some extent by Giuliano et al. (2008) in their study of the terminal gate appointment system at the ports of Los Angeles and Long Beach , will allow us to delve into the impacts of the Containerchain portal at both an individual park level as well as at a whole-of-chain level.

Clearly, the interpretation of primary, computer-generated data noted above will be cross-referenced with the evidence gathered in interviews so as to increase the internal validity of the case study findings on the basis of events being supported by more than a single source of evidence. This cross-referencing among converging lines of inquiry will be facilitated by the triangulation of data sources. Thus, the overall findings are likely to be more reliable if these are built upon convergent sources of information that validate one another, increasing the construct validity. The purpose is to collect data from numerous sources with a view to corroborate the same fact or phenomenon (Yin 2009).

Further, once interviews are conducted and transcribed, the software Nvivo will be of assistance in effectively organising, systematising and codifying the accounts derived from the interviews with participants. It will expedite the analysis of data by means of streamlining the process of establishing similar as well as opposing views on the various topics addressed in this thesis. In effect, if adequately used, Nvivo may be an effective tool in triangulating the data collected during the course of the study.

The proposition that IT delivers superior chain efficiency by means of effectively integrating the operational interactions among supply chain participants is tested in Chapters 4 and 5.

CHAPTER 3: CONTAINERCHAIN SOLUTION: A FRAMEWORK FOR ANALYSIS

This chapter falls into two parts. The first part is a background note and describes, in general terms, what the IT package sets out to do, the broad elements of its design and what its outcomes are expected to be. The second part focuses on the relationships between chain integration and operational efficiency and recognises three key integrative mechanisms which may be defined from the IT package.

PART 1: CONTAINERCHAIN – A BACKGROUND NOTE

3.1 Concept and operating conditions of the Containerchain IT application

The Containerchain application is a web-based solution which provides a platform for the transfer of operational communications among empty-container chain members.

To develop this initiative, Containerchain presented a business proposition to the container parks. This proposal comprised, first, the funding of the licencing and implementation of the software and hardware necessary to use Containerchain in the container parks. Second, it provided for a platform that facilitated the communications between container parks and transport operators. This translated into transport companies having to subscribe to and be on account with Containerchain to enable them to prebook their truck arrivals at empty-container parks. This subscription also facilitated the invoicing and collection of transaction fees for the services provided by container parks to transport operators. Last, it provided for the technical support available for the IT hardware so as to ensure the efficient functioning of the system. In return, Containerchain would impose a fee on every transaction, that is, on every container that was gated in or out of the empty-container park with a few exceptions (Containerchain Pty Ltd 2010b).

This proposal was related to the increasingly prevalent practice in the IT industry called Software as a Service (SaaS). SaaS is a software distribution model in which a service provider supplies customers with available software over the Internet (TechTarget 2013). Among its advantages have been easier deployment and administration, automatic updates, compatibility among all its users who have the same version of the software and, hence, reduced acquisition costs for customers.

As part of opening a commercial account with Containerchain, transport companies had to agree to the Carrier Access Arrangements (CAA) with each empty-container park, for the dehire or collection of empty containers. These CAAs contain the entry conditions and governing rules to enter each participating depot.

In order to return or collect a container to/from a depot, transport operators are required to make a notification through their commercial accounts at Containerchain.com before the truck arrives at the depot. All notifications require the truck registration number to be recorded. In the event of a truck collecting or returning multiple containers in the same trip, a notification is required for each individual container.

Notifications are assigned to time windows, which are time intervals of thirty minutes in which depots announce their operating capacity – that is, the number of slots allocated to that particular time window. This operating capacity can be defined in terms of optimum and maximum capacity. The former, optimum capacity, is the number of containers that the depot can optimally gate in and out in a given notification window that would guarantee an efficient flow of trucks and containers. The latter, maximum capacity, is the maximum number of containers that a depot can gate in and out but prime service levels to transport operators are not guaranteed – that is, slight congestion may occur.

Containerchain does not restrict a transport operator from surpassing the optimum or maximum capacity advertised at the time of making the notification. The operating capacity may only be restricted and modified by the empty-container park – these parameters are individually administered by each participating depot so as to prevent transport operators from exceeding the optimum and maximum capacities.

When trucks arrive at a depot, drivers are required to identify themselves by quoting their truck registration number, notification number or container release number – for returns – which will activate the return or collection of the empty container. In the instances of fully paperless transactions, the truck registration number may be sighted from the gatehouse, where the staff verifies this information and, thus, truck drivers are not required to proceed to the office.

If a truck arrives early or late for a notification, it will be serviced at the discretion of each container park. Containerchain records truck arrivals as 'On Time', 'Late' or 'Early', always in accordance with the operational rules set out in the CAA of each participating container park. Conversely, if a truck fails to arrive for a notification, it will be recorded as 'Unutilised'. Unutilised notifications are charged the container fee, which is also found in the CAA of each depot and may vary from one park to another.

All trucks arriving at a container park to dehire or collect an empty container must have made a notification through Containerchain.com, otherwise, they will not be allowed entry and the container park will not service them. However, there is one exception that will be further discussed in Chapter 5, which deals with the empirical findings of moderately integrated empty-container supply chains.

3.2 Containerchain: anticipated benefits to the empty-container supply chain

Containerchain is a privately owned, easily navigated web portal, which provides stakeholders with information visibility regarding empty container management. Its purpose is to deliver enhanced information transparency and consistency of data. The introduction of this platform has the potential to obtain operational efficiencies across the container supply chain by allowing depots to plan the workload ahead and better utilise their human and material resources. In addition, it allows depots to increase their throughput capacity (ACCC 2011).

As noted above, the legal basis for the implementation of an empty container management IT solution was the compliance with the Chain of Responsibility Legislation[2] which classifies empty-container parks as 'loading managers'. Further, the non-compliance with the legislation in force may result in regulatory bodies such as Worksafe[3] and VicRoads[4] imposing sanctions on depots. These sanctions range from improvement notices to criminal sanctions which could negatively affect the survival of the business.

[2] Brief note on Chain of Responsibility from Appendix 1.
[3] Worksafe is a regulatory body that enforces occupational health and safety laws in the workplace.
[4] VicRoads is a statutory corporation responsible for the maintenance and construction of roads, driver licensing, vehicle registration and road safety in the state of Victoria.

In addition, an IT solution for the management of empty containers has been acclaimed in past industry reports as the optimum solution to better manage the anticipated growth in containerised freight volumes and ensuing capacity issues through the port of Melbourne, thus, making the chain more efficient.

The key purpose of this technology portal is to reduce truck queuing by smoothing the traffic of trucks across the day so that high demand periods can be apportioned more evenly throughout the operating day. This management of truck queues may only be achieved by systematising the information flows across participants of the empty-container chain. This systematisation of processes allows for paperless interactions between transport operators and depots which streamlines the servicing of truck drivers at the depots and leads to improved truck turnaround times.

The anticipated improvements from the adoption of this IT solution may be analysed from various stakeholders' standpoints, pursuant to their positions and interests in the empty-container chain.

For transport operators the most relevant anticipated benefit is the reduction in truck idling time outside depots gates. This, together with enhanced gate-in and gate-out processes due to paperless transactions results in improved truck turnaround times. This also leads to transport operators being able to realise cost savings through a reduction in truck queuing time which will translate into a lesser consumption of fuel, reduced labour costs and a reduction in truck fleet sizes[5].

Of further significance is the elimination of futile trips to empty-container parks. These occurred in the past as a result of incorrect information among the empty-container chain parties. That is, transport operators arriving at the wrong depot to return or collect an empty container or, the other scenario being, transport operators arriving at depots to pick-up an empty container and depots not having available stock owing to the 'first in first served' system. Conversely, by booking a notification online through the Containerchain portal, transport companies have the certainty that the depot has

[5] According to the information provided by CC Containers in *its Exclusive Dealing Notification N95465* from the 14th of July 2011, truck fleet sizes diminished as a consequence of the adoption of the 1-Stop platform by the stevedores. The evidence behind this statement is the reduction in the vehicle booking system registrations experienced by DP World over time, from over three hundred companies registered 'in the times of P&O Ports' to approximately 150 in 2011.

received the release number from the shipping line and that the depot has sufficient stock to service that notification[6]. This certainty comes with the enhanced visibility to monitor depot container activity and capacities, thus, enabling transport operators to make informed decisions and proactively manage their own fleet. Additionally, and as noted above, transport companies will have access to information not previously available; namely, depot performance reports, historic data, statistical reports and container number search (Containerchain Pty Ltd 2011a).

Among the projected operational benefits for empty-container parks, we may identify the proactive management of truck queuing achieved through full visibility on truck arrivals which, in turn, allows depots to forward plan their labour and equipment accordingly so as to optimally handle truck moves. The automation of the information allows depots to, first, streamline gate-in and gate-out operations by introducing a paperless gate control and systematically allocate forklift operations to truck arrivals. Second, these forklift-mounted terminals provide forklift drivers with full visibility on container inventories. Third, depots use handheld terminals that capture container survey information as the work occurs – that is, these devices provide real time information on empty container status, including photographs.

In addition, depots obtain financial benefits by securing revenue as the work happens, allowing them to track profitability on a daily basis. The superior visibility derived from this IT solution implementation provides empty-container parks with the long pursued operational and financial monitoring through the access to management reports and the digital dash boards. Another important economic measure stemming from this initiative is the ability to quantify the 'unmet demand' so as to match labour to real demand. This may lead to varying depot working hours in response to high or low demand periods, based on real-time data (Containerchain Pty Ltd 2011b).

Shipping lines also benefit from this scheme mainly by managing their assets – the empty containers – more efficiently. Shipping lines are able to send and receive electronic updates regarding empty container movements through the yard on a real-time basis by having complete visibility on their empty container inventories. This, in

[6] This certainty that the depot will have available stock to attend to pick-up notifications results if the container park actively engages in the management of stock levels. This capacity to effectively manage stock inventories is further examined in Chapter 4.

turn, results in shipping lines proactively monitoring the performance of empty-container parks.

As noted above, the most relevant feature of the Containerchain IT application is the transparency of data which allows for the systematic transfer of data to the relevant participants of the empty-container chain. Other stakeholders of the empty-container chain who may also benefit are importers, exporters and freight forwarders. This group will have access to reliable and up-to-date information on container movements and their locations. Consequently, there will be more certainty concerning the status and location of empty containers as they move across the chain.

3.3 From inefficient chains to supply chain efficiency: a before/after perspective

Figure 3.1 displays the information flows among empty-container chain participants prior to the adoption of Containerchain. This exchange of information did not reproduce the operational interactions between players of the empty-container chain. Transport operators and container parks shared no communications but were operationally interacting resulting in inefficient truck moves at container parks. If issues arose during their interface, the information had to do a complete loop to get to the other party. This points to the fact that there was a disconnect between commercial and operational relationships between transport operators and depots. Namely, the depots' revenue comes mainly from shipping lines while empty-container parks interact with transport operators and the operational inefficiencies to which transport operators were subject at the container parks' gates, did not directly affect depots' main customers, the shipping lines. Similarly, depots had little incentive to invest in additional labour and new equipment as that investment would only add to the cost structure without attracting any revenue.

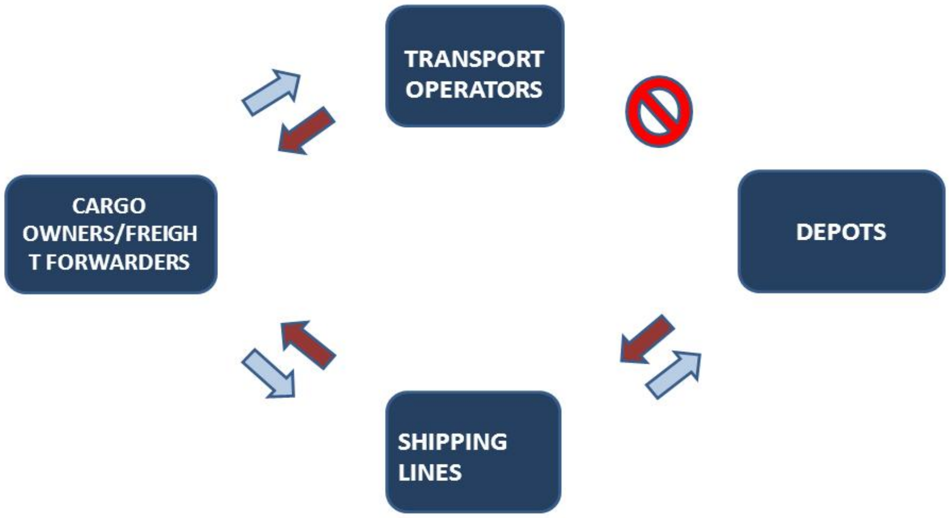

Figure 3**.1 Inefficient Information Flows prior to Containerchain implementation**

IT systems facilitate collaboration and the exchange of information that lead to operational and strategic efficiencies across the chain. In consequence, IT has acquired a leading role in orchestrating and integrating channel members in a supply chain network (Frohlich & Westbrook 2001; Gunasekaran & Ngai 2004). In Figure 3.2, we may appreciate how IT can restructure and modernise chain operations and deliver chain efficiency by adopting an effective vehicle appointment system, as supported by the study conducted by Giuliano and O'Brien (2007).

Arguably, IT has a central role in integrating and streamlining container chain operations leading to superior supply chain efficiency. It does so particularly, but not only, by ensuring the provision of superior operational and chain systems information providing transparency to appropriate chain participants – in this context, through the application of the Containerchain IT solution.

Thus, in streamlining supply chain operations, this IT solution eliminates the above mentioned operational-commercial disconnect between transport operators and empty-container parks. It transforms this inefficient operational interface into a standard contractual relationship, from which both parties may benefit. By entering into a customer-supplier relationship, transport operators are made accountable to honour the notifications made through Containerchain. Similarly, depots, as suppliers, are encouraged to be more competitive and deliver improved service levels resulting from increased revenue to invest in labour and equipment.

Figure 3.2 Efficient Information Flows deriving from Containerchain implementation

PART 2: CONTAINERCHAIN, CHAIN INTEGRATION AND OPERATIONAL EFFICIENCY

In any supply chain value is delivered into the chain (or eroded from it) when individual firms are operating efficiently and effectively; but it is the chain itself which delivers the value required by the end customer. The level of integration within chains is, therefore, of critical importance and effective information systems will play a key role in underwriting chain integration. In this section of the chapter we focus on how Containerchain contributes to chain integration.

3.4 Operational efficiency and chain integration

In view of the phenomenon of globalisation, it is increasingly important to integrate the internal and external activities of firms. This entails coordinating partnering firms by means of an integrated IT that allows for effective exchange of information on value-adding activities within and outside the boundaries of a firm (Cross 2000; Fosso Wamba et al. 2008; Frohlich & Westbrook 2001; Grover & Malhotra 1999;

Gunasekaran & Ngai 2004; Kent & Mentzer 2003; Sanders 2007; Thun 2010; Vickery et al. 2003; Wu et al. 2006). This approach to integrate activities and processes intra and inter organisations is triggered by the need to streamline operations in an effort to reduce costs across the chain by way of enhancing supply chain agility, improving cycle times, achieving superior efficiency and providing products and services to customers in a timely manner (Radjou 2003).

High-quality information sharing among supply chain participants enables firms to effectively coordinate production and distribution processes, outsourcing functions and services if required. The collected information supports an enriched analysis of suppliers' performance and identifies areas for improvement in the operations arena (Roh, Kunnathur & Tarafdar 2009).

Researchers have widely validated the proposition that IT facilitates real-time collaboration and efficiently integrates partnering organisations by delivering forward visibility (Attaran 2007; Dehning, Richardson & Zmud 2007; Gang et al. 2006; Gunasekaran, Patel & McGaughey 2004; Ngai et al. 2007; Roh, Kunnathur & Tarafdar 2009; Sanders 2007; Vickery et al. 2003); as well as improving inventory control and planning capabilities (Sanders & Premus 2005). In particular, Roh, Kunnathur and Tarafdar (2009) further this discussion by elaborating on the benefits of IT on supply chain visibility. They underscore the IT's ability to track the location of goods, inventory and information in a chain resulting in fewer bottlenecks, stockouts and bullwhip effect.

The work of Ngai et al. (2007) on the operations of a RFID enabled container depot highlights the competitive advantage attained through greater visibility of the location of each container at any particular point in time, which enables the depot to process containers more rapidly and efficiently. This assists the container depot in boosting throughput by decreasing the waiting time of trucks seeking to collect their containers as well as reducing operating costs.

This study documents the impacts of IT, in particular the Containerchain IT software solution, on the operational efficiency of empty-container parks and related key chain players in the port of Melbourne; and it argues that the higher the degree of internal and external collaboration among channel participants, the greater the operational gains for all the stakeholders concerned.

How, then, does the Containerchain IT package define, describe and measure the relationship between operational efficiency and integration in the empty-container chain?

The package defines the operational efficiency/integration relationship in terms of three fundamental management capabilities of empty-container parks – the ability to effectively manage capacity is seen to be the critical 'entry level' capability; a second level attribute is to do so within a fully web-based or paperless environment, indicating an advanced technology/cost environment; and third and highest-level attribute of the ability to effectively manage stocks across the whole-of-terminal operations (Figure 3.3).

More specifically, capacity management denotes the control that container parks have to allocate and administer slots in the system so as to regulate truck arrivals, and hence, obtain a constant flow of truck moves across the operating day. A paperless environment, the automation of processes resulting from timely and accurate information sets, strict disciplines in place as well as providing innovative technology as a means for securing reduced truck turnaround times. Stock management complements the notion of capacity management in that it ensures the availability of empty containers for truck pick-ups, which is the ultimate indicator of slots in the system, with a view to eliminate futile trips.

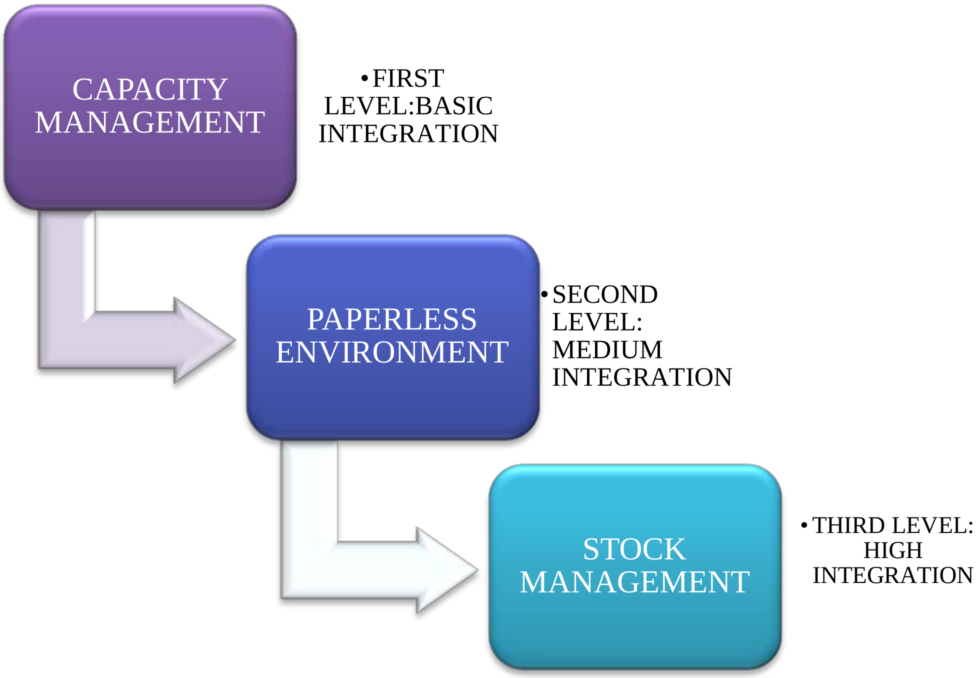

Figure 3.3 The three levels of Operational Efficiency

In order to further understand the notion of Operational Efficiency obtained through the Containerchain IT package we discuss in greater detail the underlying mechanisms and dynamics of managing system characteristics.

3.5 Capacity management: the fundamental requirement

The implementation of the Containerchain IT solution gave rise to the allocation of slots in the system in time intervals called time windows. This quantification of capacity has been a major milestone as this was the first attempt in estimating the actual number of trucks depots could process in half hour time windows.

Prior to this, trucks arrived at the depots' premises unannounced as they were uninformed of the real capabilities of the container park as well as other transport companies' demand to enter that container park. This situation posed a problem for both container parks and transport operators. On the one hand, if numerous trucks arrived simultaneously, lengthy queues resulted hindering the depot's obligation as a 'loading manager' to manage heavy vehicle driver fatigue in accordance with the Chain of Responsibility Legislation. Under this legislation truck turnaround times cannot exceed a thirty-minute time window. On the other hand, the queuing of heavy vehicles while waiting to enter the depot resulted in suboptimal use of resources, which could have been utilised more effectively elsewhere had they been advised on the reduced capabilities of a depot.

This raises the further question – what is capacity management?

Capacity management is, on the one hand, the allocation of slots by container parks, that is, the assignment of maximum and optimum capacities per time window subject to the capabilities of the depot – including the gate and forklift capacities as well as the particular events occurring in a depot at a particular point in time[7]. On the other hand, capacity management relates to the introduction of measures to efficiently manage maximum and optimum capacities so that truck moves are evenly apportioned across the operating day, preventing delays and queues.

Maximum capacity relates to the maximum number of truck arrivals a depot may process in half hour window slots without generating queues that spill out on to the neighbouring streets. This implies that the depot is utilising all its resources in servicing trucks which are seeking to collect or return an empty container. Thus, the provision of ancillary services such as repairs, upgrades or steam cleaning activities would be left partially unattended so as to deal with the increased volume of trucks through their gates.

Optimum capacity denotes the number of truck moves a depot may optimally process in a half hour window without generating queues that spill out on to the neighbouring streets and simultaneously, operate ancillary services. In both instances the depot would be working at full capacity, that is, fully utilising its resources. Yet, at maximum capacity, the depot's resources are mainly used in servicing the collection and return of empty containers. Both of these capacity measures have been devised and introduced by Containerchain.

[7] Some external events may cause the depot to alter its normal maximum and/or optimum capacities on the basis that these may have a direct impact on the trucks moves the depot can process. These events may take the form of bulk runs, adverse weather conditions such as heavy winds and internal works at the empty-container park.

In figure 3.4, maximum capacity is displayed in red and optimum capacity in green. In the axis X of the graph, the day is divided into half hour fractions or time windows which represent the distribution of truck moves across the operating day. Additionally, the number of slots in the system for maximum and optimum capacities is shown in the axis Y. As depot capabilities decrease or increase throughout the day, maximum and optimum capacities may vary, replicating these variations in the graph.

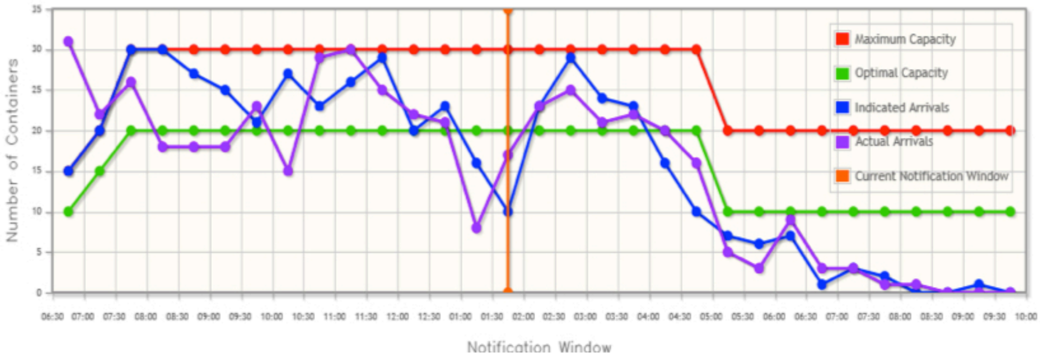

Figure 3.4 Example of Container ETA monitor showing maximum and optimum capacities as well as indicated and actual arrivals for the operating day

However, whether the calculation of the maximum and optimum capacities is adequate is beyond the scope of this study as these parameters are set in the system by the individual container parks. Namely, Containerchain does not assist in this calculation nor does it question the appropriateness of these restrictions on the basis of gate and forklift capacities – although it is clear that further research would be appropriate.

Similarly, gate capacity centres on the notion of driveway or available queuing capacity inside and outside the depot[8] without generating congestion in the vicinity of the site. It would respond to the question of gate dimensions. The measurement unit used to quantify gate capacity is the 'semi-trailer'. According to one participant interviewed, the average length of a semi-trailer is 16 metres. This length would comprise the cabin

[8] In a couple of container parks there is available truck queuing capacity on the public road. In the first depot, this is a truck queuing lane which resulted from a lobby with the city council. It is a five-minute truck zone, which does not allow trucks to idle for longer than five minutes; thus, the flow of trucks is relatively fast. In the other depot, there is a queuing arrangement with the Port Authority; thus, this is a port road and trucks are permitted to queue if required.

of the truck and a 40’ container. Thus, to effectively calculate gate capacity, the total number of queuing metres would have to be divided by 16 (metres).

Another concept required to understand depot capacity is the ‘forklift capacity’. Forklift capacity relates to the number of forklifts in a depot allocated to loading and unloading empty containers (‘road works’), as well as internal works. This number is determined by several factors. First, the capacity of the site or number of containers the site is capable of handling in its current configuration. In other words, there is a physical limitation to the number of forklifts which can operate in the various areas of a depot since excessive forklift capacity would restrict efficient movement of these machines. Second, forklifts are vulnerable to mechanical failures and may be inoperative until they are repaired. Last, the number of forklifts available is subject to the number of drivers available. That is, absenteeism negatively influences forklift capacity. Furthermore, the capabilities of each machine may vary according to the speed at which a forklift loads or unloads a container.

Hence, in order to obtain a constant flow of trucks, gate and forklift capacities must be properly aligned and this alignment must be adequately disclosed in the maximum and optimum capacities set in the system.

For the purpose of this research, capacity management relates to the number of time windows in an operating day in which truck flows are contained within the boundaries of maximum capacity – 100% of capacity – and 40% of capacity provided the capabilities of the empty-container park as well as the external conditions occurring in a container park at a particular point in time. The more time windows contained within this band, the more operationally efficient in terms of capacity management. This band visually reveals as well as quantifies the number of time windows in which actual truck arrivals are contained within maximum capacity, which denotes 100% of the depot’s working capacity, and 40% of that working capacity. Conversely, if truck moves are displayed above maximum capacity, the depot experiences delays or busy periods – that is, excess workload which constrains its working capacity to effectively service truck arrivals. Likewise, if truck flows are scarce, capacity and resources at the container park are unutilised. Thus, a system that regulates truck arrivals so that extra workload occurs during an underutilised time frame results in congestion and waiting times at depots being eradicated by means of efficiently utilising the depot's resources and capacity. And this, in turn, provides the means for a constant and uniform flow of truck moves in view of the capabilities of the depot.

Further, in order to manage capacity efficiently, the system provides depots with effective measures to regulate truck arrivals across the day and, thus, maintain truck flows within the aforementioned band, preventing undesired delays. These measures take the form of, first restrictions on maximum capacity, that is, prohibiting transport operators to book slots above maximum capacity. Second, restrictions on truck arrivals times to 90 minutes time frames – that is, 30 minutes either side of the allocated time window or three consecutive time windows. The aim of this measure is to put a stop to the erratic behaviour of transport operators since total leeway to arrive at the depot at a time of their convenience may result in transport companies making notifications in the system that are irrelevant to the actual time of arrival, which would lead to inconsistent arrival patterns. Last, adjustment of capacity, that is, modification of maximum and/or optimum capacity so as to disclose to the marketplace the current capabilities and conditions taking place in a depot. Consequently, the band of operational efficiency would also be modified.

Figure 3.5 represents a container park which is using the three measures to efficiently administer truck moves through their gates. First, the cap on maximum capacity is visible since the blue line (Indicated Arrivals) never exceeds the red line (Maximum Capacity). Indicated arrivals note bookings – notifications – in the system for a specific time window while actual arrivals depict the actual number of truck arrivals at the depot. Second, the 30-minute entry policy either side of the allocated time window is difficult to demonstrate in the graph. However, the outcome of this measure is noticeable since transport companies' behaviour is consistent and actual arrivals effectively replicate indicated arrivals. Last, capacity is withdrawn early in the morning due to reduced forklift capacity and then fed back into the system around 7:30 am. Again, capacity decreases around 5 pm as trading activities in the industry also decrease. Thus, capacity adjustments are obvious to the eye and, as noted above, these indicate modified capacities and capabilities at the depot to service truck moves.

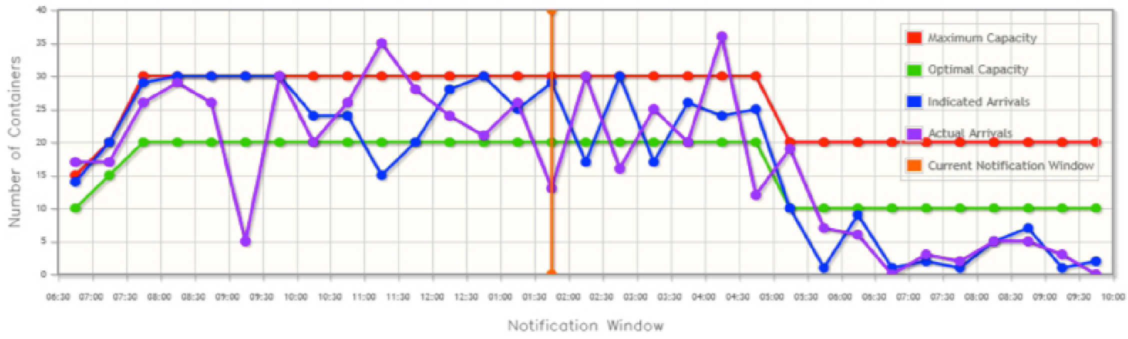

Figure 3.5 Example of Container ETA monitor displaying measures to regulate truck moves across the operating day

3.6 A Paperless environment: an advanced level of integration

The paperless environment may well be the best example of coordinated effort in the empty-container supply chain among various stakeholders to streamline operations, and hence, obtain the desired chain operational efficiency.

The paperless environment points to the automation of information so as to make depot environments more efficient and dynamic. True automation of information is only possible if all relevant supply chain partners are on board, that is, if all players do their share in having the adequate technology in place as well as sharing vital information concerning key business processes across the chain. As Dehning, Richardson and Zmud (2007) noted, IT strongly supports the integration of the value chain through the capture, coordination and exchange of crucial information across organisational boundaries.

The viability of the depot paperless environment hinges on three aspects. First, the container park technological deployment, that is, container parks should have in place forklift mounted terminals or FMTs for the efficient gate-in and gate-out of empty containers. A FMT is a large tablet that sits on a cradle with a suction cup mounted at the back that sticks on the windscreen of the forklift and assists the forklift driver with container enquiries around the yard. Thus, if the driver types in the last four digits of a container, the system advises the driver about the ownership of the container and ISO (International Standards Organisation) type, thus, recognising the correct location for that container.

However, the ultimate functionality of the FMT is to correctly process empty container admittances and discharges in and out of the system. The FMT presents the forklift driver with three screens. Each screen represents half hour blocks or time windows. This identifies the trucks that have been booked in for the present time window as well as the bookings made up to that moment for the two following consecutive time windows.

This procedure removes most of the two-way communications between the forklift driver and the office because the FMT provides the forklift driver access to the same container stock records which were previously only at the disposal of the office.

Second, shipping lines should engage in the correct and timely transfer of Electronic Data Interchange (EDI) dehire messages to Containerchain. Thus, if the shipping lines transfer the shipping manifest to Containerchain, the system filters this information by container park, that is, the Container Return Advice – or CRA, which is a detailed breakdown of the containers which are expected to be returned from a particular vessel. One of the greatest challenges faced by container parks nowadays is the disengagement that some shipping lines show from port landside operations; hence, not transferring EDI messages to Containerchain or the individual depots. Pursuant to the information disclosed by Containerchain at *Freightweek*[9] in September 2013 only 75% of the dehire notifications made by transport operators use EDI messages, leaving one quarter of the total return of empty containers at the mercy of transport operators taking the delivery orders with them. These issues will be discussed in more detail below.

Finally, accuracy in the gate-in and gate-out processes. To what extent are transport companies obligated to correctly complete the information in their online booking such as the container number, container prefix or truck registration number. If this is inaccurate, are they denied entry in the depot?

The number of scenarios which may arise are numerous depending on the individual commitment to chain operational efficiency as well as other relevant circumstantial

[9] Freightweek is an industry event which is held every two years by the Victorian Transport Association and the Victorian Automobile Chamber of Commerce. Its agenda incorporates a broad spectrum of industry issues. In Freightweek 2013, ten sessions took place in the course of five days; these included Technology Highway, Managing Congestion, Waterfront, Rail Trends, Trucks on Local Roads, Future Workforce, Road Transport Trends, Safety Day, Emergency Response Seminar and Freight Outlook.

factors. As a result, the issues emerging and the combinations and extent of issues are diverse.

We, thus, toy with the notion that superior automated practices by means of IT implementation are likely to reduce truck turnaround times. This stems from the anticipation that Containerchain will provide the means for streamlining gate-in and gate-out processes on the basis that container parks will be able to process trucks faster in an environment free of paperwork.

3.7 Stock management: an optimal level of integration

The purpose of stock management is to efficiently align active bookings which will ultimate translate into truck arrivals with available stock and avoid futile trips. Truck arrivals are determined by the slots in the system, that is, the capacity at the depot subject to its gate capacity, forklift capacity and particular events occurring at specific times. Thus, the management of stocks is restricted by the number of slots offered in the system in accordance with certain criteria.

The coordination of truck arrivals with available stock originates from the need to prevent futile trips at container parks in an effort to deliver the required service levels to transport operators. The rationale is that the payment of the Containerchain fee by transport companies should suffice to ensure the availability of stocks upon their arrival.

Arguably, the shipping line's involvement in terms of transferring the export release is key to the successful organisation of the depot's stocks. The export release provides the container park with the information regarding the empty containers that are to be released to transport operators on behalf of exporters. Thus, it advises the park on the bookings that become valid on a certain date, i.e., from that day on, if transport operators make an online pick-up booking for the collection of an empty container, they may arrive at any time.

Ideally, the export release should be sent in the form of an EDI message. Yet some shipping lines do not provide the information in this type of format, which would be updated automatically in Containerchain. The resulting manual input leads to human errors and labour intensive practices.

Not surprisingly, efficient stock management is not without its challenges. As suggested by various participants in this study, shipping lines are not willing to disclose their stock levels, protecting their commercial interests and maintain their competitive advantage. Hence, they tend to overbook so as to be competitive in the marketplace as well as to compensate for likely last-minute cancellations. As pointed out by the shipping line interviewed, disclosing inventory levels may have negative implications on prospective contracts with customers. On the one hand, stock levels are very dynamic if the workshop turnover is high. Consequently, an empty container may become available immediately after being dehired at the container park. On the other hand, freight forwarders continue to 'shadow book' with various shipping lines waiting for the letters of credit to be approved. This practice translates into an average drop-off rate per vessel of 15%. This, in turn, results in export releases not being utilised in the system and overbooking practices by shipping lines.

Furthermore, the management of stock levels by monitoring the 'pending movement screen' has demonstrated poor results and occasionally generates futile trips. This is discussed in more detail below.

In an attempt to fully understand and quantify operational efficiency we have designed a template which measures the level of operational efficiency for a number of chains. It constitutes a framework for the classification of empty-container chains as highly integrated, moderately integrated or fragmented (Table 3.3).

Table 3.1 Level of Supply Chain Integration with their corresponding operational efficiency score

LEVEL OF SUPPLY CHAIN INTEGRATION	OPERATIONAL EFFICIENCY SCORE
HIGH INTEGRATION	8.6-10 (>8.5)
MODERATE INTEGRATION	6-8.5
FRAGMENTATION	0-5.9 (<6.0)

The template noted above comprises a set of questions in which empty-container chains obtain a score according to the degree of operational efficiency in that specific area.

The overall operational efficiency score is based on the sum of the individual scores obtained in each of the seven questions listed in the chart.

The template is used to measure the degree of operational efficiency in a number of empty-container chains. The level of operational efficiency is measured on a 0-10 scale. A highly integrated empty chain will obtain a score greater than 8.5 (>8.5). In this category, chain participants co-operate with dyadic partners strengthening the linkages by sharing information upstream and downstream the chain in a timely and accurately manner.

A moderately integrated supply chain, on the other hand, shows signs of efficiency in some segments of the chain, that is, some parties engage in the transfer of information across the chain. These attempts to efficiently operate might not be properly utilised, however, if other members of the chain fail to share or manage the information in a timely manner. At this level we start to observe poor business practices detrimental to operational efficiency. We argue that a moderately integrated empty supply chain score may range between 6.0 and 8.5 (6-8.5).

In contrast, the signs of operational efficiency in a fragmented supply chain are fewer and dispersed across the chain. In addition to undisciplined management of resources and operational information, the exchange of data between partners may be insufficient and inconsistent, leading to disjointed chain links which reveal little operational efficiency among trading partners. Consequently, we suggest that any empty chain scoring less than 6 (<6) in the chart may be depicted as 'fragmented' or 'disintegrated'.

OPERATIONAL EFFICIENCY TEMPLATE	
1. CAPACITY MANAGEMENT	
1. Regulation of truck arrivals and prevention of delays (daily measure, however, an average of various days may be used) Capacity management score should be converted into a 0-3.5 scale, subject to the number of time windows in which values are comprised within the band of capacity management. Thus, no capacity management (0) and total capacity management (3.5)	____
2. PAPERLESS ENVIRONMENT (drop-offs)	
2. Use of FMTs at container parks? Yes 1 No 0	___
3. How many of the shipping lines that store at your container park send CRA – dehire Notifications – (EDI message) Rescale score into a 0-1 scale, subject to the number of shipping lines that send through CRA notifications relative to the total number of shipping lines that store at the container park. Thus, no shipping lines sending CRA (0) and all shipping lines sending CRA (1)	___
4. Are transport operators obligated to correctly populate all the fields in their online bookings such as container number, container prefix and truck registration number, otherwise, they are denied entry in the park? Yes 1 No 0	___
3. STOCK MANAGEMENT (pick-ups)	
5. Monitoring of pending movement screen (transport companies' online bookings) so as to prevent futile trips Yes 1 No 0	___
6. How many of the shipping lines that store at your container park send EXPORT RELEASES electronically (EDI message)? Score should be transformed into a 0-1 scale, subject to the number of shipping lines that send EXPORT RELEASES electronically relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending export releases (0) and all shipping lines sending export releases (1). If score is 1, continue to the next question, otherwise, skip.	___
7. Monitoring of shipping lines' active bookings and match that information against AVAILABLE STOCK. The whole purpose is to prevent futile trips Yes 1.5 No 0	___
OVERALL SCORE	

CHAPTER 4: CONTAINERCHAIN AND HIGH-LEVEL EFFICIENCY RESPONSES

4.1 Introduction

Thorough case study analysis has provided insights into the impacts of IT on the operational efficiency of empty-container chains by means of integrating partnering firms and business-related practices across the chain. It sheds light on the operational efficiency achieved in managing the supply of empty containers generated by import flows and the demand for export empty containers originated by shippers. It explores the efficiency achieved in integrating the operations of empty-container parks with that of shipping lines and transport operators in landside activities long perceived as non-value generating. The analysis also identifies the supply chain visibility provided by the system to effectively manage capacity and stock levels as well as enhanced making-decision processes by all stakeholders involved. Visibility is key to efficiently manage supply chain processes by virtue of seamless information flows that span across firms' boundaries. This is enabled by the support of technology that allows for intra and inter organisational collaboration (Clark, Croson & Schiano 2001). This IT software has, in fact, the potential to impact the efficiency of depots, container trucking and the shipping lines and their container/asset utilisation practices – in short, the levels and effectiveness of the relevant chain operations.

This research examined, in considerable detail, six empty-container chains focused through six depots considered to be representative of the operational practices observed among the set of depots in and around the port of Melbourne in 2013 and 2014. Clearly, each depot exhibits individual differences representing its particular circumstances, but in this chapter and in Chapter 5 we focus on the operations of three depots and their chains which demonstrate differing levels of integrative efficiency as revealed by the adoption of the Containerchain IT software solution. Particularly, we note the ways in which Containerchain has delivered high-level efficiency; but detailed analysis has revealed also that, for numerous reasons, less-than efficient and seriously inefficient outcomes are possible.

4.2 High-level efficiency responses: the profile of an efficient chain

Chain 1 is a highly integrated empty-container chain. The superior operational efficiency results from streamlined capacity and stock management practices as well as heightened automation of information that allows for improved gate-in and gate-out moves. The efficient coordination of supply chain operations is enabled by the operational linkages which emphasise the integration of interdependent processes and information flows that provide the means for players to effectively plan for efficient operations (Holcomb 2010). In addition, disciplined management practices have been demonstrated to be crucial in leveraging operational efficiency by means of competently utilising the tools and resources provided by this IT solution.

The overall operational efficiency score obtained in Chain 1 is of 9, which is greater than 8.5. Hence, this chain is regarded as highly integrated.

Chain 1 comprises:

- An empty-container park or depot which performs a storage service plus maintenance, steam-cleaning and related empty container services for
- A major shipping line;
- Two transport companies which provide services for a full range of customers including importers, exporters and freight forwarders. They typically drop-off and pick-up empty containers from multiple depots subject to the arrangements made between their customers – freight forwarders or cargo owners – and the shipping lines, which typically store containers in more than one container park;
- A transport and logistics professional with extensive experience in the transport industry as well as being a member of a transport association

Figure 4.1 is the Operational Efficiency Template for Chain 1 and provides a framework for more detailed comments in the following section of this chapter.

OPERATIONAL EFFICIENCY TEMPLATE- CHAIN 1	
1. CAPACITY MANAGEMENT	
1. Regulation of truck arrivals and prevention of delays (daily measure) The capacity management score should be converted into a 0-3.5 scale, subject to the number of time windows in which values are comprised within the band of capacity management. Thus, no capacity management (0) and total capacity management (3.5)	2.5
2. PAPERLESS ENVIRONMENT (drop-offs)	
2. Use of FMTs at ECPs? Yes 1 No 0	1
3. How many of the shipping lines that store at your ECP send CRA – dehire Notifications – (EDI message) Rescale score into a 0-1 scale, subject to the number of shipping lines that send through CRA notifications relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending CRA notifications (0) and all shipping lines sending CRA notifications (1)	1
4. Are CTOs obligated to correctly populate all the fields in their online bookings such as container number, container prefix and registration number, otherwise, they are denied entry in the park? Yes 1 No 0	1
3. STOCK MANAGEMENT (pick-ups)	
5. Monitoring of pending movement screen (CTOs' bookings) so as to prevent futile trips Yes 1 No 0	1
6. How many of the shipping lines that store at your ECP send EXPORT RELEASES ELECTRONICALLY (EDI MESSAGE)? Score should be transformed into a 0-1 scale, subject to the number of shipping lines that send EXPORT RELEASES electronically relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending export releases (0) and all shipping lines sending export releases (1). If score is 1, continue to the next question, otherwise, skip.	1
7. Monitoring of shipping lines' active bookings and match that information against AVAILABLE STOCK. The whole purpose is to prevent futile trips Yes 1.5 No 0	1.5
OVERALL SCORE	**9**

Figure 4.1 The profile of an operationally efficient chain

4.3 Capacity management in a highly integrated empty-container supply chain

Concerning the management of slots in the system, it is the depot the one that establishes the restrictions on capacity, that is, maximum and optimum capacities. However, evaluating the accuracy of the maximum and optimum capacities implemented by the container park is beyond the breadth of this study and further work needs to be undertaken to establish the appropriateness and accuracy of these measurements. In addition, the measures introduced by the depot to obtain a constant flow of trucks contained within the band of capacity management are administered at the container park's discretion.

So, this raises the question, what is the band of capacity management? The band of capacity management is a range of values that we estimated at 100% of capacity – or maximum capacity – and 40% of capacity. This band quantifies the number of time windows – or percentage of time windows – in which capacity is neither over utilised (>100%) nor underutilised (<40%) for a particular time interval. The purpose, thus, is to assess whether truck moves are apportioned across the operating day by way of capitalising on the underutilised capacity, which provides the means for the elimination of undesired delays at the container park.

4.3.1 Day 1 – truck arrivals

The 2.5/3.5 score obtained for capacity management by Chain 1 derives from the data contained in the Container ETA (Estimated Time of Arrival) monitors and refer to each of four days. The allocation of these dates was selected by the participant in response to what was the typical capacity at a container depot on a normal day. The purpose was to avoid days in which capacity was excessively adjusted, thereby, possibly leading to truck moves not being contained within the band.

Figure 4.2 refers to truck arrivals on Day 1 – a typical working day at the depot. The red line corresponds to maximum capacity, which typically is 35 truck arrivals in a 30 minute time window. The green line relates to optimum capacity, which typically is 25 truck arrivals in a 30 minute time window. These two values are uniform should the capabilities of the depot remain constant without unexpected events at the container park. The blue line represents indicated arrivals, that is, number of online notifications made by transport companies indicating the intent to arrive at the depot at a particular time window. The purple line denotes actual truck arrivals – that is the actual number of truck moves during a specific time window.

Further, in relation to the measures of management capacity, the depot does not restrict maximum capacity – that is, transport operators are allowed to book above the stated maximum capacity if required. Furthermore, there are no restrictions on truck arrival times, i.e., truck moves are not restricted to 30 minutes either side of their allocated time window. Thus, transport companies may make a booking for a particular time window and arrive at a time of their convenience.

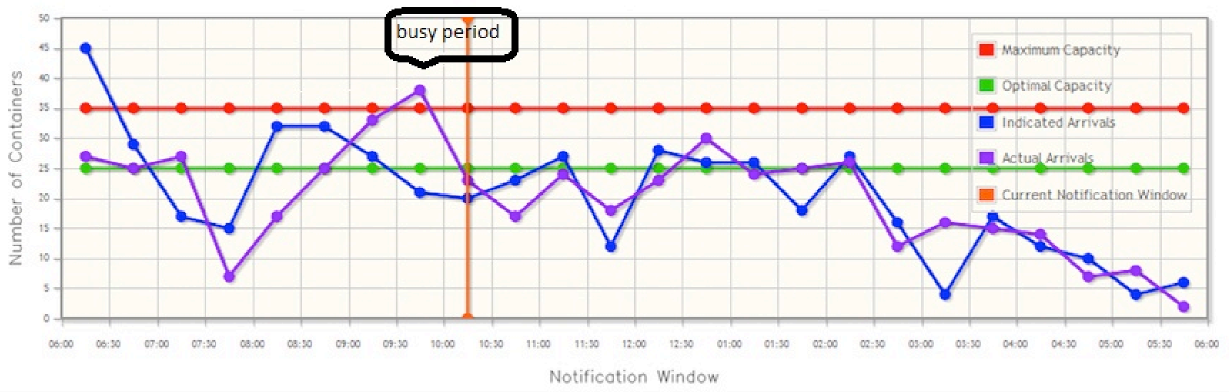

Figure 4.2 Container ETA monitor – truck arrivals recorded for Day 1

Figure 4.2 indicates that the depot opens for 12 hours (6 am-6pm) and there are 24 time windows in an operating day. At the start of the day – first time window – transport companies book above maximum capacity, however, only 27 arrive. During the 09:30-10:00 time window, actual arrivals slightly exceed maximum capacity, resulting in a small queue or busy period that quickly disappears in the next time window. For the rest of the day, both indicated and actual arrivals remain below maximum capacity, which indicates absence of delays and a constant flow of truck moves across the day.

The purple line indicates actual arrivals which flows quite closely to the blue line – indicated arrivals, which suggests that transport operators typically honour their preferable time to arrive at the depot.

Table 4.1 Analysis of truck arrivals for Day 1

TIME WINDOW	ACTUAL ARRIVALS Day 1	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:00-06:30	27	35	25	45	77%
06:30-07:00	25	35	25	29	71%
07:00-07:30	27	35	25	17	77%
07:30-08:00	7	35	25	15	20%
08:00-08:30	17	35	25	33	49%
08:30-09:00	25	35	25	33	71%
09:00-09:30	34	35	25	27	97%
09:30-10:00	37	35	25	22	106%
10:00-10:30	24	35	25	20	69%
10:30-11:00	17	35	25	24	49%
11:00-11:30	24	35	25	27	69%
11:30-12:00	19	35	25	13	54%
12:00-12:30	24	35	25	28	69%
12:30-13:00	30	35	25	26	86%
13:00-13:30	24	35	25	26	69%
13:30-14:00	25	35	25	18	71%
14:00-14:30	26	35	25	27	74%
14:30-15:00	13	35	25	16	37%
15:00-15:30	16	35	25	4	46%
15:30-16:00	15	35	25	17	43%
16:00-16:30	14	35	25	13	40%
16:30-17:00	7	35	25	10	20%
17:00-17:30	8	35	25	4	23%
17:30-18:00	2	35	25	6	6%

Table 4.1 represents truck arrivals for Day 1. During 18 out of 24 time windows – or 75% of time windows – actual truck arrivals remain within the boundaries of effective capacity management, that is, 100% of capacity – or maximum capacity – and 40% of capacity; meaning that truck arrivals are rather apportioned across the operating day. For the remaining 6 time windows, capacity is underutilised (<40%) during 5 or 21% of the time windows; especially towards the end of the working day as transport companies' demand for slots in the system lessens. In contrast, only during 1 time window or 4% of the time windows actual arrivals slightly exceed maximum capacity, and this busy period is rapidly dealt with and, hence, the normal truck traffic reinstated.

The average overall capacity utilised throughout the day is 58%, leaving a 42% of capacity unutilised. This shows that a high percentage of the overall capacity is unutilised and will be elaborated further on in this chapter.

4.3.2 Day 2 – truck arrivals

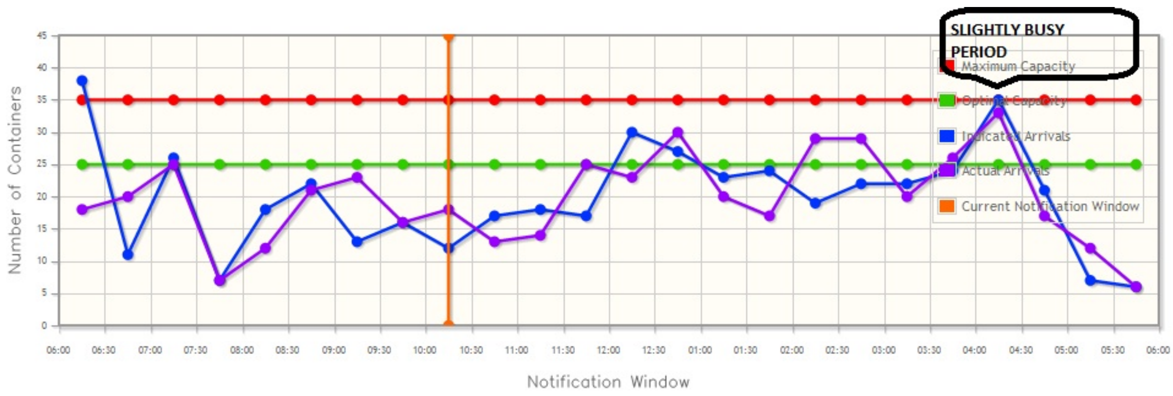

Figure 4.3 Container ETA monitor – truck arrivals recorded for Day 2

Figure 4.3 corresponds to truck moves for Day 2, which also depicts the conventional volume of truck traffic at the container park during a normal day. As in the previous graph, bookings exceed maximum capacity during the first time window of the day but actual arrivals stay below optimum capacity. Until midday, both indicated and actual arrivals remain below optimum capacity and from then on, indicated and actual arrivals fluctuate between maximum, optimum and below optimum capacities. The most active period of the day takes place during the 4:00-4:30 pm time window; however, this remains just below maximum capacity and actual arrivals quickly drop down to below optimum capacity in the next time window.

Table 4.2 Analysis of truck arrivals for Day 2

TIME WINDOW	ACTUAL ARRIVALS Day 2	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:00-06:30	18	35	25	38	51%
06:30-07:00	20	35	25	11	57%
07:00-07:30	25	35	25	26	71%
07:30-08:00	7	35	25	7	20%
08:00-08:30	12	35	25	18	34%
08:30-09:00	21	35	25	23	60%
09:00-09:30	23	35	25	13	66%
09:30-10:00	16	35	25	16	46%
10:00-10:30	18	35	25	12	51%
10:30-11:00	13	35	25	17	37%
11:00-11:30	14	35	25	18	40%
11:30-12:00	25	35	25	17	71%
12:00-12:30	23	35	25	30	66%
12:30-13:00	30	35	25	27	86%
13:00-13:30	20	35	25	23	57%
13:30-14:00	17	35	25	24	49%
14:00-14:30	29	35	25	19	83%
14:30-15:00	29	35	25	22	83%
15:00-15:30	20	35	25	22	57%
15:30-16:00	26	35	25	24	74%
16:00-16:30	33	35	25	35	94%
16:30-17:00	17	35	25	21	49%
17:00-17:30	13	35	25	7	37%
17:30-18:00	6	35	25	6	17%

Table 4.2 above shows truck moves for Day 2. It indicates that during 19 or 79% of the time windows truck moves remain within the bounds of streamlined capacity management, indicating, again, that there is a constant flow of trucks across the day. In the remaining 5 or 21% of time windows that fall outside of this band, capacity is underutilised; in other words, actual truck arrivals never exceed maximum capacity across the operating day. Part of this underutilised capacity takes place at the end of the operating day and results from a decrease in the transport companies' demand for capacity in the system; since typically after 4:00/4:30 pm industry trading activities decline as some supply chain members' working hours conclude.

The average overall capacity used across the day is 57%, implying that 43% of the capacity is unmet. Again, these figures demonstrate high levels of overall unutilised capacity, which will be discussed further in the chapter.

4.3.3 Day 3 – truck arrivals.

Figure 4.4 shows truck arrivals for Day 3 which, again, represents a prototypical working day at the depot with no unexpected events.

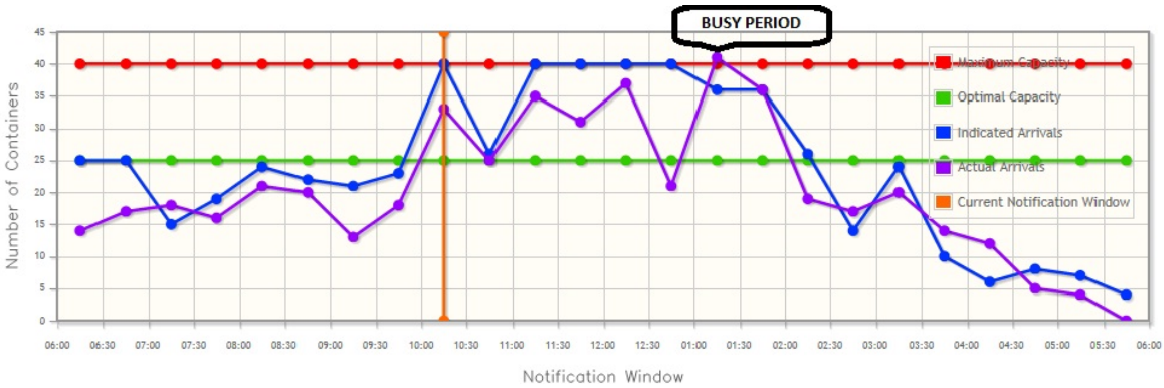

Figure 4.4 Container ETA monitor – truck arrivals recorded for Day 3

In Figure 4.4, both indicated and actual arrivals run below optimum capacity until 10 am. From 10 am until 2 pm, actual arrivals fluctuate between maximum and optimum capacities with a slightly busy period in the 1:00-1:30 pm time window that progressively dissipates in the next hour. Further, from 11 am until 1 pm, slots are consistently booked to maximum capacity; however, the actual volume of truck moves remains below this mark. It should be noted that indicated arrivals – or bookings – do not exceed maximum capacity across the operating day. Hence, this leads us to argue that transport companies abide by the parameters set in place by the depot since they, potentially, could book above maximum capacity.

From 2 pm onwards, indicated and actual arrivals gradually decline in number as the day progresses, remaining below optimum capacity.

Table 4.3 Analysis of truck arrivals for Day 3

TIME WINDOW	ACTUAL ARRIVALS Day 3	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:00-06:30	14	40	25	25	35%
06:30-07:00	17	40	25	25	43%
07:00-07:30	18	40	25	15	45%
07:30-08:00	16	40	25	19	40%
08:00-08:30	21	40	25	24	53%
08:30-09:00	20	40	25	22	50%
09:00-09:30	13	40	25	21	33%
09:30-10:00	18	40	25	23	45%
10:00-10:30	33	40	25	40	83%
10:30-11:00	25	40	25	26	63%
11:00-11:30	35	40	25	40	88%
11:30-12:00	31	40	25	40	78%
12:00-12:30	37	40	25	40	93%
12:30-13:00	21	40	25	40	53%
13:00-13:30	41	40	25	36	103%
13:30-14:00	36	40	25	36	90%
14:00-14:30	19	40	25	26	48%
14:30-15:00	17	40	25	14	43%
15:00-15:30	20	40	25	24	50%
15:30-16:00	14	40	25	10	35%
16:00-16:30	13	40	25	6	33%
16:30-17:00	5	40	25	8	13%
17:00-17:30	4	40	25	7	10%
17:30-18:00	1	40	25	5	3%

The Table above displays truck moves for Day 3. It reveals that 16 or 67% of the time windows are situated within the band of capacity management, that is, truck moves are generally distributed across the day. In the remaining 8 time windows, capacity is underutilised in 7 or 29% of the time windows; and as in previous days, most of this underutilised capacity occurs towards the end of the operating day as transport operators demand fewer slots to cover their needs stemming from a decrease in industry commercial activities. Conversely, only during 1 or 4% of the time windows maximum capacity is vaguely exceeded and this busy period is quickly remedied and, hence, a controlled flow of trucks restored.

The mean overall capacity used across the day is 51%, which translates into 49% of the capacity not being utilised. Once more, this container park displays high levels of overall unutilised capacity and as noted above, this matter will be explained further on.

4.3.4 Day 4 – truck arrivals

Figure 4.5 portrays the flow of trucks for Day 4, in which a twilight bulk run[10] kicks off at 2 pm and goes on, at least, until closing time at 6 pm.

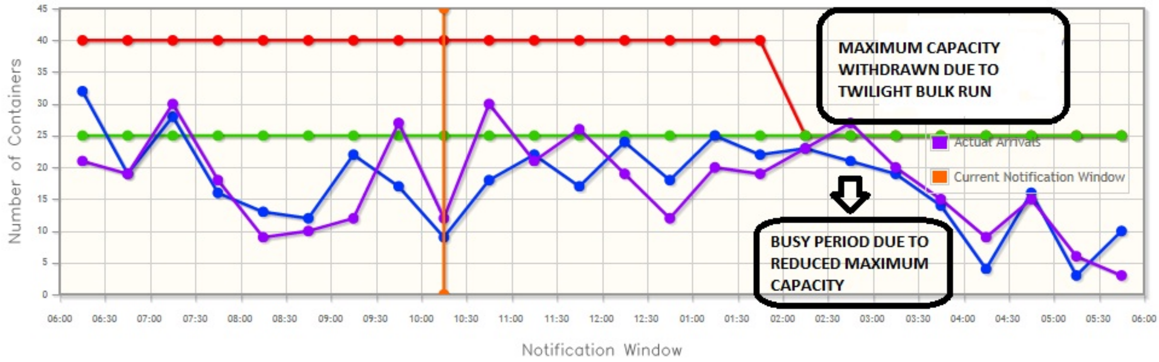

Figure 4.5 Container ETA monitor – truck arrivals recorded for Day 4

During this bulk run maximum capacity is pulled down to optimum capacity levels, pointing to decreased capabilities at the depot as a result of combining the regular gate-in and gate-out of empty containers with the additional workload of a bulk run. This reduction in capacity and capabilities in the container park provides transport operators with the required visibility so as to make an informed decision in terms of effectively deploying their resources at the container park or elsewhere.

Both indicated and actual arrivals remain well under maximum capacity until 2 pm. During the 2:30-3:00 pm time window there is a slightly busy period as a result of the reduced capacity at the container park and from then on, indicated and actual arrivals slowly decrease in number as the day goes on. In this depot, bulk runs are recorded in

[10] A bulk run refers to the redirection of empty containers from the container park to the terminal so as to be repositioned to deficit offshore locations since these empty containers have not been loaded with export cargo. Typically, the container park notifies the terminal of this movement using an EDI message called a 'Stack Run Interface'.

the system, which means that capacity is automatically removed out of the system, disclosing this withdrawn capacity to the industry. It should be stated that, irrespective of the bulk run, this does not negatively impact on the regular traffic of trucks at the depot since transport operators could theoretically book over optimum capacity if required and both indicated and actual arrivals remain well under optimum capacity. This, again, implies that transport companies conform to the disciplines enforced by the container park.

Table 4.4 Analysis of truck arrivals for Day 4

TIME WINDOW	ACTUAL ARRIVALS Day 4	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:00-06:30	21	40	25	33	53%
06:30-07:00	19	40	25	19	48%
07:00-07:30	30	40	25	29	75%
07:30-08:00	18	40	25	16	45%
08:00-08:30	9	40	25	14	23%
08:30-09:00	10	40	25	13	25%
09:00-09:30	13	40	25	23	33%
09:30-10:00	26	40	25	17	65%
10:00-10:30	13	40	25	10	33%
10:30-11:00	30	40	25	18	75%
11:00-11:30	21	40	25	23	53%
11:30-12:00	26	40	25	17	65%
12:00-12:30	19	40	25	24	48%
12:30-13:00	13	40	25	19	33%
13:00-13:30	20	40	25	25	50%
13:30-14:00	19	40	25	23	48%
14:00-14:30	23	25	25	24	92%
14:30-15:00	27	25	25	21	108%
15:00-15:30	20	25	25	19	80%
15:30-16:00	15	25	25	14	60%
16:00-16:30	10	25	25	4	40%
16:30-17:00	15	25	25	16	60%
17:00-17:30	6	25	25	3	24%
17:30-18:00	4	25	25	10	16%

As shown in Table 4.4, 16 or 67% of the time windows fall within the range of capacity management, which suggests that, by and large, truck traffic is evenly apportioned across the working day. Similar to the previous table, from the remaining 8 time windows that fall outside of this band, during 7 or 29% of the time windows capacity is underutilised; in particular during the last hour – or the last two time windows – of the operating day. This mirrors the reduced transport carriers' demand for slots in Containerchain as industry business activities lessen across the chain. Consequently, maximum capacity is moderately exceeded only once – or during 4% of the time windows – throughout the operating day.

In addition, the average overall capacity used throughout the day is 52%, implying that 48% of the capacity is not utilised. As previously noted, this denotes high levels of low truck activity and this will be explained further on.

4.3.5 Remarks: capacity management in a highly integrated chain

On the basis of the data collected during these four operating days, the following conclusions can be drawn regarding the management of capacity at the empty-container park.

The average operational efficiency score obtained for capacity management is 2.5 out of 3.5. This overall score was obtained by calculating the average of the sum of the individual daily scores for the above mentioned days. This suggests that for the four days analysed, during 72% of the time windows, truck moves fall within the range of efficient capacity management, that is, maximum capacity – or 100% of capacity – and 40% of capacity. This figure demonstrates that, largely, truck moves are evenly distributed across the operating days, eliminating the undesired peaks and troughs in truck traffic at the container park's gates. Conversely, for the most part of the remaining time windows that fall outside of the band – 24% of the time windows, capacity is underutilised (<40%); particularly towards the end of the working days, when transport carriers demand less capacity in response to a decline in the commercial activities occurring in the industry. In consequence, maximum capacity is only exceeded during 3% of the time windows for the days examined. This low percentage of exceeded capacity corresponds to three busy periods that take place in isolation in three out of the four days under study. This indicates that maximum capacity is never exceeded during two consecutive time windows – truck moves may surpass maximum capacity during one time window and then subside to more manageable capacity levels.

Further, the depot indicates that since Containerchain started, it has not seen a day in which multiple continuous windows surpassed maximum capacity. If this occurred "it would go over maximum capacity once, so generally we always catch up”. In addition, the container park could not consistently go above maximum capacity since no other depot services, such as repairs or steam cleaning services, could be performed. Thus, while servicing the queue takes priority over the rest of the depot activities, it would not be feasible to allocate all the depot’s resources to only gate in and gate out empty containers since, eventually, the park would run out of empty containers and, hence, come to a standstill.

We hereby conclude from the data analysed that this empty-container park is very rarely congested. Further, the overall unutilised capacity indicates that during ¼ of the time windows for the days examined, the container park experiences periods of low truck activity. While the score obtained by this depot for capacity management level is not higher than the one obtained by other container parks, it must be noted that it exhibits the highest percentage of unutilised capacity. Why is this worth noting? From a capacity management perspective, it is preferable to have unused slots in the system than lengthy queues that spill out on to the neighbouring streets causing undesired bottlenecks and adversely affecting residential amenities of adjoining properties. The rationale behind this statement lies in the fact that queues are the main issue at hand, while unused capacity is the formula to resolve congestion issues. Namely, the purpose of having truck moves within a band that we estimated at 100%-40% of capacity is to have a constant flow of trucks, preventing the alternation of periods of inactivity with periods of excess demand. Further, these fluctuations in truck activity may be prevented by means of using the available slots in the system, which will, in turn, result in fewer delays at the container parks.

During the course of the data collection, different container parks pointed to the lack of records concerning the analysis of queuing before the implementation of Containerchain. Data on queuing times before the introduction of Containerchain do not exist and it was not possible to compare performance before and after its introduction as there is no basis for comparison. The depot noted, however, that since the company went live with this IT application it had not had any issues with any regulatory body resulting from undesired delays as well as heavy vehicle driver fatigue management.

Concerning the imposition of measures so as to regulate truck traffic, the depot notes that the introduction of restrictions on maximum capacity is uncalled for as this is rarely exceeded. That is, the average capacity utilised during the days examined was 54%, leaving 46% of the capacity unutilised; which indicates that a significant number of slots are unused, i.e., the depot's capabilities to service trucks greatly exceeds the present transport operators' demand for slots in the system.

Consequently and arguably, this depot is not required to implement restrictive measures such as a quota on maximum capacity as well as restrictions on truck arrival times. As specified by the participant – the depot, if the transport operators' demand for slots in the system was higher, that is, if the levels of utilised capacity were greater and, likely, maximum capacity was exceeded on a regular basis it would need to introduce stricter gate access measures[11]. Further, the adequacy of these operating rules to regulate truck arrivals is not in question. Conversely, we argue that these measures are highly useful in managing truck traffic so as to obtain a uniform and predictable flow of truck moves across the operating day, preventing undesired delays as well as the randomness of truck arrivals at the depot. These measures, thus, assist in attaining certainty of gate moves. As argued by the depot "If truck queuing became an issue then the company would consider it and put the same rules in place".

The depot underscores, also, that to efficiently regulate truck arrivals it is important to have constant optimum and maximum capacities across the operating day, that is, not to adjust capacity regularly unless there is an operational impact on the normal flow of trucks, such is in a large bulk run – Day 4. Furthermore, the container park notes that frequently changing the capacity may lead to confusion among transport companies with regard to maximum capacity is likely leading to erratic truck arrival patterns and

[11] *"Depot: Different parks run it differently, some people cap and will not accept bookings above maximum capacity. If it became an issue in terms of truck queuing, that's something that I'd potentially look at. Until it becomes an issue and I'll always look ahead and make sure it doesn't become a constant problem, but if it did become a problem, well, we could put the same rules in place".*

delays at the depot. This is the basis for the consistency recorded in the maximum and optimum capacities in three out of the four days under study.

We thus infer that maintaining consistent levels of maximum and optimum capacities across the operating day stimulates a predictable and regular transport companies' behaviour. This reasoning originates in the fact that maximum capacity is unrestricted, allowing transport carriers to book above maximum capacity if desired. Yet, this regularity in truck arrival patterns may be enabled by the fact that there is plenty of unmet demand in the system, that is, if there is a significant amount of unused capacity in the system, it is uncalled for to adjust capacities as the supply of slots by the depot greatly surpasses transport operators' demand. Conversely, if capacity is constricted, as it occurs in other container parks adjusting capacities would be an effective measure to regulate truck moves inasmuch as there are other gate access regulating measures in place such as the quota on maximum capacity or the 30-minute either side of the allocated time window entry policy.

4.4 Paperless environment in a highly integrated empty-container supply chain

4.4.1 Introduction

The score attained for the paperless environment by Chain 1 is 3 out of 3. This results from collaborative efforts among chain partners, which support coordinated actions that provide the means for superior operational efficiency. Further, in order for an empty-container chain to exhibit an efficient paperless environment, all supply chain participants need to be on board to collaboratively work towards achieving a true setting free of paperwork

So, what is a paperless environment? A paperless environment is a physical setting devoid of paperwork exchanges between stakeholders, in which information flows electronically and with minimum human interaction. This generates shorter truck turnaround times resulting from streamlined operational practices to gate more empty containers in and out of the container park. It is, hence, an environment with the least possible physical contact among truck drivers, forklift drivers and the office staff.

And, how do stakeholders benefit from a paperless environment? First, as noted above and further evidenced in the chapter, a real paperless environment leads to increased depot capabilities to service trucks more expeditiously, that is, it generates shorter truck turnaround times, which, in turn, generates a greater capacity to offer more slots in the system. These shorter truck turnaround times are also beneficial for container parks in terms of adhering to the heavy vehicle driver fatigue regulations, by which truck turnaround times should not exceed 30 minutes from the moment the truck joins the queue. Second, pursuant to discussions held with experts in the logistics and transport fields, the cost to run a truck in Australia is approximately \$2/min. This figure is based on 2 x 8 hour shifts, 5 days a week – Monday to Friday. This estimate may decrease if more shifts or extended hours are worked. However, industry experts stated that trucks typically run two shifts per day, five days a week (Monday-Friday). A detailed breakdown of this cost is shown below:

COST TO RUN A TRUCK IN AUSTRALIA	
Labour	\$35/hr
Fuel	\$20/hr
Prime mover	\$50/hr
Other (registration, insurance, etc.)	\$15/hr
TOTAL	\$120/hr

Thus, from a transport operator's standpoint shorter truck turnaround time and the least amount of time spent in a container park's premises, whether it is queuing, loading or unloading empty containers, the more efficient utilisation of time and resources.

4.4.2 Paperless environment: the shipping lines' and transport carriers' input

Prior to a ship entering territorial waters of any country, it must send an electronic shipping manifest to the terminal. This document lists all cargo contained in the ship as well as passengers and crew. In Australia, this electronic manifest is transferred to 1-Stop, which is the IT software system operated by the stevedores. Following this, 1-Stop forwards it to Customs and the Department of Agriculture, Fisheries and Forestry (DAFF), ex Australian Quarantine and Inspection Service (AQIS). While all shipping lines must comply with this procedure as imposed by regulatory bodies, only 75% of the dehire notifications are transmitted to Containerchain.

Figure 4.6 indicates that in the event that the manifest is transferred to Containerchain, the software filters all the information per container park automatically and systematically sends the Container Return Advice (CRA) – EDI message – to each individual empty-container park indicating the container numbers that are anticipated to be returned from a specific vessel. Thus, the CRA specifies what containers the depot may expect to be dehired within a few days or weeks.

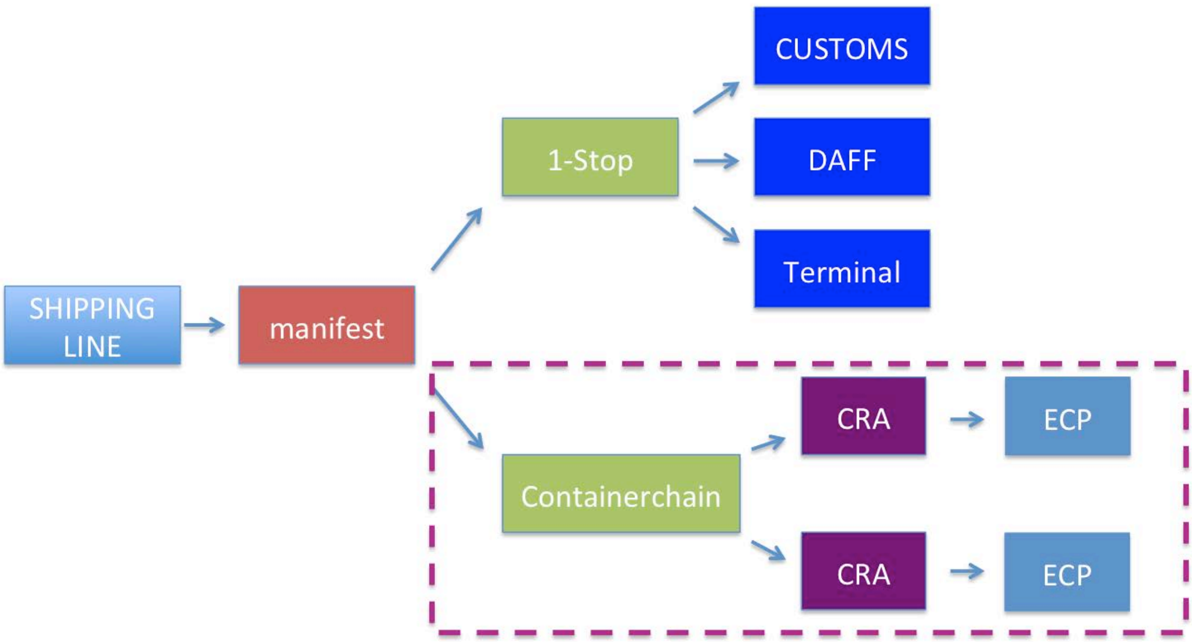

Figure 4.6 Manifest transfer from shipping line to Containerchain and 1-Stop

The following data must be included in all CRA communications from shipping lines to container parks (Tradegate 2009):

- Message function, e.g. original, cancellation, replacement
- Issue date/time
- Lloyd’s number
- Voyage number
- ETA (Estimated Time of Arrival) of vessel
- Port of discharge
- Message recipient
- ISO type
- Container number (s)
- Number of containers by type
- Container park to be returned

If this information is not transmitted electronically via Containerchain, the shipping line typically emails to the container park all the details of the containers that are expected to be dehired from a vessel. Conversely, this information is not automatically updated in the system and, hence, needs to be manually entered in the container park’s IT system. Thus, this is time that could have been saved if the shipping line had transferred the shipping’s manifest to Containerchain; in addition to all the potential human errors associated with manually entering data.

Concurrently, the shipping line releases an Electronic Delivery Order (EDO) to the customer, who typically is a freight forwarder or an importer. This document is then passed on electronically to the transport operator for the dehire of the empty container at the container park.

In the instances in which the EDO is not transferred electronically, the shipping line issues a physical delivery order – or handover – comprising all the container details.

This document is then transferred to their customer, who, in turn, passes it on to the transport operator who needs to show it at the gatehouse of the container park where it is matched against their records.

Typically, the shipping lines that share the manifest with Containerchain are the ones that issue an EDO to their customers. Similarly, the shipping lines that do not transmit this information to Containerchain are the ones that still deal with physical delivery orders.

And, how does the port-oriented landside benefit from this electronic transfer of information?

Traditionally, there has been a commercial and operational disconnect among empty-container parks, shipping lines and transport operators. While container parks' revenue comes mainly from shipping lines, these depots operationally interact with transport operators, who typically work for the shipping lines' customers – freight forwarders and cargo owners. Thus, the operational inefficiencies to which transport companies are subject at the container parks' gates, do not directly affect the container parks' customers, the shipping lines (ACCC 2011). As pointed out by most participants, this situation results from the indifference that some shipping lines' show towards landside container flows since they are not directly impacted by these challenges. Comparably, some shipping lines deem as irrelevant any contributions to achieve operational gains if they are not directly affected by these improvements. Thus, a setting free of paperwork for more expeditious empty collections and returns and thus shorter truck turnaround times may, in actual fact, have implications for a higher turnover of the shipping lines' assets. Yet, and as noted by some participants, shipping lines focus their efforts on the portside and terminal operations on the basis that these are revenue generating activities, whereas landside mainly creates expenditure to cater for export trade. We will delve into these matters further on.

As indicted by the depot, there is a full electronic interface between their customers – the shipping lines – and the depot via Containerchain. This electronic exchange of data between shipping lines and container parks is transmitted by means of EDI, which may be classified as:

- GATE-IN: empty return. Message from the container park to the shipping line.
- GATE-OUT: empty collection. Message from the container park to the shipping line.
- BOOKING RELEASE: shipping line releases empty containers for export cargo. Message from the shipping line to the container park. Unfortunately, not all shipping lines transfer this information electronically via EDI. Consequently, this booking release might need to be manually typed in by the container park personnel.
- REPAIR ESTIMATE: quotation on a container repair. Message from the container park to the shipping line.
- REPAIR APPROVAL: the quotation regarding the repair is either approved or rejected by the shipping line. Message from the shipping line to the container park.
- STATUS UPDATE: change in the status of a container. From the moment the empty container is dehired at the depot, various services may need to be performed so as to prepare it for collection. Every time there is a modification in the status, the shipping line is notified. Thus, the message is transmitted from the container park to the shipping line.
- CONTAINER DEHIRE: this message hinges on the shipping line transferring the manifest to Containerchain. Unfortunately, not all shipping lines share this information. Thus, container parks may be uninformed of the return of empty containers coming from a vessel until the dehire online notification is made by the transport company and, thereby, appears on the pending movements screen. Therefore, this message is transferred from the shipping line to the container park.
- STACK RUN INTERFACE: notification of a bulk run from the container park to 1-Stop/terminal.

As pointed to by the depot, the paperless environment it provides prevents truck drivers from getting off and on their vehicles, moving around the depot as well as handling paperwork. The staff at the gatehouse ensures that the transport company has made a notification – online booking – either for a collection or a return. They also confirm that the details of the notification are accurate, that is, that the electronic notification comprises the right container number and shipping line's prefix – for drop-offs – as well as the correct truck registration number. They may validate this information by sighting the truck from the gatehouse as the truck drives through. This validation process is particularly important for empty returns since the online notification has to be in sync with the CRA in terms of container number as well as shipping line's prefix and dehires can only be paperless if the shipping lines has transferred the manifest. If this was not the case, the transport operator would need to proceed to the gatehouse with a physical delivery order. The paperless environment for dehires is subject to the shipping lines' input so as to make the supply chain more efficient.

At the time of making an online booking – for both collections and dehires, the transport operator selects a time slot to arrive at the depot. In this process, as one of the transport operators specifies below, it may enter a false truck registration number, which it may amend at a later stage when it knows which truck will do that particular job[12].

Yet, this may cause issues at the depot gates if the transport operator does not amend the registration details and arrives at the container park with incorrect information in the online notification. As indicated by the depot, if a truck arrives at its premises with no notification or if the information contained in the notification is inaccurate or insufficient, the truck will be denied entry to the container park.

Thus, if there are any issues with the notifications made by the transport operators, these are dealt with at the gatehouse before the trucks enters the container park. Therefore, one of the main tasks performed by the gatehouse staff is to verify that notifications have been made and the details contained in the notification are correct. The rationale behind this is that, in the event of an issue with a notification, the forklift

[12] *" we go through and book slots throughout the day and* ***put a fake rego in****, (…) well this needs to be dehired at 1 pm. When we know who is going to do that job we simply go back and amend this and put the correct rego in. It's one of the only ways that you can get around this if you want to actually do that job that day".*

driver does not deal with it instead, maximises his time by focusing on loading and unloading trucks in the shortest period of time.

This utilisation of the forklift drivers' time translates into maximum financial gains for the container park by means of concentrating their efforts in gating empty containers in and out of the container park in the shortest time interval. In addition, transport companies also benefit from this prompt service of their trucks as it shortens their truck turnaround times, in particular, the transaction times at the container park. As noted above, the average truck running cost in Australia is $2/minute and maximum financial benefit may be gained from minimising the transport operators' time at the container park.

4.4.3 Paperless environment: the depots' input: IT systems in place

Once the truck's notification has been verified, the staff at the gatehouse enters the truck registration number into the system and books the truck movement in and the system creates a container dehire advice for returns or a container pickup advice for collections. This movement then goes into a job pool for either collections or returns that the forklift driver will be able to visualise in the FMT.

First, if the truck is dropping-off the empty container, the driver will be sent to the drop-off lane and this job will appear in the FMT located in the forklift. The purpose of this device is to perform container enquiries, as well as to book empty containers in and out of the yard; thus, the FMT finalises the gate-out and gate-in process of empty containers at the depot. So, once the truck is in the unloading area, the forklift driver confirms that the information contained in the FMT's screen – container number booked in by the office staff and truck registration number – matches the container number that he is about to unload as well as the actual registration number of the truck. The forklift driver then lifts the container off the truck, confirms the dehire and the container is then automatically gated-in. This movement is then transferred to the shipping line as a gate-in EDI message.

Second, if the truck is collecting an empty container, it is a similar process to the dehire and will be sent to the load lane. Once the truck is in the loading area, this job will then show up in the forklift driver's FMT – that is, the truck registration number associated with a specific shipping line's prefix, ISO type and grade. Next, he matches the truck registration number on the screen to the actual registration number of the truck and types in the last four digits of the container that he is going to load onto the truck and books it out. This movement is then transmitted to the shipping line as a gate-out EDI message.

To complete the paperless process it is necessary to have FMTs in all the forklifts that book empty containers in and out of the container yard finalising the task by means of transferring this information to the shipping lines via EDI message. As specified by various respondents, the FMT eliminates a significant number of 2-way communications between the forklift driver and the office since it allows the forklift driver to access the same container stock records as in the office. Also, by having access to future jobs in their FMTs – that is, the truck movements that have been booked in by the office staff – forklift drivers may organise the workload accordingly without having to be instructed by the gatehouse to perform those tasks. Thus, if the forklift driver drives past a stack of containers, he may take hold of a container and load it onto the truck and book it out by typing in the last four digits of the container number. Hence, this increases the depot efficiencies by servicing the trucks more expeditiously, that is, loading and unloading trucks in a more efficient manner which results in streamlined container gate-in and gate-out processes and reduced truck turnaround times at the depot gates.

4.4.4 Impacts of the paperless environment on depot capacity levels

The container park indicated that since the implementation of Containerchain, the daily capacity to process trucks has significantly increased in view of the modernisation of the container park's processes and resources to gate-in and gate-out empty containers in a more efficient fashion. On the one hand, the introduction of this IT solution has brought about a uniform and predictable flow of truck moves across the operating hours of the park by allocating maximum and optimum capacities per time window; hence, preventing the peaks and troughs caused by periods of underutilised capacity coupled with periods with extensive waiting times at the depot. This even distribution of truck traffic across the day has contributed to reducing the average truck turnaround time at the container park by eradicating delays and lengthy queues and by preventing a significant number of trucks from arriving simultaneously at the container park. Thus, the regulation of truck arrivals throughout the operating day provides the means for reduced waiting or queuing times at the depot which, in combination with transaction times results in reduced overall truck turnaround times.

On the other hand, the paperless environment has generated significant time savings, in particular transaction times at the depot. First, shipping lines must share the shipping manifest with Containerchain and, consequently, the system provides the container park with the CRA – that is, the containers that are due to arrive from a certain vessel. In addition, transport operators must make an online notification that must be accurately completed with the correct container number and shipping line's prefix – for dehires – as well as the correct truck registration number. Should these two previous conditions apply, the truck driver does not need to leave the truck. It may drive straight into the loading and unloading area once the office staff has validated the notification by sighting the truck registration number. Second, empty-container parks must use FMTs to gate-in and gate-out empty containers. The use of these tablets significantly accelerates the loading and unloading processes for the reasons previously stated.

Hence, a setting free of paperwork together with an even distribution of truck arrivals across the day results in, first, reduced transaction times and, second, reduced waiting times. These two combined generate shorter truck turnaround times!

As with queuing times, there are no accounts on truck turnaround times before the introduction of Containerchain. While the system currently provides information regarding truck turnaround times this information is not accurate and/or reliable. Yet, the implementation of the Autogate system will allow for the effective quantification of truck turnaround times, which, for the time being, has not been implemented in any container park.

The Autogate system is an application that is purchased from Containerchain. It needs to be installed in a device, such an IPhone, IPad or Smartphone. The purpose is to facilitate the recognition of truck arrivals and, thus, measure the turnaround times of trucks by breaking in and out of a couple of perimeters. When the truck breaks in the first geo fence – or perimeter – a green or red light will be displayed on the screen of the device. That is, green denotes that a valid notification has been made and that the information contained in the notification is accurate and that the truck arrival time is correct if the depot has imposed time access disciplines in the system. Alternatively, red indicates an issue with the information noted above. When the truck breaks in the second geo fence, the system automatically autogates the truck into the system and the truck may drive straight into the loading or unloading area. In some container parks, the truck turnaround time may finish when the empty container is loaded or unloaded, i.e., when the forklift driver enters the information in the FMT and, thus, finalises the gate-in or gate-out process. Otherwise, the turnaround time of the truck may conclude when the truck breaks out of the first geo fence on the way out.

While there are no truck turnaround records prior to the introduction of Containerchain, the process has demonstrably been streamlined. So, why do we assume that truck turnaround times have decreased if there are no records pertaining to the period prior to the introduction of Containerchain? This assumption arises on the basis that processes have been streamlined leading to operational efficiencies. First, truck drivers do not have to leave their vehicles and they may drive straight into the loading or unloading area instead of having to leave their trucks and proceed to the gatehouse. Second, forklift drivers gate empty containers in and out of the depot more efficiently as they have access to container stocks and future truck arrivals from their FMTs as opposed to having to receive instructions from the office to perform these duties. Thus, it is beyond question that these events generate time savings since tasks are performed more expeditiously than prior to the implementation of Containerchain

Further, this argument led us to anticipate that if truck turnaround times are shorter in response to the seamless integration of information flows, technology and disciplined business practices enabled by the implementation of this IT application, capacity slots in the system should increase. Namely, if trucks are processed faster, the system should allow additional trucks to be serviced during a time window and, by extension, across the operating day. In discussion[13], the container park points to an increase in the

[13] *“Teresa: if truck turnaround times are shorter due to a paperless environment (…) and the fact that truck arrivals are spread out evenly throughout the day since Containerchain started, this leads me to assume that your capacity before Containerchain was lower than the 35 maximum and 25 optimum marks because NOW you can process trucks faster. That is, you can*

depot's capacity to process more trucks in light of the operational efficiencies brought about by Containerchain.

As indicated by the depot, the impacts of these operational efficiencies in the form of paperless environment and uniform distribution of truck arrivals across the operating hours of the park, are evidenced by the increase in the number of slots in the system, more precisely, in the number of slots allocated to maximum capacity per time window; i.e., from 35 slots to 40 slots per half an hour window.

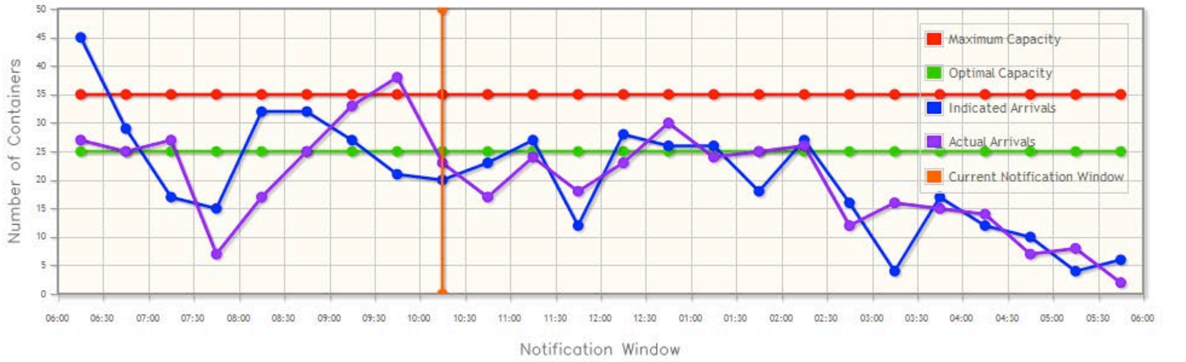

Figure 4.7 Container ETA monitor - truck arrivals recorded for 28.01.2014

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do more now than what you could before Containerchain was introduced. If you can now do approx. 700 moves per day comfortably (divided by 24 times windows, that's 29 trucks per half an hour, given that truck arrivals are evened out), before Containerchain this total number of trucks serviced per day had to be lower because your capacity to process trucks was less. I know that trade through the port depends on the shipping lines and their commercial arrangements with their customers but containerised trade volumes through the port of Melbourne have increased in recent years. Thus, moves per day should be more now and more should be the capacity to process trucks in the same amount of time since the implementation of this software. Would you like to say something about it? Any clarifications?
Depot: ***Our maximum has now been increased to 40 for the exact reasons that you mentioned****. Overall daily movements haven't increased however partly due to trade and partly as a result of other commercial factors. We are definitely in a position now to handle more throughput; however our standing capacity hasn't changed which can still restrict us at times".*

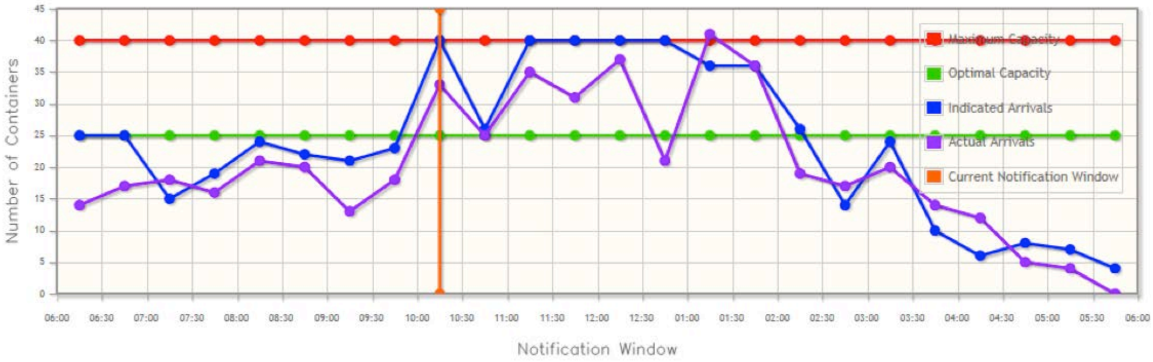

Figure 4.8 Container ETA monitor – truck arrivals recorded for 03.11.2014

Thus, as shown above in Figures 4.7 and 4.8, maximum capacity has increased from 35 slots per time window to 40 slots per time window owing to operational efficiency being streamlined over time. Further, given there are 24 time windows in a 12-hour working day, the maximum number of trucks that the container park may process has increased from 840 truck moves (35*24) to 960 truck moves (40*24). This translates into additional depot capacity to process more trucks while still conducting ancillary services, which ultimately are necessary to provide empty collections with available stock.

In addition, the depot noted that, historically, the maximum number of truck moves it could process in a 12-hour shift was approximately 700. Hence, if optimum capacity is the number of trucks a depot may optimally process in half an hour window without generating idling queues and, simultaneously, operate ancillary services. This optimum capacity post-Containerchain is of 25 truck moves per time window or 600 truck moves per operating day (24*25); this leads us to argue that optimum capacity post-Containerchain approximately equals the maximum number of truck moves the container park could possibly process before the implementation of this IT software. Namely, the depot may now – post-Containerchain – optimally and comfortably handle the maximum number of truck moves it could process prior to the introduction of Containerchain.

Consequently, this additional capacity in the system allows for an increased turnover of the shipping lines' assets, the empty containers. The paperless environment, therefore, positively impacts on the shipping lines by means of enabling the container park to gate-in and gate-out more empty containers across the operating day resulting from enhanced operational efficiency to process trucks more promptly.

In addition, port-related trade has grown in the last decade and it is anticipated to increase in the foreseeable future. By 2025, the containerised seaborne freight is expected to increase to 4.7 million TEUs, which translates into a 214% increase on the 2.2 million TEUs of container volumes handled by the port of Melbourne in 2013-14 (PoMC 2015a). This growth in the trade task poses capacity constraints on depot facilities and freight transport infrastructures resulting from increased truck movements in and around the port of Melbourne. Further, initiatives –such as Containerchain – to provide for additional capacity in port-hinterland facilities significantly contributes to alleviating the challenges that the port is already experiencing in terms of efficiently managing the increase in containerised trade volumes through the port.

4.5 Stock management in a highly integrated empty-container supply chain

4.5.1 Introduction

The score derived from stock management by Chain 1 is 3.5 out of 3.5. This score points to the timely engagement of the container park in effectively aligning active export releases to available stock leading to the elimination of futile trips and lengthy queues by means of ensuring the availability of stock for empty collections. This task also implies the collaboration of shipping lines in terms of transferring EDI booking releases with their allocated pick-up dates so that this information is automatically updated in the system leading to time savings and, thus, superior operational efficiency.

Prior to the introduction of Containerchain, futile trips were common as the container park did not have the visibility and the mechanisms in place to effectively monitor, on the one hand, the number and time of truck arrivals so as to forward planning resources accordingly as well as prioritise repairs or steam-clean services pursuant to the allocated time window. On the other hand, export releases did not have valid pick-up dates meaning that there was no prioritisation of such export releases subject to the shipping lines' cut-off dates, thus, transport companies' demand to collect empty containers was not regulated. Trucks were thus serviced on a 'first-come, first-served' basis, which noted a total lack of stock inventory management at the container park as noted by the depot[14].

Futile trips mainly affect transport operators for two reasons. First, these are a costly expense that may be avoided or minimised. As noted in the previous section, the average cost to run a truck in Australia is $2/min, thus, futile trips as well as delays are high-cost expenses predominantly sustained by transport companies. Second, transport companies have to pay a fee every time they make an online notification so as to gain entry to the container park to collect or return an empty container. Hence, their expectation to be able to pick-up an empty container if they have notified the depot of their intention to arrive at a certain time.

The depot's viewpoint on the payment of the Containerchain fee by transport operators is that this constitutes a financial transaction based on the exchange of a service for a payment (or vice versa); thus, the liability on the part of the container park to effectively provide transport operators with empty containers. It is this transactional relationship, i.e., the exchange of monies for a service that brings about superior operational efficiency.

In this line, the depot highlights that ensuring the availability of stock is central to the reputation and brand image of the container park as a means for providing superior service levels to transport operators. Namely, the elimination of futile trips by means of effectively managing stock levels and ensuring available stock for empty collections provides the depot with a distinct competitive advantage over its competitors in the marketplace since other container parks operate differently by not engaging in the management of stocks and, hence, leaving this task to shipping lines.

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[14] *"Depot: there were a lot of futile trips, heaps of them because we had no way of even knowing they – transport companies – were coming (…) There'd be a release, the outstanding releases, 400 outstanding releases and they can come and get any of them (…). You couldn't stop it; if they had a booking they could turn up and pick it up. You couldn't stop them from coming here (…) it didn't matter what order they came in. One guy could have a container for two weeks time and one could have one for today and the guy for two weeks time could get a container and the one who needed one today might not get one. It was crazy. There was no management, it was a lottery. Turn up, open the gates, and let's see who turns up (…) hope for the best and see what we can do today. That's why we had massive queues, trying to deal with all these issues and problems. A truck would turn up and you wouldn't have a container, so then the truck would be sitting out here and we'd be running around trying to find one somewhere or trying to repair one, get it ready on the spot. In the meantime he is sitting there and I have a line of trucks queuing up".*

While other container parks do not engage in the management of stock levels, the depot argues it is the container park's responsibility to do so because the Containerchain IT solution has provided depots with the tools to effectively monitor stock levels. Namely, there are certain features in the system only accessible to container parks, such as the monitoring of, first, active bookings as well as modifying the ready date if it anticipates the unavailability of stocks to attend to that export booking; second, the online notifications made by transport operators containing the truck arrival times visible in the pending movements screen. Last, the reception of stock alerts once a threshold for a particular shipping line, ISO type and grade has been reached. This threshold is arbitrarily established in the system by the empty-container park, so that when the pick-up notifications made by transport carriers reach a certain degree of the available stock for a particular shipping line, ISO type and grade, the container park receives a text message and an email advising it of such shortage of stock levels.

The challenge of this situation is compounded by the fact that, even though the container park has the means to manage stocks, the empty containers are the shipping lines assets and some shipping lines are not willing to relinquish their ability to manipulate stock levels in light of their reluctance to disclose inventory levels to any party and ensuing overbooking practices to secure commercial contracts. This will be discussed further below.

4.5.2 Stock management: the shipping line's contribution

As specified in the previous section, there is a full electronic interchange between the depot and its customers, the shipping lines. Namely, there is instantaneous reporting on every incoming or outgoing empty container movement among the container park, the shipping line and the terminal for bulk runs. Thus, the participation of the shipping line in the effective transfer of EDI communications is key to obtaining seamless operational efficiency across the supply chain.

In the management of empty stocks, the transfer of the booking release EDI message from the shipping line to Containerchain and, by extension, the container park is critical in gaining operational efficiencies so as to effectively manage stocks. Namely, the EDI booking release provides the export release with a valid pick-up date which indicates that on that date the export booking becomes active in the system and transport operators may make a notification from that date onwards. It is at this point that the depot needs to ensure the availability of stocks for active export releases so as to prevent futile trips.

Seemingly, other container parks do not have full electronic compatibility of IT systems since some of their customers reject any involvement in the transfer of the shipping manifest as well as booking releases to Containerchain. Yet, in the discussion held with the shipping line, it argued that there are benefits to be gained by all supply chain members in the full electronic interface of EDI data. It pointed at time savings and efficiency to be achieved by means of preventing the manual entry of data by the container park which may potentially lead to human errors and, thus, empty containers being booked into or released to the wrong customer; in addition to the labour costs associated with this practice. Further, phone calls made from the depot to the shipping line to confirm the ownership and return location of empty containers, which would not be necessary, had the shipping line transferred the corresponding EDI message.

In addition, and as noted by the shipping line there are efficiency and financial gains to be realised from a shipping line's standpoint. On the one hand, the transparency of information provided by Containerchain in terms of streamlined control and management of stocks which leads to the elimination of numerous phone calls from the shipping line to the container park and adds to time that may be used more productively. On the other hand, the elimination of futile trips by means of agreeing on pushing the ready date back of a booking if stocks are not ready for collection, thus, contributing to the effective alignment of bookings with a valid pick-up date to available stock. Also, the increased visibility on stocks allows for repairs and maintenance works to be performed to effectively attend to empty collections on a less costly basis.

Shipping lines typically measure empty container stock levels at container parks on the basis of 'empty: export' ratios, that is, the correlation between the Stock On Hand[15]

[15] Stock of Hand refers to the total number of empty containers located in a particular container park, inclusive of all the empty container statuses, that is, available, damage, waiting steam clean, under repair, to be surveyed, etc.

(SOH) for any particular ISO container type to export releases. As specified by the shipping line, in an ideal scenario there should be 2.5 empty containers for any particular ISO container type per export release. For example, if the depot had to supply 100 empty containers of a particular ISO type to cover exports, there should be 250 empty containers on stock for that particular ISO type. In this context, releases in the system could be active. However, times are changing and pressure is on shipping lines to be lean and increase operational efficiencies and achieve a greater turnover of their assets in an effort to maximise revenue by constantly moving containers globally. Hence, enhancing the turnover of empty containers translates into reducing the empty: export ratio to 1.4: 1.

Conversely, when there is a shortage of stocks and these go below 1 (<1:1), that is, when there is less than one empty container to attend to an export booking for a particular ISO type; the management of stocks adopts a more strategic approach. The allocation of pick-up dates to booking releases entails the early prioritisation of these bookings subject to the vessel cut-off dates as exporters need the empty containers a few days prior to the vessel cut-off date so as to load them with the export cargo, in addition to preparing all the required export documentation. Thus, these dates are allocated to these export releases approximately one week in advance by means of distributing the collection of empty containers across a number of days, meaning that on those days the bookings become active in the system and transport operators may make the online pick-up notification from that date onwards. Further, the purpose of distributing pick-ups throughout an interval of days is to allow time to receive empty containers – imports/returns – as well as to repair containers. These repairs are performed on the grounds of attending to active export bookings with the less costly repairing services as the more expensive ones are shipped overseas where labour and parts costs are much lower.

Essentially, and as indicated in Figure 4.9, the objective in the management of stocks is to effectively assign a valid pick-up date to an export booking so that the depot provides those export bookings with available stock when they become active in the system with a view to prevent futile trips.

Figure 4.9 Management of Stocks in short supply by a shipping line in a highly integrated chain

In a highly integrated empty-container supply chain, the shipping line takes a different approach to futile trips. It takes ownership of futile trips if these occurred as a result of having been notified by the container park on the shortage of empty stocks to cover active bookings and it still refuses to push the ready date back, leaving the bookings open in the system and allowing transport companies to make online pick-up notifications. Thus, if a futile trip results from the previous situation, the shipping line is liable, meaning that it has to compensate its customer for such an incident. Hence, this monetary compensation is the catalyst in preventing this unnecessary cost in achieving operational efficiency.

4.5.3 Stock management: the role of the container park as a stock controller

As noted above, Containerchain has provided container parks with the tools to effectively manage stocks when these are in short supply by allowing the depot, first, to manage export bookings with a valid pick-up date and push the ready date back of these export releases if it foresees the unavailability of stocks. And, second, monitor truck arrivals, in particular empty collections, displayed in the pending movements screen. The aim of this practice is to eliminate futile trips by means of aligning active export bookings to available stock.

Challenges arise when there is a scarcity of available stock and export releases remain active in the system allowing transport operators to make online pick-up notifications which will inevitably lead to futile trips. This is due to the fact that open/active bookings do not necessarily translate into available stock unless the container park effectively correlates available stocks to active export bookings – that is, only allowing transport operators to make pick-up notifications when it anticipates the availability of stocks to service empty collections. This may involve modifying the pick-up date to a later date if stocks are not ready for collection. Thus, ultimately ensuring the availability of stock is, essentially, the task of a depot as a stock administrator. When there is plenty of available stock to cover export releases, however, the bookings may remain active/open in the system.

As noted by the depot, the basic procedure to manage stock levels is to monitor the date on which an export release for a particular shipping line, ISO type and grade becomes active in the system[16]. This task needs to be performed the day prior to the booking becoming available in the system or, alternatively, when the depot opens at 6 am. Next, this information is matched against available stock for that particular shipping line, ISO type and grade so as to cover the export release. Export releases have a valid pick-up date, meaning that on that date they become active in the system and transport companies may make a pick-up notification from that date onwards to collect the empty containers. Hence, the need to have the stocks available to match those active export releases so that futile trips are eliminated.

[16] *"I monitor their total stock levels, what they – shipping lines – have available for each equipment type. I then look at what bookings are in the system, that have a valid pick-up date".*

"I can screen this release, I can screen shipping line, grade, ISO type. I can look at that any given day and it'll tell me all the bookings for that equipment type that are in the system at the moment and it tells me when the pick-up date is available, the pick-up date is for all those bookings".

4.5.3.1 Stock management in shortage of stocks

We will, thus, focus on the situations characterised by limited stocks since challenges may arise resulting in futile trips if not appropriately addressed.

A shortage of stock levels occurs when demand for a particular shipping line's container ISO type and grade exceeds its supply. Namely, when bookings with a valid/active pick-up date exceed the available stocks for that particular shipping line, ISO type and grade. Thus, the need to target those stocks which are approaching the available status so as to cover the maximum number of active export releases with the SOH.

In order to attend to the maximum number of active export releases it is crucial to have a thorough knowledge of the SOH as well as the depot's daily capabilities that affect the workshop and wash bay turnover, so that stocks become available to attend to those active export bookings for the day. This involves analysing, by and large, what is already available at the depot as well as targeting the stocks which are in the vicinity of being converted into available stock, that is, under repair (UR) and waiting steam clean (WSC) for a particular shipping line, ISO type and grade.

Having an exhaustive understanding of the depot's capabilities involves assessing external and internal factors that may have implications for a higher or lower workshop and wash bay turnover. External factors denote outside conditions which are beyond the control of the depot; however, these may impact on the efficient running of repairs and steam cleaning services. In this category, we find adverse climatic conditions such as heavy rain given the impossibility to perform repairs in the outside areas. On the other hand, internal factors refer to capabilities which are specific to the container park. Depot capabilities are restricted by the size of the workshop in which repairs are conducted, and the size of the wash bay in which empty containers are steam cleaned. Thus, the number of empty containers which may be repaired or steam cleaned simultaneously or during the course of the day may be limited by spatial considerations. In addition, mechanical failures and absenteeism may have direct implications on the capabilities of the depot, that is, on the number of available forklifts and the number of available staff to perform repairs and container washes as well as move empty containers around the depot. This is, as opposed to the monitoring of the pending movements screen, a comprehensive approach concerning the management of stocks since the container park is assessing the depot's capabilities for the day so as to attend to the maximum number of export releases with the SOH.

The purpose of assessing the particular depot's capabilities is to take timely action on these active export bookings as transport operators may make notifications since these are open in the system, which may lead to futile trips if the depot does not have available stock to attend to empty collections. Thus, the need to modify the initial pick-up date of export releases should the depot anticipate the unavailability of stocks to service these export releases given the SOH and the depot's daily capabilities.

So, what exactly is 'pushing the ready date back' and in what circumstances is it used? When bookings become active/open in the system, these have a valid pick-up date in the system and, by default, this date and the ready date are identical. However, if the depot foresees that there is a strong likelihood that it will not be able to service active export releases with the available stock or the stock that is approaching the available status in view of the depot's daily capabilities given the internal and external factors for the day, it will push the ready date back of the booking to a date in which it anticipates the availability of stocks. Thus, modifying the ready date of a booking is the last resource in the stock management hierarchy and denotes that the booking is no longer active in the system and, hence, transport operators may no longer make pick-up notifications for these bookings. As the depot noted, most transport companies may not necessarily need to pick up the empty containers on the initial pick-up date, thereby, pushing the ready date back may not negatively affect them. Further, in the event of transport operators truly requiring empty containers as the vessel cut-off dates are approaching, the container park holds a small safety stock for each shipping line, ISO type and grade before changing the ready date to a subsequent date so as to ensure the availability of stocks for those transport operators in real need of empty containers.

Also, as notifications are made – both collections and returns – by transport operators; these are displayed on the pending movements screen with the time window allocated for each truck arrival. Hence, the depot may ascertain the priority of stocks, that is, arrange the sequence of repairs and washes on the basis of the time window assigned to each particular empty collection. Yet, and in accordance with the data provided by Containerchain for the month of August 2014 concerning the time pick-up notifications are made, 49.4% of pick-up notifications are made between 15 and 60 minutes before the start of the time window and 17.4% of pick-up notifications are made under 15 minutes before the start of the time window. Thus, the notice given to the depot to have empty containers ready for collection may be limited or insufficient in some cases. Nonetheless and undoubtedly, the pending movements screen is an effective tool inasmuch as it provides the container park with the much sought after visibility regarding the number of truck arrivals per time window. And this visibility provides the means for an effective utilisation of the depot's resources as well as – the limited – management of stocks subject to truck arrival times.

4.5.3.2 Criticality of stock management

So, why is the management of stocks so critical? As previously noted, the purpose of such task is to align active bookings to available stock so as to eliminate futile trips. However, challenges arise in light of the practice of overbooking by shipping lines.

And, what is the practice of overbooking and why does it happen? Overbooking refers to the provision of export releases to customers in excess of SOH to cover those export releases. Namely, while shipping lines are cognizant of the small likelihood to cover all export releases with the SOH they deliberately provide their customers with export bookings in the hope that a certain percentage of customers will cancel those bookings. This practice is aimed at ensuring that the majority of the SOH is used to carry export cargo, resulting in maximum financial benefits for the shipping line. Overbooking is a commercial practice to stay competitive in the marketplace by means of not losing business to the competition. In other words, if a shipping line disclosed to the marketplace its unavailability of stocks to cover bookings, in all probability its customers would cancel commercial contracts with it and establish new ones with the competition. This is, hence, the rationale underlying their reluctance to advertise stock levels to the public. Further, stock levels are very dynamic and subject to constant change; that is, a setting with no available stock may rapidly change if the workshop and wash bay turnover is high and, thus, empty containers may be upgraded to available status in no time.

Thus, the management of stocks conducted by the container park assists in the minimisation of the negative effects of the practice of overbooking by means of prioritising notifications and pushing the ready date back. First, the container park may focus on the stocks that are UR and WSC – approaching the available status – so as to cover the maximum number of active export releases. This task involves assessing the internal and external factors that may affect the depot's capabilities in terms of wash bay and workshop turnover rate for the operating day. Second, the depot may determine the urgency of stocks, that is, the sequence of maintenance services subject to the truck arrival times displayed on the pending movements screen Last, it may push the ready date back when it has grounds to believe that the available and nearly available stock will not suffice to fulfil all active bookings. Figure 4.10 describes the stock management procedure per shipping line, ISO type and grade for both a standard situation, that is, when there is plenty of stock available to attend to export bookings as well as shortage of stocks, that is, when the container park foresees the scarcity of stocks available to fulfil export releases.

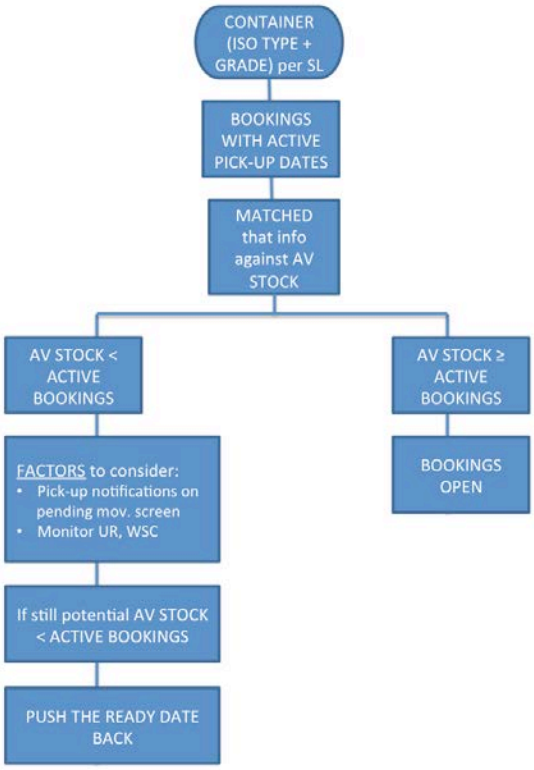

Figure 4.10 Management of Stocks by a depot in a standard situation and in shortage of stocks

Yet, and as previously noted, open/active bookings do not necessarily translate into available stock unless the depot effectively aligns export releases to available stock, ensuring the availability of empty containers to collecting trucks. This practice may entail, if required, changing the ready date of an export booking to a subsequent date, thus, preventing transport companies from making online pick-up notifications – and likely futile trips – if it foresees the unavailability of stocks on that initial date.

Thereby, the claim made by industry members, in particular, transport operators, to disclose shipping lines' stock levels to the marketplace so as to prevent futile trips would be uncalled for if stocks are efficiently managed by the container park and, hence, pick-up dates modified if the depot anticipates the scarcity of stocks; not allowing transport companies to make pick-up notifications until empty containers are available or almost available for collection. This scenario would entail that shipping lines entrust the management of their stocks to the container park since the container park has been provided with the means and the tools to efficiently supervise stocks.

Thus, the involvement of the container park as a stock manager is key to effectively integrate the chain by means of aligning active bookings to available stock and, thus, deliver superior operational gains across the chain.

4.6 Concluding comments

Chapter 4 presents the empirical findings regarding the operational efficiency found in Chain 1. The findings are presented pursuant to the operational efficiency template, i.e., capacity management, paperless environment and stock management. The overall score obtained by Chain 1 is 9, which is greater than 8.5 and this supply chain, consequently, is regarded as highly integrated.

Among the six empty-container supply chains examined for this case study, only Chain 1 showed distinctively integrative measures which resulted in highly efficient operational practices across the chain.

First, the average operational efficiency score obtained for capacity management by the depot is 2.5 out of 3.5 for the four days examined. This suggests that during 72% of the time windows truck moves fall within the band of efficient capacity management, that is, maximum capacity – or 100% of capacity – and 40% of capacity. In addition, maximum capacity is only exceeded during 3% of the time windows; hence, capacity is underutilised during 25% of the time windows. These data evidence that truck arrivals are fairly distributed across the operating days as well as the container park is very rarely congested, experiencing periods of low activity during ¼ of the time windows for the days analysed.

In line with these findings, the average unutilised capacity for the sample days amounts to 46%. Thus, there is a significant amount of unmet demand in the system, i.e., the depot's capabilities to service trucks greatly exceeds the present transport operators' demand for slots in the system thereby making unnecessary the implementation of restrictions on maximum capacity.

Second, the average operational efficiency score resulting from the paperless environment is 3 out of 3 for the days under study. The depot provides a fully paperless environment, that is, a setting entirely devoid of paperwork exchanges between stakeholders, in which information flows electronically and with minimum human interaction. Further, transport carriers' notification details are validated from the gatehouse by the depot staff and trucks may drive straight into the loading or unloading area. These paperless transactions result from, on the one hand, the full electronic interface between the container park and its customers, the shipping lines. And, on the other hand, the accurateness in the online notifications made by transport operators as well as the introduction of the FMTs by the container park to gate-in and gate-out empty containers.

All of the efficiencies noted above provide the means for significant time savings, in particular transaction times. Hence, a setting free of paperwork together with an even distribution of truck arrivals across the day results in, first, reduced transaction times and, second, reduced waiting times. And, these two combined generate shorter truck turnaround times. Furthermore, and as corroborated by the Container ETA monitors provided by the depot, shorter truck turnaround times have enabled an increase in the number of slots in the system over time. Namely, the fact that trucks are serviced more expeditiously since the adoption of the Containerchain IT solution, has given rise to additional trucks being processed during a time window and, by extension, across the operating day.

Last, the mean operational efficiency score attained for the stock management level by the depot is 3.5 out of 3.5. Further, the depot is the only container park in the present study that actively engages in the efficient management of stock levels, that is, the alignment of active export bookings in the system to available stock so as to eliminate futile trips.

In order to perform this task, the system – Containerchain – has provided container parks with effective tools to manage inventory levels such as the modification of the initial pick-up date if it foresees the unavailability of stocks to cover active export bookings and, hence, preventing transport carriers from making pick-up notifications and ensuing futile trips. In addition, truck arrivals may be monitored in the pending movements screen with their allocated time windows; yet, the control of stocks by way of monitoring truck arrivals per time window may be somewhat restricted since most pick-up notifications are made immediately before the start of the time window, thus, the notice given to the depot may be, in some instances, fairly short to have the empty containers ready for collection in the event these empty containers were not available. Also, the management of stocks is not without its challenges as shipping lines are not willing to relinquish the management of their assets to container parks in view of their reluctance to disclose stock levels. Thus, the involvement of the container park as a stock manager is key to obtain operational gains across organisational boundaries; and this calls for the use of disciplined management practices by the container park in engaging chain members to display integrative efforts with a view to leverage operational efficiencies by way of effectively utilising the tools and resources provided by this IT solution. The active participation of the container park is, hence, critical in achieving total chain operational efficiency.

CHAPTER 5: CONTAINERCHAIN AND INEFFICIENCY: IDENTIFYING THE ISSUES

Simple observation suggests that some empty-container chains and empty container depots are less efficient than others and more detailed research confirms that despite the management disciplines and insights which the Containerchain IT solution offers, it is clear that existing practices, poor management and numerous other reasons indicate that system inefficiencies persist.

This chapter reports the results of detailed research into two different chains and demonstrates not only the extent and dimensions of inefficiency in the selected chains but also the fundamental reasons for inefficient depots and chains as revealed by the Containerchain IT application and by discussions with chain stakeholders. The chapter falls into two parts – the first indicates that some chains exhibit moderate integration and some loss of efficiency; the second exemplifies serious inefficiencies, suggesting a disintegrated chain operation.

PART 1: MODERATELY INTEGRATED CHAINS

5.1 The profile of a moderately integrated chain

Moderate integration stems from the degree of integrative efforts across chain partners in an attempt to obtain an efficient chain. It is a chain that exhibits fragmentation in some segments as well as integration in other segments resulting from somewhat inefficient interactions among partnering organisations. These moderately integrated supply chains reveal some efficient operational practices across the chain; however, operational inefficiencies may arise caused by rather unsuitable management practices, failure to transfer timely information and/or inadequacy of technological implementation. Yet, the integrative measures displayed in various sections of the supply chain may be severely constrained by the poor performance resulting from inefficient practices between trading partners to the extent where the partial efficiency yielded may be to little avail.

Chain 2 has obtained an overall operational efficiency score of 6.1, which is comprised between 6 and 8.5. Hence, this chain is regarded as moderately integrated.

Chain 2 comprises:

- An empty-container park or depot which performs storage and ancillary services such as repairs, container upgrades, steam-cleaning services and pre-trips for their customers, the shipping lines
- Two transport operators, which deliver transport services for various types of customers such as cargo owners – importers and exporters – and freight forwarders. Hence, they typically collect or return empty containers from multiple empty-container parks pursuant to the agreements between their customers – freight forwarders or cargo owners – and the shipping lines, which typically divide their total workload between two depots
- Transport and logistics professionals with substantial working knowledge and experience in the transport and supply chain arena

Figure 5.1 is the Operational Efficiency Template for Chain 2 and provides a framework for more detailed analysis in the following paragraphs.

OPERATIONAL EFFICIENCY TEMPLATE- CHAIN 2	
1. CAPACITY MANAGEMENT	
1. Regulation of truck arrivals and prevention of delays (daily measure) The capacity management score should be converted into a 0-3.5 scale, subject to the number of time windows in which values are comprised within the band of capacity management. Thus, no capacity management (0) and total capacity management (3.5)	2.1
2. PAPERLESS ENVIRONMENT (drop-offs)	
2. Use of FMTs at ECPs? Yes 1 No 0	1
3. How many of the shipping lines that store at your ECP send CRA – dehire Notifications – (EDI message) Rescale score into a 0-1 scale, subject to the number of shipping lines that send through CRA notifications relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending CRA notifications (0) and all shipping lines sending CRA notifications (1)	1
4. Are CTOs obligated to correctly populate all the fields in their online bookings such as container number, container prefix and registration number, otherwise, they are denied entry in the park? Yes 1 No 0	0
3. STOCK MANAGEMENT (pick-ups)	
5. Monitoring of pending movement screen (CTOs' bookings) so as to prevent futile trips Yes 1 No 0	1
6. How many of the shipping lines that store at your ECP send EXPORT RELEASES ELECTRONICALLY (EDI MESSAGE)? Score should be transformed into a 0-1 scale, subject to the number of shipping lines that send EXPORT RELEASES electronically relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending export releases (0) and all shipping lines sending export releases (1). If score is 1, continue to the next question, otherwise, skip.	1
7. Monitoring of shipping lines' active bookings and match that information against AVAILABLE STOCK. The whole purpose is to prevent futile trips Yes 1.5 No 0	0
OVERALL SCORE	**6.1**

Figure 5.1 The profile of a moderately integrated chain

5.2 Capacity management in a moderately integrated empty-container supply chain

In relation to the management of capacity, it is the depot which establishes maximum and optimum capacity subject to its internal capabilities as well as other external factors. Yet, the adequacy of these parameters is not in question and a better understanding of their appropriateness needs to be developed. In addition, the measures imposed by the container park to effectively regulate truck moves so these are contained within the band of capacity management are administered at the container park's discretion.

The 2.1/3.5 score obtained for capacity management by Chain 2 derives from the data contained in the Container ETA monitors and refers to each of three days. The depot selected these dates in response to what normal working days at the depot looked like in terms of capacity management. As shown in the graphs and tables below, delays at the container park are frequent resulting in lengthy queues that spill on to the adjacent streets causing discomfort to residents.

Maximum capacity is typically 22 truck arrivals per 30-minute time window and optimum capacity is 15 truck arrivals per 30-minute time window. Hence, in the absence of unpredicted events as well as constant depot capabilities, these values should remain constant across the operating day.

In relation to the measures to manage capacity and maintain truck moves within the band of maximum capacity – 100% of capacity – and 40% of capacity during operating hours, the depot has imposed a quota on maximum capacity; hence, transport operators are not allowed to book above this parameter. In addition, there are no restrictions on truck arrival times, thus, transport carriers may make a notification for a particular time window and arrive at the depot at a time of their convenience.

To the best of our knowledge, this is the only container park in Melbourne where transport companies may arrive unannounced, that is, without having made an online notification. As specified by the container park, initially any trucks that arrived at the container park with no notifications were turned away. However, as conflicts resulted from dismissing trucks, the next step was to allow carriers to contact their fleet controllers to obtain these notifications. Yet, issues arose as this led to significant delays while truck drivers were making these phone calls. Thus, the container park introduced the manual processing fee[17]. This fee, which is processed *in situ* by the depot staff, was intended to act as a deterrent to future unplanned truck arrivals; unpredictably, the outcome obtained fully diverged from the initial expectations on its imposition.

Hence, we argue that the restrictions on maximum capacity are worthless provided that truck operators may arrive at the depot unannounced. For example, if transport operators cannot make an online booking for a time of their convenience as a result of that time window being fully booked, they have two options. The first option would be to arrive at the depot with no notification and, thus, pay for the manual processing fee. The second option would be to make a notification for any other time window which has not been booked out and arrive at the depot when they had intended to do so.

Thus, when one of the transport companies was questioned on how restrictions on maximum capacity has affected its operations, it addressed the issue of the regular unavailability of slots in the system for a specific time window, leading to the loss of flexibility for transport companies to drive past a depot to dehire/collect an empty container since they are required to make notifications. Further, the transport operator compared the flexibility to do a random empty return or collection before and after the introduction of Containerchain. It argued that transport operators have been deprived of this flexibility by means of imposing a quota on maximum capacity. However, every container park differs. The container park in Chain 1, for example, has not introduced restrictions on maximum capacity, allowing carriers to book above maximum capacity if required. The depot in Chain 2, has imposed a cap on maximum capacity; however, transport companies may arrive unannounced – with no notification or, alternatively, may make a notification for any other time window and arrive at the depot at a time that is convenient for them. Further, other depots interviewed in this study have capped

[17] *"What I was actually hoping for is not to have to worry about that, because I thought that by introducing the manual processing fee, the transport companies would go 'hang on, I don't want to pay the manual processing fee. I'm going to make sure that every truck that arrives in XXX has a valid notification'. That was my hope behind this, that eventually everybody wouldn't want to pay the manual processing fee; that they would make sure they got a notification, really it's that simple. Make sure you got a notification before you arrive so I wouldn't have to manually charge anybody.* ***Unfortunately this hasn't been the case****".*

maximum capacity; yet, transport carriers may make a notification for the next time window if the one they want to target is booked out – that is, if they intend to arrive at the depot in the 12:30 -1:00 pm time window and this one is fully booked, they could make a notification for the 1:00-1:30 time window and still arrive when they had intended to do so. Evidently, we do not consider the previous time window in the instances of random truck arrivals because it is unlikely to arrive early. This gives transport operators some leeway in terms of arriving at the container park at a time of their convenience.

Nonetheless, some of the respondents participating in this research study pointed to the fact that there are a couple of container parks in Melbourne that, seemingly, are booked out for the whole operating day on a regular basis making random arrivals unfeasible. Yet, if random arrivals are not feasible because the container park is already congested and thus booked out for the whole day we argue that, from a broader perspective, the elimination of random arrivals may be an adequate course of action to prevent further congestion.

The other transport operator noted, the way it proceeds to target these two empty-container parks is by estimating the time of arrival at the depot[18]. Then it enters a fake truck registration number in the online notification, and when it knows what truck is going to do the job, it modifies this information by entering the correct truck registration number in the notification.

[18] *"What we have been doing recently because XXX and XXX at like 11 am they are **booked out until 4 pm**; we go through and book slots throughout the day and **put a fake rego in**, all right? So, they come up into here and so we know then that when the time comes (…) well this needs to be dehired at 1 pm. **When we know who is going to do that job we simply go back and amend this** and put the correct rego in. It's one of the only ways that you can get around this if you want to actually do that job that day".*

5.2.1 Day 1 – truck arrivals

In this section we note differences in truck arrivals on three days

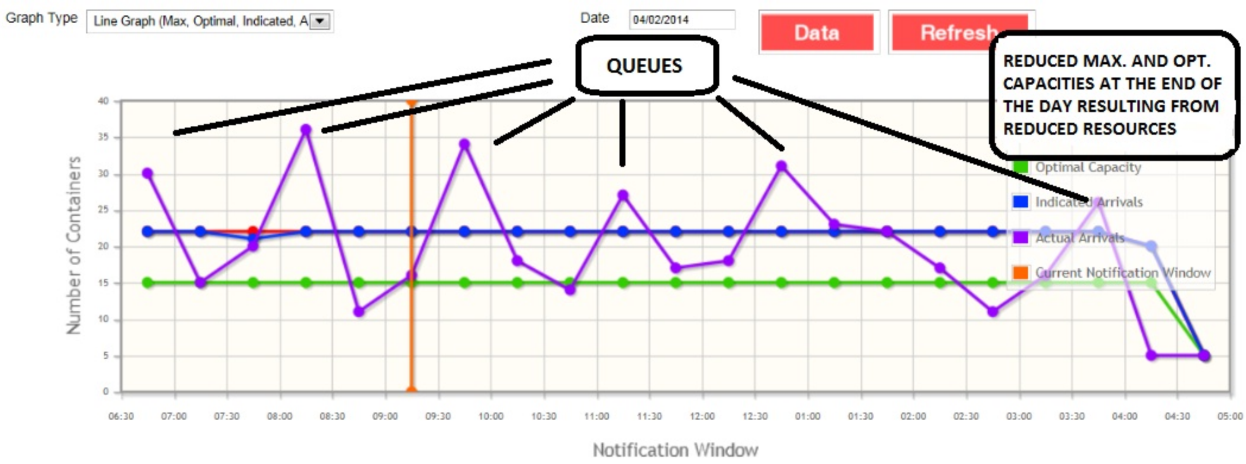

Figure 5.2 Container ETA monitor – truck arrivals recorded for Day 1

In Figure 5.2, we observe that the depot opens for 10 ½ hours (6:30 am – 5:00 pm), that is, the operating day consists of 21 time windows. As noted by the interviewee, the above graph depicts a typical working day at the container park in terms of truck traffic volumes. The day starts off with delays, however, at 7:00 am truck activity drops to optimum capacity levels, that is, it seems that queues are quickly remedied. However, at 8:00 am, the park experiences heavy congestion again, but at 8:30 am truck moves fall below optimum capacity, indicating that delays are rapidly reabsorbed. And this pattern continues for the remaining of the day; that is, periods of excessive demand and, thus, delays at 9:30 am, 11:00 am, 12:30 pm and 3:30 pm alternate with periods in which truck moves drop to more manageable levels, at optimum capacity levels or just above it. Nevertheless, during the last two time windows of the operating day actual arrivals add up to 10 truck moves in total, which denotes, on the one hand, a decreased demand for capacity[19] by transport companies and, on the other hand, reduced resources to gate empty containers in and out of the depot as maximum and optimum

[19] We use the expression ‘decreased demand’ on the basis of actual arrivals and not indicated arrivals. The rationale behind this is that, as previously discussed, transport operators may make a notification for a particular time window and arrive at the container park at a time of their convenience. Thus, the number of actual arrivals better represents the actual demand for slots in the system.

capacities come down to 5 truck moves during the last time window of the operating day. It may be noted that, seemingly, this decreased demand for slots in the system after 4:00-4:30 pm is consistent with low levels of truck activity observed during this interval in Chain 1 stemming, in all probability, from the mismatch of working hours among industry stakeholders. We will delve into this matter further on in the chapter.

The graph suggests that truck arrival patterns are unpredictable and inconsistent, that is, the purple line distinctly shows fluctuations between lengthy queues that, in all likelihood, spill on to the neighbouring streets, and more reasonable levels of workload activity. As noted by the depot, these peaks point to the removal of forklifts used for internal works and their temporary assignment to service the queue so as to quickly eliminate the undesired delays which may be causing distress to nearby residents.

Table 5.1 Analysis of truck arrivals for Day 1

TIME WINDOW	ACTUAL ARRIVALS Day 1	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:30-07:00	30	22	15	22	136%
07:00-07:30	15	22	15	22	68%
07:30-08:00	20	22	15	21	91%
08:00-08:30	36	22	15	22	164%
08:30-09:00	11	22	15	22	50%
09:00-09:30	16	22	15	22	73%
09:30-10:00	34	22	15	22	155%
10:00-10:30	18	22	15	22	82%
10:30-11:00	14	22	15	22	64%
11:00-11:30	27	22	15	22	123%
11:30-12:00	17	22	15	22	77%
12:00-12:30	18	22	15	22	82%
12:30-13:00	31	22	15	22	141%
13:00-13:30	23	22	15	22	105%
13:30-14:00	22	22	15	22	100%
14:00-14:30	17	22	15	22	77%
14:30-15:00	11	22	15	22	50%
15:00-15:30	16	22	15	22	73%
15:30-16:00	26	22	15	22	118%
16:00-16:30	5	20	15	20	25%
16:30-17:00	5	5	5	5	100%

Truck arrivals recorded for Day 1 are shown in the table above. Analysis has demonstrated that 13 out of the 21 time windows that comprise the operating day – or 62% of the time windows – are located within the band of capacity management. In the remaining 8 time windows, maximum capacity is exceeded during 7 time windows – or 33% of the time windows – and capacity is underutilised only once during the day or 5% of the time windows which happens at the end of the operating day, resulting from decreased demand for capacity. From these data we may infer that there is not a uniform distribution of truck moves across the day, that is, bottlenecks – peaks – are common, followed by periods of much more manageable truck activity levels – troughs. And this truck arrival pattern delineates distinct fluctuations in truck traffic across the operating day.

Also, the mean overall capacity used across the day is 93%, suggesting that only 7% of the capacity is unutilised. In contrast to Chain 1, these figures point to very high levels of utilised capacity, that is, transport carriers demand for slots in the system is virtually using up all the depot’s capabilities to gate empty containers in and out of the container park.

5.2.2 Day 2 – truck arrivals

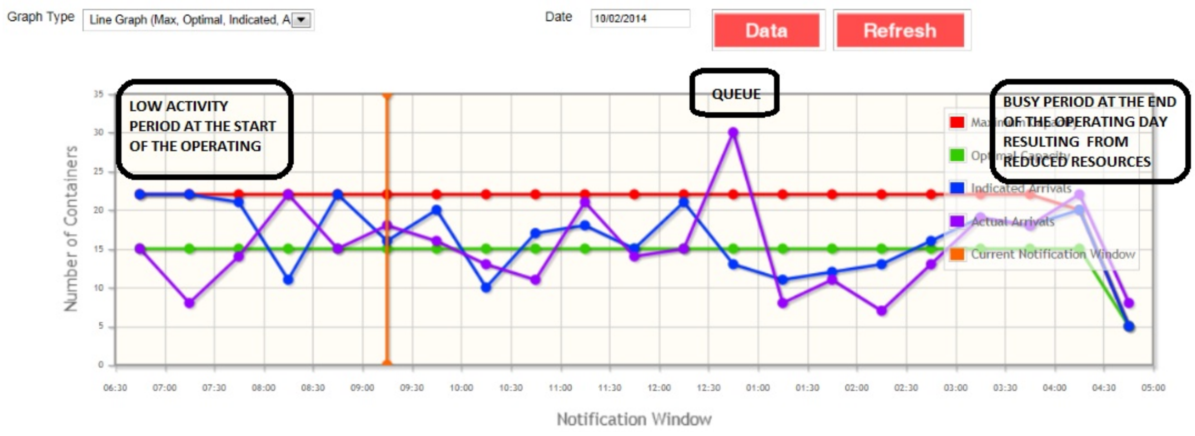

Figure 5.3 Container ETA monitor - truck arrivals for Day 2

Figure 5.3 shows the truck traffic recorded for Day 2, in which the first three time windows, that is, from 6:30 am to 8:00 am truck arrivals remain below or at optimum capacity levels. Next, in the 8:00-8:30 am time window, truck moves hit maximum capacity and then from 8:30 am to 12:30 pm, the truck traffic oscillates between maximum capacity and just below optimum capacity. However, pronounced delays are recorded in the 12:30-1:00 pm time window; yet, this queue is rapidly reabsorbed by the container park and normal truck traffic restored as in the next time window (1:00-1:30 pm) actual truck moves drop to 8 and stay below optimum capacity levels until 3:00 pm, when there is a slight increase in truck traffic to below maximum capacity levels until 4:00 pm. In the last operating hour of the container park, actual arrivals slightly exceed maximum capacity resulting in a busy period in response to reduced resources to service trucks at the container park.

Table 5.2 Analysis of truck arrivals for Day 2

TIME WINDOW	ACTUAL ARRIVALS Day 2	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:30-07:00	15	22	15	22	68%
07:00-07:30	8	22	15	22	36%
07:30-08:00	14	22	15	21	64%
08:00-08:30	22	22	15	11	100%
08:30-09:00	15	22	15	22	68%
09:00-09:30	18	22	15	16	82%
09:30-10:00	16	22	15	20	73%
10:00-10:30	13	22	15	10	59%
10:30-11:00	11	22	15	17	50%
11:00-11:30	21	22	15	18	95%
11:30-12:00	14	22	15	15	64%
12:00-12:30	15	22	15	21	68%
12:30-13:00	30	22	15	13	136%
13:00-13:30	8	22	15	11	36%
13:30-14:00	11	22	15	12	50%
14:00-14:30	7	22	15	13	32%
14:30-15:00	13	22	15	16	59%
15:00-15:30	19	22	15	19	86%
15:30-16:00	18	22	15	18	82%
16:00-16:30	22	20	15	20	110%
16:30-17:00	8	5	5	5	160%

As indicated in the table above, during 15 of the time windows – or 72% of the time windows – truck moves fall within the range of capacity management. In the remaining 6 time windows that fall outside of this band, capacity is underutilised in 3 time windows – or 14% of the time windows – and in the other 3 time windows – or 14% of the time windows – maximum capacity is exceeded; however, and for the most part, just slightly and during the last operating hour of the container park resulting from reduced resources at the depot – limited forklift capacity. Thus, in light of these data, we may conclude that, truck moves across the day exhibit a fairly constant pattern, especially if compared to truck traffic for Day 1.

In addition, the mean overall capacity used across the day is 75%, which leaves 25% of the overall capacity unutilised. Compared with Day 1, transport operators' demand points to a more controlled flow of truck moves across the day – more consistent with the container park's capabilities to attend to empty collections and returns.

5.2.3 Day 3 – truck arrivals

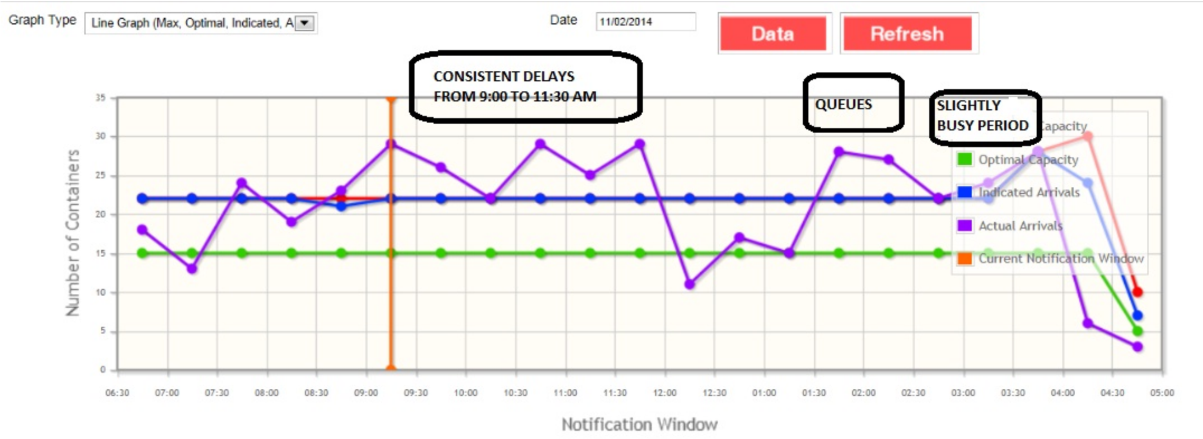

Figure 5.4 Container ETA monitor - truck arrivals recorded for Day 3

Figure 5.4 displays truck moves recorded for Day 3 which, according to the depot, represents a common working day with regard to truck traffic volumes through the depot gates. Activity levels are manageable right at the start of the day; however, at 7:30 am there is a slightly busy period that is quickly reabsorbed by the depot during the next time window (8:00-8:30 am). Next, at 8:30 am delays start and continue until midday. Yet, during the 12:00-12:30 pm time window, truck moves drop to below optimum capacity and remain under controlled levels until 1:30 pm when, again, truck volumes start to escalate exceeding maximum capacity and generating, initially, lengthy queues until 2:30 pm that lessen in intensity to busy period levels until 4:00 pm. It must be noted that between 3:00 pm to 4:30 pm, maximum capacity is increased in the system in all likelihood to accommodate the demands of transport operators to book notifications to pick-up or drop-off empty containers. Similar to the graph recorded for Day 1, during the last hour of the operating day – or last two time windows – actual truck arrivals fall well under optimum capacity, that is, to 6 and 3 respectively; presumably in response to the reduced commercial activities in the industry.

Table 5.3 Analysis of truck arrivals for Day 3

TIME WINDOW	ACTUAL ARRIVALS Day 3	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
06:30-07:00	18	22	15	22	82%
07:00-07:30	13	22	15	22	59%
07:30-08:00	24	22	15	22	109%
08:00-08:30	19	22	15	22	86%
08:30-09:00	23	22	15	21	105%
09:00-09:30	29	22	15	22	132%
09:30-10:00	26	22	15	22	118%
10:00-10:30	22	22	15	22	100%
10:30-11:00	29	22	15	22	132%
11:00-11:30	25	22	15	22	114%
11:30-12:00	29	22	15	22	132%
12:00-12:30	11	22	15	22	50%
12:30-13:00	17	22	15	22	77%
13:00-13:30	15	22	15	22	68%
13:30-14:00	28	22	15	22	127%
14:00-14:30	27	22	15	22	123%
14:30-15:00	22	22	15	22	100%
15:00-15:30	24	22	15	22	109%
15:30-16:00	28	28	15	28	100%
16:00-16:30	6	30	15	24	20%
16:30-17:00	3	10	5	7	30%

As evidenced in Table 5.3 (above), during 9 of the time windows – or 43 % of the time windows – truck traffic is found within the band of streamlined capacity management. In the remaining 12 time windows, capacity goes beyond maximum capacity during 10 time windows – or 48% of the time windows – meaning that delays amount to almost half of the operating day. Conversely, capacity is underutilised during 2 time windows – or 9.5% of the time windows – at the end of the working day resulting from a reduction in the demand for empty collections or returns. Thus, similar to the conclusions inferred for truck moves pertaining to Day 1, we may conclude that truck arrivals distinctly fluctuate between periods of excess demand, in which a great number of trucks arrive simultaneously – leading to delays and periods of much lower truck traffic activity; however, delays are consistent throughout the operating day. Hence, the flow of truck moves is inconsistent and erratic for the most part of the operating day.

Further, the average overall capacity used across the day is 94%, meaning that only 6% of the overall capacity is unutilised. Comparable to Day 1, the capacity provided by the depot in the system is practically exhausted by transport companies' demand to arrive at the container park.

5.2.4 Remarks: capacity management in a moderately integrated chain

In light of the data gathered during these three days, the following conclusions with respect to the management of capacity were derived.

The average operational efficiency score for capacity management is 2.1 out of 3.5. In order to quantify this overall score, the average of the sum of the individual daily scores was calculated for the three days analysed. This score indicates that truck traffic falls within the band of capacity management during 58% of the time windows, that is, maximum capacity – or 100% of capacity – and 40% of capacity. In contrast, in most of the remaining time windows that fall outside of the band, maximum capacity is exceeded during 32% of the time windows, which results in capacity being underutilised (<40%) during 10% of the time windows. Thus, an aggregate level we may infer that delays at the container park are constant, resulting in an erratic and unpredictable truck arrival behaviour across the day that typically oscillates between high demand periods and periods of distinctly lower demand or insufficient truck traffic activity.

However, the days examined differ in various aspects, hindering the task of making consistent inferences across the three operating days.

First, the utilisation rate in the first hour of the day as well as in the last hour of the day varies across the three operating days. As specified by the depot, early mornings are typically peaky creating delays.

Further, on Day 1 the average capacity used in the first hour – or first two time windows – of the day is 102%, leading to congestion during the first time window resulting from insufficient resources – forklift capacity – to service the queue. In contrast, on Day 2, the average capacity used comes down to 52%; and, similarly, on

Day 3 this figure amounts to 70.5%. Consequently, while the container park is very busy on Day 1 right at the start of the day, on Days 2 and 3 truck flows remain under manageable levels.

As noted above, the utilisation rate in the last hour of the day diverges across days. While on Day 1 the average capacity used in the last two time windows of the day – or 4:00-5:00 pm – is 62.5%; on Day 2 this adds up to 135% in response to scarce resources to attend to the actual demand for slots in the system – or actual truck arrivals. Further, on Day 3 this figure comes down to 25%. Consequently, while the depot notes that the utilisation rate is regularly fairly good for this interval, we suggest there is no consistency on the basis of the evidence provided.

The depot did a trial extension of depot hours from 6:00 am to 6:00 pm for a period of six months starting in January 2011. However, the utilisation rate proved to be particularly poor in the 5:00-6:00 pm interval and, thus, the operating day was reduced to 6:30 am to 5:00 pm since there were greater levels of demand during these hours.

Second, while on Day 1 and Day 3, delays are consistent throughout the operating days, resulting in visible fluctuations in the graphs from high activity periods to periods of prominently lower demand or, even, unutilised capacity on Day 2 maximum capacity is greatly exceeded only once during the day and the normal flow of trucks is quickly reinstated in the next time window. As indicated by the depot, lengthy queues are consistent and occur on a regular basis, generating constant oscillations in truck arrivals patterns.

Further, as a result of constant delays throughout the day and, thus, maximum capacity being frequently exceeded the average overall capacity utilised is 93% and 94% for Day 1 and Day 3 respectively, while on Day 2 the average total capacity used is 75%. Consequently, on the basis of the results obtained for Day 1 and Day 3, we may conclude that transport carriers' demand for capacity in the system is nearly exhausting all of the depot's supply for slots, and the depot is practically using all its resources to attend to transport operators' arrivals. Thus, on the basis of this evidence we may suggest that the container park is in real need of additional capacity by way of increasing maximum and optimum capacities to attend to the actual demand for slots in the system; yet, this may lead to increased bottlenecks and congested environments at the container park. Alternatively, extended gate hours may alleviate capacity issues. On Day 2, however, the transport carriers' demand is significantly more in line with the container park's capabilities to process truck arrivals than in the other two operating days.

In line with these findings, the container park was questioned on the likelihood of increasing maximum capacity so as to allow carriers to make more notifications for empty collections and returns since the provision of maximum capacity seemed to be insufficient for the actual demand of capacity. Its response was that in the four months prior to the interview it had put slots in the system in the instances in which there was no congestion at the container park so as to facilitate transport operators to make online notifications in an effort to provide them with some flexibility. And, by flexibility, the depot relates to operating the depot without imposing the restriction on truck arrivals times to 30-minutes either side of the allocated time window, which is a common measure adopted by other depots. However, it noted that it was not going to increase optimum and maximum capacities on a permanent basis until those oscillations in arrival patterns receded, leading to actual truck arrivals being uniformly evened out across the day.

However, only on Day 3 an increase in capacity to allow for extra slots in the system is recorded. This increase occurred for no more than two consecutive time windows towards the end of the day. The other two operating days display constant optimum and maximum capacities across the day.

Yet, the additional alternative of reducing maximum and optimum capacities so as to obtain an even distribution of truck moves across the day has not been contemplated since these capacities seem to be insufficient to attend to the present demand for slots in the system, which would lead to major issues among transport operators and, by extension, their customers.

In view of all these inconsistencies across the three working days, we suggest that further research would enable in-depth exploration and analysis, resulting in a greater degree of accuracy on all these matters. In fact, the depot was contacted in November 2014 so as to provide us with additional Container ETA monitors. However, due to some company modifications, it was not willing to disclose this information for the time being.

As pointed out by the container park, the cause of these fluctuations in the graphs and bottlenecks at the container park stems from the absence of restrictions on truck arrival times. This interpretation contrasts with that of the depot in Chain 1, who argues that it is irrelevant if one particular truck is early or late for a time window – the relevancy lies in 'the collective', that is, the correlation between total number of actual arrivals and total number of indicated arrivals for a particular time window. However, the utilisation of capacity greatly differs in both container parks. Namely, while the container park in Chain 1 has a great amount of unmet demand, Chain 2 depot's capacity to service arriving trucks is remarkably more limited, thus, the likely need for transport operators to arrive at the container park closer to their assigned time window.

We suggest, however, there are a few other factors that have implications for these fluctuating arrival patterns and congested environments at this depot. First, while increasing capacity for periods of time appears to be a valid option to allow for additional truck traffic through its gates in the instances in which truck activity levels are manageable, transport operators may make a notification for that capacity-increased interval and still arrive at the container park at a time of their convenience, leading to intensified delays at the container park. Second, and as previously mentioned, the quota on maximum capacity serves little purpose if transport companies are allowed entry should they arrive unannounced. That is, if transport carriers need to target a specific time window and this time window is booked out, all they have to do is arrive at the container park without a notification and pay for the manual-processing fee once there. Alternatively, they can make a notification for any other time window that has not been booked out and arrive at the depot when they had intended to do so. Last, there are no restrictions on truck access times – as noted by the depot – whether the carrier has made a notification or not.

We, thus, argue that the parameters put in place by the depot to manage truck moves and, hence, prevent delays are too accommodating in light of the limited maximum and optimum capacities. Namely, the measures implemented by this participant lack the discipline required to obtain a constant flow of truck moves across the operating day.

We consequently suggest that adequate initiatives may incorporate, on the one hand, eliminating the manual-processing fee and, thereby, imposing notifications on all arriving trucks. And, on the other hand, applying restrictions on truck arrival times to (at least) 30-minutes either side of the allocated time windows.

5.3 Paperless environment in a moderately integrated empty-container supply chain

In Chapter 4 the attributes of a paperless environment were described as well as its implications for various stakeholders and ways in which supply chain participants may benefit from it.

This moderate integration at this level derives from undisciplined practices by means of allowing inefficient behaviours and/or supply chain members to act negligently. Also, this lack of total integration results from business expressions of self-interest exhibited, in particular, by shipping lines since they are not directly impacted by these operational inefficiencies as they do not have to physically interact with container parks or transport companies. Conversely and concurrently, there are sections of the supply chain that display integration by synchronising activities and sharing of information that result in operational gains for the supply chain. Consequently, this combination of integration and fragmentation across the chain generates moderate integration which has room for improvement in some segments that will be further below.

The score obtained for the paperless environment by Chain 2 is 2 out of 3. This results from the degree of collaboration among supply chain members so as to obtain a setting devoid of paperwork and human interaction between the transport carriers and the container park with the aim of reducing truck turnaround times. It derives from the level of collective efforts and integrative actions on the part of transport companies, shipping lines and the depot, thus, all supply chain participants need to be on board to obtain a true paperless setting. We will analyse these integrated efforts, but most importantly, the actions that cause fragmentation across the full range of component functions.

The container park provides container storage and ancillary services for only one shipping line, which is involved in the transmission of EDI messages – that is, there is full electronic compatibility of IT systems between their only customer and the depot, contributing to a depot free of paperwork exchanges. Dehires are totally paperless as transport operators drive straight into the unloading area without having to report at the office for verification purposes. Further, and as noted above, truck carriers may arrive unannounced or out of their allocated time window making this verification process uncalled for. In addition, the only problem that may arise in relation to incorrect information contained in the dehire notification is the returning depot of the empty container as there is, at least, one more depot that works for the same shipping line, in which case the transport carrier may likely be turned away.

On the other hand, empty collections are not entirely paperless as there is a likelihood that the forklift driver loads the wrong container, that is, he may book a container number out in the system, yet this does not correspond with the actual container number he is loading onto the truck. Consequently, once the container has been loaded, all truck drivers are required to proceed to the office for verification purposes, that is, the office staff corroborates that these two pieces of information – actual container number and container number contained in the gate-out are consistent – thus, truck drivers are then provided with the Equipment Interchange Receipt (EIR). Further, this verification process in the gate-outs is required resulting from the location of the office. The office is not situated at the gate, hindering the monitoring of truck arrivals, in particular pick-ups for the reasons previously mentioned. Yet, this situation is anticipated to change as the container park is relocating to new premises, in which the office will be a vantage point from which truck moves may be effectively supervised, leading to a fully paperless environment for gate-ins and gate-outs – this will result in reduced truck turnaround times for transport carriers.

What have been the impacts of a paperless environment on a depot capacity levels?

The depot has also implemented FMTs in all the forklifts that book empty containers in and out of the container park. The functionalities and *modus operandi* do not differ from those previously examined.

On the one hand, for empty collections – with notifications, the transport carrier drives straight into the loading area. Once there, the forklift driver types the truck registration number in the FMT and the job comes up in the screen of the FMT, that is, the truck registration number associated with the ISO type and grade that needs to be picked-up. The forklift driver then verifies that the truck registration number on the screen coincides with the registration number of the truck and types in the last four digits of the container that he is going to load onto the truck and, then, gates it out. This movement is then transmitted to the shipping line as a gate-out EDI message. As noted above, on the way out, truck drivers must stop at the office to validate that the container number that has been gated out in the system corresponds with the container number loaded on the truck.

On the other hand, dehires – with notifications, the transport operator drives straight into the unloading area; the forklift driver enters the truck registration number in the FMT and confirms that the container number and truck registration number that come up in the FMT's screen correspond with the container number that he is about to unload as well as the actual registration number of the truck. Next, the dehire is verified and the container is booked in the system. This movement is then transferred to the shipping line as a gate-in EDI message.

In spite of the fact that time savings obtained by way of efficient technological implementation and enhanced information flows may be somewhat jeopardised by allowing unannounced truck moves as these lead to increased truck turnaround times; we may yet conclude that an environment free of paperwork provides the means for a streamlined chain. That is, by means of eliminating the reporting at the office – in the empty returns – and, thus, allowing transport operators to drive straight into the unloading area, the depot has reduced truck turnaround times as well as increased its capacity to gate additional containers in comparison with empty dehires before the implementation of Containerchain. In addition, most of the container controlling tasks as well as the gate-in and gate-out processes are no longer performed by the office staff as these functionalities are now executed by the FMTs, which results in additional time for the office staff to perform other duties around the yard.

5.4 Stock management in a moderately integrated empty-container supply chain

As noted in Chapter 4, stock management denotes the participation of the container park in the effective correlation of active export releases in the system to available stock, preventing futile trips and undesired delays at the depot by way of securing the provision of containers for empty collections.

For this purpose, Containerchain has provided container parks with tools to efficiently manage inventory levels at depots. One of these tools is the reception of stock alerts once a threshold for a particular shipping line, ISO type and grade has been reached. The other measure introduced in the system to effectively monitor truck arrivals is the pending movements screen. As notifications are made – both pick-ups and dehires – by transport carriers these are shown on the pending movements screen with the time window assigned to each truck arrival. Thus, in the instances of dearth of stock, the prioritisation of jobs, in particular steam cleans and repairs – so as to have available stock – is assessed subject to the time window allocated to a particular empty collection. Yet, and as discussed in Chapter 4 – section 4.5.3.1, the greater number of pick-up notifications are made between 15 and 60 minutes before the start of the time window and almost one fifth of these pick-up notifications are made immediately before the start of the time window. This reveals that the management of stocks subject to truck arrival times is quite restricted as the container park is given, in some instances, short notice to have the empty containers ready for collection in the event these empty containers were not available.

The score derived from the stock management by Chain 2 is 2 out of 3.5. This is due to the fact that the depot does not engage in the management of stocks *per se*, that is, it does not go the extra mile in aligning active export bookings in the system to available stock so as to efficiently prevent futile trips. Further, the main difference between the depot in Chain 1, on the one hand, and the depot in Chain 2, on the other hand, is the type of approach or behaviour adopted concerning the administration of export releases. Namely, while the depot in Chain 1 has adopted a proactive approach in managing stocks and, thus, may change the ready date of an export booking if it foresees the unavailability of stocks to attend to that export booking and prevent transport carriers from making pick-up notifications, the depot in Chain 2 behaves reactively in this regard and may leave the export bookings open, allowing transport companies to make pick-up notifications. So, in the instances of shortage of available stock, the *modus operandi* is to cancel the pick-up notifications the container park may not be able to provide empty containers for in the pending movements screen which may likely lead to futile trips. This will be explained and exemplified further on.

As noted by the depot[20], it is the shipping lines' responsibility to manage their own assets and it emphatically refuses to participate in this task. It argues that shipping lines frequently overbook on the basis of a drop-off percentage per vessel subject to its own estimations. Hence, the depot claims that the onus is on the shipping line to manage challenges arising from these situations, such as interruptions in the standard container cycle.

Thus, the viewpoints adopted by the depot in Chain 1 and the depot in Chain 2 significantly differ. While the depot in Chain 1 actively engages in the management of stock issues resulting from overbooking practices by shipping lines; the depot in Chain 2 emphatically declines any involvement in this task. This engagement in the alignment of export bookings to available stock delivers value to the chain by streamlining the operations between transport operators and empty-container parks, leading to superior operational efficiency across the chain by means of effectively eliminating futile trips. That is, while for the depot in Chain 1 ensuring the availability of empty containers for collecting trucks and, hence, eliminating futile trips is critical for the reputation of their business in light of the Containerchain fee paid by transport carriers as well as the revenue derived from shipping lines, the depot in Chain 2 is of the view that the onus is on shipping lines to manage their stocks. Nevertheless, and as discussed in Chapter 4, even though the containers are the shipping lines' assets, Containerchain has provided

[20] *"It's not that much different to airlines, they* ***overbook*** *seats and they know they overbook seats because they know that some people would drop off.* ***The shipping lines do the same*** *thing. And they'll make a booking, quite often in good faith, knowing that Mr Coles has 200 containers and he is going to start unpacking them and bringing them back into the system based on a normal cycle of containers. Now, Mr Coles has a picnic day or something happens and they don't unpack those containers for 2 days and the supply drops off through the depot.* ***Well, the shipping line has to manage that the best they can. Quite frankly, it's their job to manage it, not us to manage their stocks for them. Do I want all that stuff – stock levels – in the system? No, because all it does is transfer the responsibility to me as a depot and it's not my responsibility, it's the shipping line's responsibility and they have to manage that****"*.

container parks with effective inventory control mechanisms that shipping lines do not have access to.

The depot operator points to a situation in which available stock at the depot does not suffice to service the pick-up notifications made by transport operators. The course of action followed by the container park in these instances is by deleting the pick-up notifications in the pending movements screen it will not be able to attend to, that is, by reacting to collecting trucks once the online notifications have been made – reactive behaviour. In addition, transport companies are contacted twice, that is, when the stock is not ready and, thus, the pick-up notifications are cancelled and when the stock is available for collection and, thus, new pick-up notifications need to be made[21].

As noted in the previous example the depot operates their stocks on a 'notification basis', instead of acting on the pick-up date of export bookings. Thus, this inadequate supervision of stocks may result in futile trips and phone calls that could have been prevented if the export bookings had not been left open and, thus, transport operators had not been allowed to make pick-up notifications. The transport operator revealed how the system may allow transport carriers to make a pick-up notification, only to arrive at the container park to find out that there is not available stock[22].

As noted in Chapter 4 – section 4.5.3, Containerchain may allow transport carriers to make pick-up notifications in the system; however, this does not translate into available stock unless the container park effectively aligns available stocks to active export bookings; that is, only allowing transport operators to make pick-up notifications when it anticipates the availability of stocks to attend to empty collections.

Thus, if this correlation of active bookings to available stock does not occur, futile trips may result. This situation derives from the shipping lines' resistance to allow container

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[21] *"It happened today for example (…)* ***that we didn't have enough containers in stock to service all those bookings****,* ***delete some of the notifications and tell those transport operators****. And when I actually got some capacity by the middle of the morning, I* ***ring the transport carrier up*** *and I say 'I have got more available (…) He books his notifications and then he comes".*

[22] *"The* ***problem*** *that you do have from time to time is when you are picking container for* ***exports****, you'll get there****, the release will work in Containerchain,*** *so as far as you are concerned you can send the truck there but you get there and they say '****sorry, we don't have any stock'****".*

parks to manipulate their stocks – the empty containers – in light of their reluctance to disclose stock levels to the marketplace as they frequently overbook in an effort to secure commercial contracts. The container park operator points to the fact that, for the most part, it is more likely that it will be able to attend to active bookings with the empty containers that are nearing the available status – finished repairs, hence, enabling the depot to provide collecting trucks with empty containers[23].

Again, the depot's views on stock management practices may be challenged by Chain 1 depot's approach. A thorough knowledge of the SOH, as well as the turnover of the wash bay and workshop pad which are affected by the depot's daily capabilities should enable the container park to effectively anticipate the export bookings it will be able to cover for the day, thereby, leaving those export bookings open for transport companies to make notifications. And, the other export releases it may not be able to service should be pushed back, preventing likely futile trips and, thus, not leave this to the 'luck of the draw'.

Not surprisingly, the likely occurrence of futile trips stemming from export releases being left open has generated mistrust among transport operators who, from time to time, make a phone call to the container park just to confirm the availability of stocks at the depot. Conversely, one of the transport operators emphatically denied making any phone calls to confirm the availability of stocks since the purpose behind the online notifications was the elimination of these phone calls.

PART 2: DISINTEGRATED CHAINS

5.5 The profile of a disintegrated chain

This second part of the chapter reviews the findings concerning Chain 3, which for the aim of this study will be described as a disintegrated chain. This lack of integration

[23] *"if we set the parameters in Containerchain* ***not to allow transport companies to book their notifications; a lot of trucks are gonna miss out on containers when there is potential stock****. What I mean by that, say for example, I've got a* ***booking for fifty food qualities*** *and I only got thirty in the stacks. But I got thirty in the workshop currently getting done. If we restrict the transport companies from making those bookings, (…) whereas potentially* ***I could give him his fifty, as boxes are coming out of the workshop****"*.

mostly arises, on the one hand, from deficient stock management practices that generate futile trips and, on the other hand, from unsuitable technological implementation as well as dearth of timely and accurate information among stakeholders that typically results in inadequate paperless settings and, thus, longer truck turnaround times and lengthy queues.

Fragmentation is hence attributed to undisciplined management practices, lax introduction of parameters, inadequate or non-existent information flows as well as deficient technological deployment that lead to operational inefficiencies across the full range of supply chain partners and component functions. And the few integrative measures displayed on the odd occasion may be severely restrained by the consistent disjointed operational interactions among supply chain partners.

In the following pages we will reveal the findings *vis-à-vis* the operational efficiency obtained in Chain 3 on the basis of the operational efficiency template, i.e., capacity management, paperless environment and stock management.

The overall score derived from operational efficiency in Chain 3 is of 4.4, which is less than 5.9. Hence, this chain is regarded as disintegrated.

Chain 3 comprises:

- An empty-container park or depot which performs storage and general maintenance services, that is, repairs, container upgrades, steam-cleaning services and pre-trips for the shipping lines
- A transport carrier, which typically collects or returns empty containers from/to numerous empty-container parks in Melbourne and its metropolitan area, subject to the indications imposed by shipping lines on their own customers – generally cargo owners or freight forwarders. As previously noted, shipping lines typically distribute their total workload between two container parks, in particular, in the instances of shipping lines of a considerable size, which customarily have a larger throughput than smaller shipping lines
- A transport and logistics expert with a vast knowledge as well as first-hand experience in the transport and supply chain fields

Figure 5.5 is the Operational Efficiency Template for Chain 3 and provides a framework for more in-depth analysis in the following paragraphs.

OPERATIONAL EFFICIENCY TEMPLATE- CHAIN 3	
1. CAPACITY MANAGEMENT	
1. Regulation of truck arrivals and prevention of delays (daily measure) The capacity management score should be converted into a 0-3.5 scale, subject to the number of time windows in which values are comprised within the band of capacity management. Thus, no capacity management (0) and total capacity management (3.5)	3
2. PAPERLESS ENVIRONMENT (drop-offs)	
2. Use of FMTs at ECPs? Yes 1 No 0	0
3. How many of the shipping lines that store at your ECP send CRA – dehire Notifications – (EDI message) Rescale score into a 0-1 scale, subject to the number of shipping lines that send through CRA notifications relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending CRA notifications (0) and all shipping lines sending CRA notifications (1)	0.2
4. Are CTOs obligated to correctly populate all the fields in their online bookings such as container number, container prefix and registration number, otherwise, they are denied entry in the park? Yes 1 No 0	0
3. STOCK MANAGEMENT (pick-ups)	
5. Monitoring of pending movement screen (CTOs' bookings) so as to prevent futile trips Yes 1 No 0	1
6. How many of the shipping lines that store at your ECP send EXPORT RELEASES ELECTRONICALLY (EDI MESSAGE)? Score should be transformed into a 0-1 scale, subject to the number of shipping lines that send EXPORT RELEASES electronically relative to the total number of shipping lines that store at the ECP. Thus, no shipping lines sending export releases (0) and all shipping lines sending export releases (1). If score is 1, continue to the next question, otherwise, skip.	0.2
7. Monitoring of shipping lines' active bookings and match that information against AVAILABLE STOCK. The whole purpose is to prevent futile trips Yes 1.5 No 0	0
OVERALL SCORE	**4.4**

Figure 5.5 The profile of a disintegrated chain

5.6 Capacity management in a disintegrated empty-container supply chain

With reference to the management of capacity in the system, that is, the imposition of optimum and maximum capacities, it is the depot's responsibility to effectively establish these parameters in the system. Also, the measures used by the depot to obtain a uniform distribution of truck moves across the operating day have been introduced at its own discretion. Note that further research needs to be conducted in order to ascertain the appropriateness and accuracy of all these disciplines which have been implemented in the system.

The 3/3.5 score obtained for capacity management by Chain 3 derives from the data contained in the Container ETA monitors and refers to each of three days. The container park designated these days which are characteristic of regular operating days in terms of truck traffic through their gates as well as management of capacity.

Figure 5.6 portrays truck arrivals for the Day 1, which as noted by the participant it depicts a common working day at the depot with regard to activity levels. As per the graph, maximum capacity is 30 truck arrivals per 30-minute time window and optimum capacity is 20 truck arrivals per 30-minute time window. Hence, in the absence of unpredicted events as well as constant depot capabilities optimum and maximum capacities should be consistent throughout the operating day.

Further, regarding the measures implemented in the system so that truck moves are evenly apportioned across the operating day, the depot has imposed a quota on maximum capacity, meaning that transport companies are not allowed to make notifications above maximum capacity once slots for that time window have been booked out. Also, the depot has introduced restrictions on the times that transport operators may arrive at the depot to 30-minutes either side of their allocated time window, which provides carriers with a 90-minute arrival window or three successive time windows to arrive at the depot. Nonetheless, this last measure is more theoretical than practical since, according to the depot, activity levels are typically low at the container park, in particular since the Global Financial Crisis (GFC). Thus, disciplines are lax as transport operators are allowed entry regardless of the time window assigned to their notifications.

5.6.1 Day 1 – truck arrivals

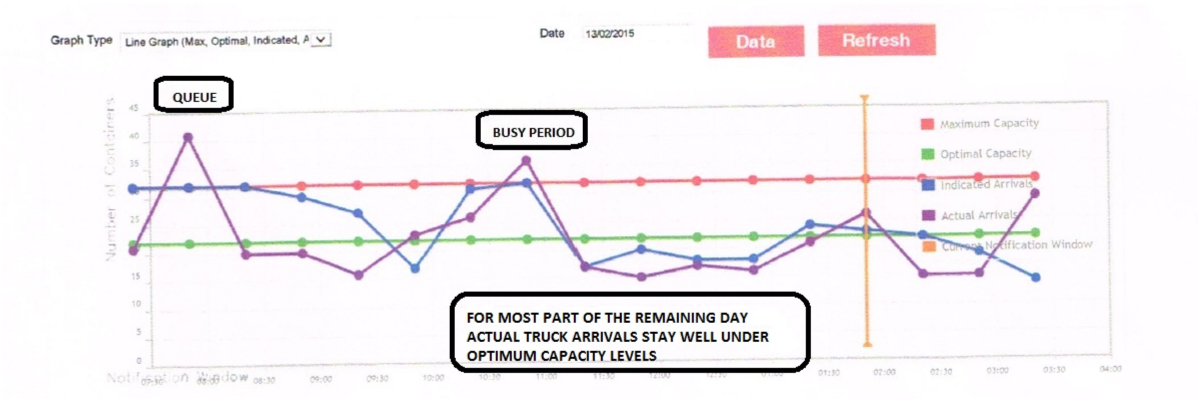

Figure 5.6 Container ETA monitor – truck arrivals recorded for Day 1

The empty-container park opens from 7:30 am to 4:00 pm, that is, 8 ½ hours – or 17 time windows – from Monday to Friday. Figure 5.6 corresponds to truck arrivals recorded for Day 1. The day starts off low during the first time window; conversely, at 8:00 am maximum capacity is exceeded by 11 truck moves, that is, a total number of 41 trucks arrive at the container park. However, the queue is quickly reabsorbed and normality reinstated during the next time window (8:30-9:00 am). Then, from 9:00 am to 11:00 am, truck moves fluctuate between just below optimum capacity levels and maximum capacity. And during the 11:00-11:30 am time window, maximum capacity is slightly exceeded leading to a moderately busy period. For the most part of the remaining day, truck arrivals stay well under optimum capacity, hence, activity levels are quite low in terms of truck traffic.

It may be observed from the graph above that transport companies' arrival behaviour appears to be somewhat erratic until 9:30 am, that is, actual truck arrivals do not mirror their bookings – indicated arrivals. However, transport operators' performance improves from 10:00 am onwards until the end of the operating day. Namely, actual arrivals follow indicated arrivals closely, meaning that transport carriers typically adhere to their designated times of arrival.

Table 5.4 Analysis of truck arrivals for Day 1

TIME WINDOW	ACTUAL ARRIVALS Day 1	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
07:30-08:00	19	30	20	30	63%
08:00-08:30	41	30	20	30	137%
08:30-09:00	18	30	20	30	60%
09:00-09:30	18	30	20	28	60%
09:30-10:00	16	30	20	26	53%
10:00-10:30	21	30	20	17	70%
10:30-11:00	24	30	20	29	80%
11:00-11:30	33	30	20	30	110%
11:30-12:00	17	30	20	17	57%
12:00-12:30	15	30	20	18	50%
12:30-13:00	16	30	20	17	53%
13:00-13:30	16	30	20	17	53%
13:30-14:00	19	30	20	22	63%
14:00-14:30	23	30	20	21	77%
14:30-15:00	15	30	20	20	50%
15:00-15:30	15	30	20	18	50%
15:30-16:00	28	30	20	15	93%

As noted in Table 5.4, during 15 out of the 17 time windows that comprise the operating day – or 88% of the time windows – truck moves remain within the bounds of capacity management, that is, 100% of capacity – or maximum capacity – and 40% of capacity. For the remaining 2 time windows – or 12% of the time windows – actual truck arrivals exceed maximum capacity, generating delays at 8:00 am, which are quickly remedied in the next time window, and thus, normal truck traffic levels reinstated. In addition, at 11:00 am there is a busy period that rapidly drops to below optimum capacity levels during the following time window. Thus, from the above data we may conclude that for Day 1 there is an even distribution of truck moves across the operating day.

In addition, the average overall capacity utilised throughout the day is 69%, which means there is 31% of capacity unutilised. This is, out of the three days analysed, the one with the highest percentage of utilised capacity and thus truck activity.

5.6.2 Day 2 – truck arrivals

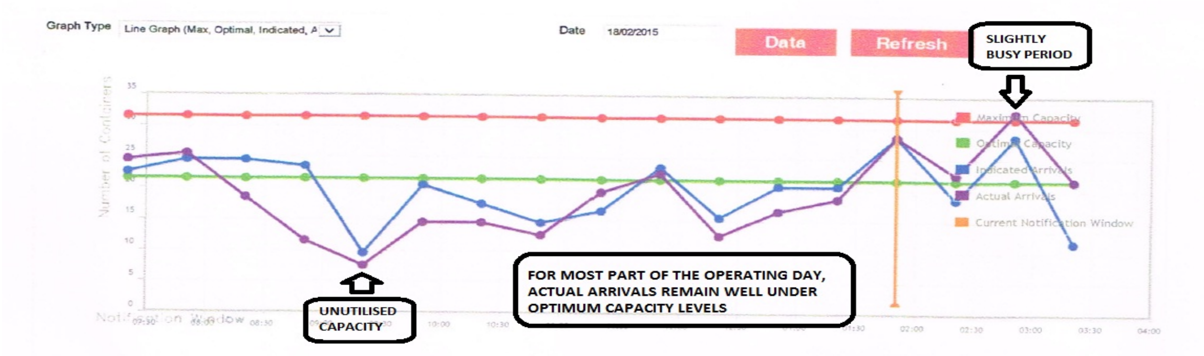

Figure 5.7 Container ETA monitor – truck arrivals for Day 2

Figure 5.7 corresponds to truck moves recorded for Day 2, which, as noted by the depot, represents a standard working day at the container park in terms of truck traffic. During the first two time windows of the day – or 7:30-8:30 am – actual truck arrivals are between optimum and maximum capacity levels. Yet, for the most part of the remaining operating day, truck moves stay below optimum capacity. However, during the last two hours, actual arrivals range between optimum capacity and maximum capacity, to be slightly exceeded by one truck move, that is, 31 truck arrivals during the 3:00-3:30 pm time window. Hence, we conclude that truck traffic peaks towards the end of the operating day.

Furthermore, for the most part of the operating day, transport operator's arrival performance seems to be consistent with the time they notified their intention to arrive at the depot, that is, transport carriers typically honour their indicated arrival times. This may be observed in the actual arrivals line following the indicated arrivals line fairly closely.

Table 5.5 Analysis of truck arrivals for Day 2

TIME WINDOW	ACTUAL ARRIVALS Day 2	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
07:30-08:00	23	30	20	21	77%
08:00-08:30	24	30	20	23	80%
08:30-09:00	17	30	20	23	57%
09:00-09:30	12	30	20	22	40%
09:30-10:00	8	30	20	10	27%
10:00-10:30	14	30	20	19	47%
10:30-11:00	14	30	20	17	47%
11:00-11:30	14	30	20	15	47%
11:30-12:00	18	30	20	16	60%
12:00-12:30	21	30	20	22	70%
12:30-13:00	14	30	20	15	47%
13:00-13:30	17	30	20	19	57%
13:30-14:00	17	30	20	19	57%
14:00-14:30	27	30	20	27	90%
14:30-15:00	21	30	20	17	70%
15:00-15:30	31	30	20	27	103%
15:30-16:00	20	30	20	12	67%

Table 5.5 documents truck arrivals for Day 2. Analysis shows that during 15 out of the 17 time windows that comprise the operating day – or 88% of the time windows, truck moves fall within the band of capacity management. The remaining 2 time windows that fall outside of this band, point to capacity being underutilised in 1 time window – or 6% of the time windows, thus, maximum capacity is exceeded in 1 time window – or 6% of the time windows. This suggests that for the most part of the operating day, truck arrivals are located within the band, which leads us to conclude that truck traffic is smoothed out across the operating day. Yet, utilisation rate levels are not prominent and additional truck traffic could be accommodated across the day since the average capacity used across the day is 61%, meaning that 39% of the capacity is unutilised.

5.6.3 Day 3 – truck arrivals

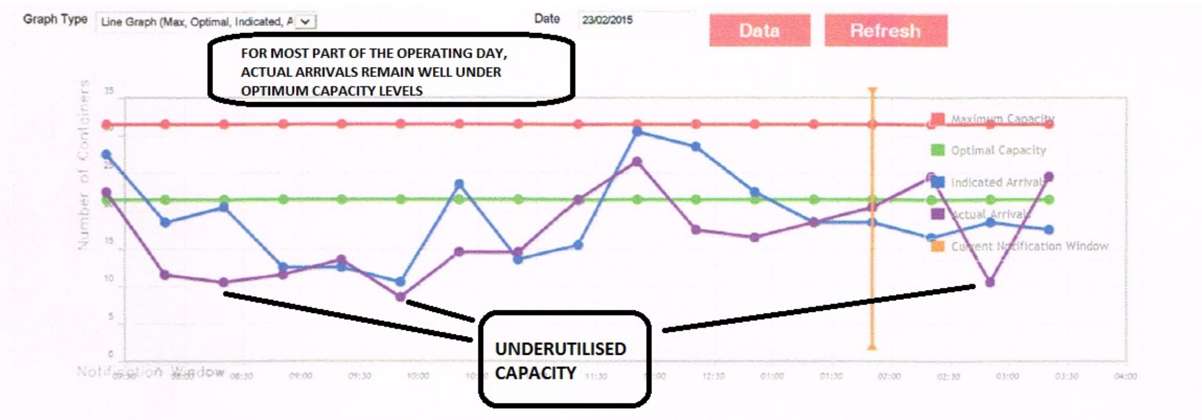

Figure 5.8 Container ETA monitor – truck arrivals recorded for Day 3

Figure 5.8 shows truck moves for Day 3. During the first time window – or 7:30-8:00 am – actual truck moves exceed optimum capacity by just one truck arrival. Then, from 8:00 am to 11:30 am, truck arrivals remain under optimum capacity levels. At 11:30 am truck moves hit optimum capacity to slightly surpass it during the next time window – 12:00-12:30 pm. Again, from 12:30 pm to 14:30 pm, truck traffic stays below the optimum capacity mark and at 14:30 pm actual truck arrivals moderately exceed optimum capacity. During the 15:00-15:30 pm time window, however, truck moves drop well below optimum capacity to slightly exceed it during the last time window of the operating day. Thus, by and large, actual truck arrivals fluctuate between above and below optimum capacity levels, never exceeding maximum capacity. Further, optimum capacity is only surpassed during four time windows across the day.

Concerning transport operators' arrival patterns and in contrast to previous days, their behaviour appears to be more inconsistent and unpredictable since notifications seem to be unrelated to actual truck arrival times. This is noted in the disparity between the blue and purple lines. Yet, truck arrivals are commonly located within the range of capacity management – see table 5.6.

Table 5.6 Analysis of truck arrivals for Day 3

TIME WINDOW	ACTUAL ARRIVALS Day 3	MAX. CAP.	OPT CAP.	INDICATED ARRIVALS	CAPACITY USED
07:30-08:00	21	30	20	26	70%
08:00-08:30	12	30	20	17	40%
08:30-09:00	11	30	20	19	37%
09:00-09:30	13	30	20	13	43%
09:30-10:00	14	30	20	13	47%
10:00-10:30	8	30	20	11	27%
10:30-11:00	15	30	20	22	50%
11:00-11:30	15	30	20	14	50%
11:30-12:00	20	30	20	15	67%
12:00-12:30	25	30	20	29	83%
12:30-13:00	16	30	20	27	53%
13:00-13:30	15	30	20	21	50%
13:30-14:00	17	30	20	17	57%
14:00-14:30	19	30	20	17	63%
14:30-15:00	23	30	20	15	77%
15:00-15:30	11	30	20	17	37%
15:30-16:00	24	30	20	16	80%

Truck arrivals recorded for Day 3 are displayed in the table above. According to the data analysed for this day, during 14 out of the 17 time windows – or 82% of the time windows – actual arrivals remain within the band of streamlined capacity management. Conversely, during the remaining 3 time windows – or 18% of the time windows – capacity is underutilised as the utilisation of slots in the system drops to under 40% of capacity. Thus, we may infer from the data contained in Table 5.6 that truck moves are fairly evenly distributed across the day as well as the absence of congestion in the container park throughout the day. Moreover, the average overall capacity utilised throughout the day is 55%, which hints at a large amount of capacity – 45% – not being utilised. This may lead us to conclude that the container park supply for capacity greatly surpasses transport operators demand for slots, thus, the depot may likely process a greater number of truck moves through its gates should there be demand.

5.6.4 Remarks: capacity management in a disintegrated chain

We may, thus, make the following inferences in relation to the management of capacity at the container park providing the data gathered for Days 1, 2 and 3. The average operational efficiency score for capacity management is 3 out of 3.5. To obtain this score, the individual daily scores for the days noted above were added and averaged. This score suggests that for the three days analysed, during 86% of the time windows, truck arrivals fall within the range of efficient capacity management, that is, maximum capacity – or 100% of capacity – and 40% of capacity. In contrast, the remaining time windows that fall outside of the band indicate that during 8% of the time windows capacity is underutilised (<40%). Consequently, maximum capacity is exceeded during 6% of the time windows; generating delays during three isolated time windows in two out of the three days under study. That is, queues do not occur – or maximum capacity is never exceeded – during two consecutive time windows as these are quickly reabsorbed during the following time window and, thus, the normal flow of trucks re-established. In light of the data examined, we cannot generate conclusions that may be broadly applied to the time when capacity is over utilised or underutilised. Namely, in previous examples with other empty-container parks, we observed patterns in which capacity was underutilised towards the end of the operating day; or, maximum capacity exceeded early in the morning resulting from increased truck traffic and/or reduced forklift capacity. Thus, the depot appears to have somewhat unpredictable and unreliable truck traffic patterns on the basis of the data collected.

Comparable to the depot in Chain 1, a large amount of the total average capacity is not utilised; more precisely, 46% in the case of the depot in Chain 1 and 38% for the depot in Chain 3. As previously noted, these figures show that the container park's capabilities to service arriving trucks greatly exceeds the present transport operators' demand for slots in the system, indicating that the depot has the means to allow for additional truck traffic through its gates.

As discussed in Chapter 4 – section 4.3.5, it is preferable to have unused capacity than lengthy queues that overflow into the neighbouring streets causing discomfort for the residents of the surrounding properties negatively affected by this heightened truck traffic. Further, the purpose of having truck moves within the band of capacity management is to prevent these delays by way of capitalising on the underutilised capacity in the system. That is, periods of excess activity are eliminated by way of using the available slots in the system; consequently, demand is regulated by assigning these excess activity intervals to periods of deficient demand, giving rise to an equilibrium in demand for slots in the system across the operating day.

This high percentage of total unused capacity in the system may shed light on the grounds for restrictions on truck arrival times being more theoretical than practical, that is, trucks are allowed access regardless of the time assigned to their notifications. Further, in light of the evidence presented by the depot in Chain 1 regarding high levels of unmet demand in the system, we may argue that the depot in Chain 3 does not need to have a quota on maximum capacity since a large number of slots in the system are unused and delays are unlikely to occur resulting from scarce demand for capacity. Consequently, the likelihood of delays increases as demand for slots in the system increases and the subsequent need to impose restrictions on maximum capacity and truck arrival times so as to as prevent undesired delays and bottlenecks as well as to ensure a constant flow of trucks across the operating day.

In line with these findings, the depot makes an interesting point regarding the concern raised by one of the transport operators in the first part of Chapter 5 – section 5.2, in relation to the loss of flexibility associated with a random empty collection or return due to the unavailability of slots in the system resulting from restrictions on maximum capacity. The container park notes that, in actual fact, the issue at hand is the absence of slots for a time window of their convenience and that, typically, there is a fair amount of unutilised capacity across the operating day. Further, and understandably, empty collections and returns are not a priority for transport operators, whose prime concern is full collections and returns since packers and cargo owners have limited working hours and, reasonably, providing for these stakeholders takes precedence over empty jobs, which ideally would be performed after hours. Yet, and as specified by the depot, some shipping lines categorically refuse to financially contribute to longer depot opening hours on the basis that there is still a surplus of unmet demand in the system; in addition to the fact that extending operating hours would only extend the dehiring/collecting period but not the actual number of empty collections or returns, which would lead to increased expenses but identical revenue and, thus, less financial gains for the depot.

5.7 Paperless environment in a disintegrated empty-container supply chain

The score obtained for the paperless environment by Chain 3 is 0.2 out of 3. This score indicates fragmentation, which stems from the depot's poor business practices by way of tolerating inefficient and negligent behaviours on the part of other supply chain partners, whose endeavours to achieve a streamlined chain are limited. These lax operational attitudes are aggravated by the depot's excessive permissiveness and over-tolerance towards attitudes of self-interest and carelessness, likely resulting from positions of power by shipping lines.

Before the introduction of Containerchain, all transport companies that were dehiring an empty container were required to show a delivery order at the gatehouse upon their arrival which included the following information – first, the returning container park, second, the vessel which carried the empty container and; last, the owner or operator of the empty container.

Since the introduction of Containerchain, there are two pieces of information that greatly contribute to a streamlined paperless environment. First, the CRA transferred from Containerchain to the container park. This occurs in the instances in which the shipping line shares the manifest with Containerchain and, thus, the dehire information is automatically updated in the system. The information contained in this electronic document serves the same purposes as the physical delivery order, that is, facilitating the empty container details to the depot, i.e., its ownership, returning depot as well as the vessel it was discharged from. Second, the online dehire notification made by transport operators containing the truck registration number, container number and shipping line's prefix. The purpose of the dehire notification is to validate the ownership and returning depot of the empty container so that when the transport operator enters these fields, these are automatically identified. Yet, for this systematic validation the information entered in the notification needs to be accurate and complete. The system may hence allow a transport company to make a dehire notification inadequately or insufficiently populated as this is not matched against the CRA because not all shipping lines transfer the manifest. The onus is, therefore, on the transport operators to enter the correct details since they have been provided with this information by the shipping line or the shipping line's customer. However, and as noted above, the dehire notification serves verification purposes as it verifies the information contained in the CRA or delivery order concerning the ownership and dehire location of the empty container. Hence, if the depot does not access the CRA or if the transport operator does not present the delivery order upon arrival, the accuracy in the dehire online notification may be to no avail.

Challenges may thus arise in the booking in process – drop-offs – at the container park when the shipping line does not share the manifest with Containerchain or when the transport operators do not take the delivery orders with them. Thereby, there is a slight chance that the empty container may be booked into the wrong customer account, which may generate a whole array of undesired costs, ranging from repacks through to repatriation of empty containers from offshore locations. Alternatively, other issues include – first, that the empty container may be gated in the container park's system when it needed to be returned to another depot outsourced by the same shipping line or, second, that the empty container is booked into the depot's system on the basis that it was discharged from a vessel operated by one of their customers – a shipping line; yet this vessel had a number of other shipping lines' slot chartering space, meaning that the empty container belongs to another shipping line.

We thus infer that an efficiently operated paperless setting requires all shipping lines to engage in the transfer of the manifest to Containerchain so delivery orders are not required at the gate-in, as well as dehire notifications to be correctly populated by transport carriers. Yet, some shipping lines behave with disregard for land-based cargo flows as they are not directly exposed to these operational inefficiencies including unnecessary delays, prolonged truck turnaround times and futile trips which have a direct negative impact on, first, transport operators as these lead to an undesired wastage of their resources and, second, empty-container parks since they have to adhere to heavy vehicle driver fatigue regulations as well as minimising the occurrence of queues in an effort to prevent financial penalties imposed by VicRoads and Worksafe.

The depot only fully shares EDI communications with one – out of the five – of their customers. Hence, the empty returns pertaining to that shipping line are completely paperless as long as the transport companies correctly populate the online dehire notifications. Similar to the depot in Chain 1, the truck registration number may be sighted from the gatehouse, and hereby, this information is entered in the system by the office staff, who gate the empty container in once they corroborate whether the notification has been made as well as the accuracy of the information contained in the dehire notification, that is, the truck registration number, container number and shipping line's prefix. In these instances, the truck driver does not need to leave the truck and may drive straight into the unloading area. The exchange of EDI data, thus, contributes to streamlining the chain by enabling a setting free of paperwork by means of systematically providing dehire information concerning the ownership and returning location of empty containers, leading to the elimination of delivery orders, and thus, more expeditious truck turnaround times. In similar fashion to the depot in Chain 2, empty collections at the container park are not entirely paperless, yet, the causes differ. The container park does not use FMTs in the forklifts that load and unload empty containers onto/off trucks, thus, the gate-out process has to be performed in the gatehouse by the office staff once the empty container has been loaded onto the truck. In the instances of container parks that use FMT in their forklifts, the book-out process is done by the FMT; however, truck drivers may be required to attend the office for verification purposes.

As specified by the depot, the other four shipping lines that do not send EDI dehire notifications[24] are not interested in so doing and, thus, not willing to engage in a full 2-way EDI reporting in which case truck drivers have to attend to the gatehouse with the physical delivery orders so as to proceed with the gate-in process. As the paperless environment has progressively been imposed in the various container parks, this physical document – the delivery order – has become less frequent hindering, in some cases, empty returns. That is, some transport carriers have assimilated this notion too literally, to the extent that they are not willing to carry delivery orders, even if these documents are required as a result of the shipping line not transmitting the manifest to

[24] 'EDI dehire notification' term is used as a synonym for the transfer of the manifest to Containerchain, which breaks this information down per container park in the form of CRA, indicating the container numbers that are anticipated to be returned from a specific vessel.

Containerchain. In these instances, the shipping lines need to be contacted to validate the ownership and returning location of the empty containers as these pieces of information are nowhere to be found in a source generated by the shipping line, that is, CRA or physical delivery order. This adds to the transport company's truck turnaround time in addition to the wastage of labour resources on the part of the empty-container park and the shipping line since these two parties have to resolve this issue via phone call. This entails labour costs on both parties which could have avoided if the shipping line had transferred the EDI dehire information and, thus, use that time more productively on other tasks. This, in turn, may be further exacerbated by the fact that transport carriers are allowed entry at the container park with inadequately or poorly populated dehire notifications – that is, the depot consents to this inefficient behaviour by amending the errors in the dehire notifications.

This leeway given to transport operators to arrive at the container park with no delivery orders – should they be required – as well as inadequately populated online dehire notifications only promotes the persistence of erratic and inconsistent behaviours among transport operators. Similarly, the permissiveness to consent to a deficient exchange of EDI data between the depot and the shipping lines results in operational inefficiencies across the chain. Understandably, the imposition of conditions on shipping lines may be an arduous task stemming from their position of power in relation to container parks. Namely, the depot's revenue derives from shipping lines, thus, forcing demands on their customers may be challenging for some container parks, which are not willing to jeopardise commercial interests.

These undisciplined business practices contrast with those introduced in Chain 1, in which the depot requires a full electronic interface with all their customers – the shipping lines – so as to ensure an environment devoid of paperwork. In addition, the container park in Chain 1 imposes the correct and accurate completion of the online notifications on all arriving trucks otherwise, these are not allowed entry in the depot. In line with these findings, one of the logistics and transport industry experts points to the differences between the depots in Chain 1 and 3 concerning opposed management approaches to enforce disciplines in the running of their respective businesses[25].

5.8 Stock management in a disintegrated empty-container supply chain

As discussed in previous chapters, stock management refers to the involvement of the container park in the effective alignment of export releases to available stock by means of ensuring that collecting trucks are provided with empty containers, leading to the elimination of futile trips and undesired bottlenecks at the container park.

This task requires the participation of the shipping line in the transfer of export releases with their allocated pick-up dates via EDI so that this information is automatically updated in the system leading to time savings and an efficient management of stocks that provide the means for operational gains upstream and downstream chain partners. In this regard, only one of the five shipping lines that outsources services to the depot, transfers EDI export releases. The other shipping lines typically email the releases and the depot has to manually type the export bookings into the system with their valid pick-up dates. This may give rise to phone calls from the transport operators to their customers – exporters or freight forwarders mainly – since releases are not yet in the system. Namely, while transport companies have been advised by their customers on the required collection, they try to make a pick-up notification on Containerchain; yet, they are unable to do so because the export release has not been entered in the system; resulting in unnecessary phone calls.

The score obtained for the stock management by Chain 3 is 1.2 out of 3.5. This poor score points to the reactive approach adopted by the depot with regard to the management of the shipping lines' stocks. Similar to the depot in Chain 2, this task is

[25] *"When a truck arrives at XXX – depot in Chain 1 – and doesn't have the right information, he tells them to go away, do it properly and then come back. In XXX – depot in Chain 3 – they let them in 'Just come in, we'll fix it' (…) So, XXX – depot in Chain 3 – probably are correct in saying that people don't do the right thing but only because XXX – depot in Chain 3 – don't force them to do the right thing (…) We are not talking about technology; we are not talking about shipping lines, EDI. We are talking about the* ***disciplines that each individual container park applies to their own site. Some are very disciplined*** *like XXX – depot in Chain 1 –* ***and some are less disciplined****".*

assigned to shipping lines on the basis that the empty containers are their assets. In the instances of shortage of stock, the depot behaves reactively by managing stocks on a notification basis, that is, by leaving the export bookings open in the system and reacting to collecting trucks once the online pick-up notifications have been made by transport carriers by way of removing the notifications from the pending movements screen. This may likely lead to futile trips if the depot does not cancel the notifications. Alternately, futile trips may result if pick-up notifications are made immediately before the start of the time window and transport carriers are already in the driveway of the depot or on their way and there is no available stock in the container park to service those empty collections. This practice contrasts with the effective forward planning conducted in Chain 1, in which the depot acts on the pick-up date of export bookings and aligns available stock accordingly, which may result in changing the ready date if it anticipates the unavailability of stocks to cover those export bookings on the initial date.

The depot operator pointed to a situation in which the available stock at the container park does not suffice to attend to all the pick-up notifications made by transport carriers[26]. Shipping companies have, thus, to prioritise the customers who are to be provided with empty containers in view of shipping lines' cut-off dates as well as customers urgency. And the other customers who have already made notifications and are not regarded as a priority, have to be notified and their pick-up notifications cancelled. Alternatively, if no prioritisation is required, shipping lines still have to issue instructions stating the 'first in first out' (FIFO) allocation of empty container subject to truck arrival times.

As noted above, the main challenge the depot is confronted with is its own reactive behaviour in relation to the management of stocks, that is, allowing shipping lines to gain control of this task. As discussed by the depot in Chain 1 in Chapter 4 – section

[26] *"So, we may have **10 available** – empty containers – here and then we might have **15 releases**. So, it's up to the shipping line to decide who gets those boxes, whether they allocate or whether it's first in first served. So we'd have **10 bookings** there for, say, food quality boxes. **And we only have 5 boxes** here, but the shipping line has issued very specific **instructions** (…) these 3 releases are the only ones that can have containers today. Out of those 3, **none of those are actually on our screen, so all of those we have to cancel**. So all of those we have to contact transport to say 'sorry, no boxes are available".*

4.5.1 – Containerchain has provided container parks with certain features in the system only available to them for an enhanced management of stocks. Consequently, assigning this task to the shipping lines may unavoidably lead to a whole array of issues at the depot[27]

The depot noted that shipping lines may efficiently manage their own stocks in light of their exhaustive knowledge of the SOH, in particular, available stock as well as the stock that is nearing the available status and, thus, match that information against export releases and/or pick-up notifications[28].

However, we may challenge this previous statement on the basis that the container park is the only one that, in actual fact, knows their own capabilities better than any third party. That is, having an in-depth understanding of their own capabilities translates into evaluating external and internal factors that may contribute to a higher or lower workshop and wash bay turnover for the operating day. We may thus question how efficient is it to leave this assessment to the shipping line when this knowledge is inherent to the depot’s business in addition to all the inventory control mechanisms provided by Containerchain that only the container park has access to.

[27] *“Depot in Chain 1: They – shipping lines – don’t have a ready date; they only have a pick-up date. We can control the ready date, that's the control mechanisms that we have (…) If I sat back and just went 'it's not my job, let the shipping lines control it' and just let all those bookings open, you get ten trucks a day that come in trying to pick-up containers you didn't have (…) the shipping lines generally, and I'm not criticising, some of them actually believe that they control things but they can't.* ***They haven't got the tools to be able to control things the way we do.*** *It's a constant battle sometimes to try educating them. You pay us to actually manage your stock levels and actually control your containers; allow me to do it and we'll make sure we do it right and there's no issues. When the shipping lines try to dictate 'no, we'll do it.* ***That's when there are problems*** *(…) I can see how many pick-ups they've got, I see the notifications coming through, they – shipping lines – don't (…) They don't see that, so they can't tell. They are basing it on this (‘Container Inventory Summary by Container Status’ report) but I'm basing it on what's actually being booked at the moment, so I can see a lot more and I can control a lot more than what they can, so I'm constantly saying 'let me manage for you and it'll be right'. And if there's a problem I'll let them know”.*

[28] *“The shipping line knows how many boxes are available and they have their container controller who is very much on top of everything in what’s available, what will be available this afternoon, tomorrow morning. Exactly how many releases, who has priority”.*

5.9 Concluding comments

Chapter 5 illustrates the empirical findings in relation to the existing operational efficiency in Chains 2 and 3, that is, the moderately integrated and disintegrated chains. Results are uncovered subject to the operational efficiency template, i.e., capacity management, paperless environment and stock management.

On the one hand, Chain 2 has obtained an overall operational efficiency score of 6.1, thus, it is regarded as moderately integrated. This moderate integration derives from limited integrative efforts among chain partners; hereby, operational linkages across organisational boundaries may be somewhat constrained. This chain thus exhibits a combination of streamlined technological deployment although management practices are undisciplined resulting from the lax implementation of parameters as well as the excessive permissiveness towards inefficient behaviours on the part of some chain participants. This chain, consequently, shows fragmentation in some segments as well as integration in other segments.

On the other hand, Chain 3 has obtained an overall operational efficiency score of 4.4, and is regarded as disintegrated. This absence of integration arises from deficient technological implementation, insufficient and ill-timed information flows as well as over-tolerant business practices which are too accommodating towards negligent behaviours or attitudes of self-interest on the part of some chain players. The synchronisation of chain operations is thus deficient, which leads to inadequate operational linkages among chain partners and silo-oriented supply chain processes.

First, the average operational efficiency score obtained by Chain 2 for capacity management is 2.1 out of 3.5. This score notes that truck traffic falls within the band of capacity management during 58% of the time windows, that is, maximum capacity – or 100% of capacity – and 40% of capacity. In contrast, in most of the remaining time windows that fall outside of the band, maximum capacity is exceeded during 32% of the time windows, which results in capacity being underutilised (<40%) during 10% of the time windows. Thus, an aggregate level suggests that delays and bottlenecks at the container park are constant giving rise to irregular and random truck arrival patterns across the operating day that typically fluctuate between high demand periods in which transport companies arrive at the container park simultaneously and periods of low truck activity. In addition, the average capacity utilised across the three operating days is 87.3%, this indicates that transport carriers' demand for capacity is practically exhausting the depot's supply for slots and, thus, the depot's capabilities to attend to arriving trucks. We may conclude that ideally maximum and optimum capacities should be increased to accommodate the actual demand for capacity; yet, in light of the restricted gate and forklift capacities, this would give rise to intensified delays at the depot.

Further, Chain 3 has obtained an average operational efficiency score of 3 out of 3.5 at this level. This score reveals that for the three days analysed, during 86% of the time windows, truck arrivals fall within the range of efficient capacity management. In contrast, the remaining of the time windows that fall outside of the band indicate that during 8% of the time windows capacity is underutilised (<40%). Consequently, maximum capacity is exceeded during 6% of the time windows generating delays during three isolated time windows in two out of the three days under study. That is, queues do not occur – or maximum capacity is never exceeded – during two consecutive time windows as these are quickly reabsorbed during the following time window and, thus, the normal flow of trucks re-established. Similar to Chain 1, a large amount of the average capacity is not utilised, in particular, 38%. This reveals that the container park's supply of slots greatly exceeds the present transport operators' demand for capacity – that is, the depot has the resources and the capabilities to attend to additional truck moves should the demand arise.

Second, the score obtained for the paperless environment by Chain 2 is 2 out of 3. In this regard, operational gains are ambivalent and inconsistent. Namely, while there is a full 2-way EDI reporting between their only customer and the depot and FMTs are installed in all the forklifts that book empty containers in and out of the container park, thus, finalising the gate-in and gate-out processes. Transport operators, however, are allowed entry unannounced by way of paying a manual processing fee. Hence, despite the fact that these unannounced truck arrivals may somewhat delay the paperless environment, this has provided the means for reduced truck turnaround times and increased capacity in the system by way of eliminating the reporting at the office – in the empty returns – and, thus, allowing transport operators to drive straight into the unloading area.

Instead, Chain 3 has obtained a much lower score of 0.2 out of 3 at this level. Various factors have implications for such a low score. The depot provides empty container storage and maintenance services for five shipping lines, and only has a full electronic interface with one of them, meaning that the empty returns pertaining to that shipping line are completely paperless as long as the transport company has correctly populated the online dehire notification. Conversely, the other four shipping lines do not send EDI dehire notifications, in which case truck drivers have to attend to the gatehouse with the physical delivery orders so as to proceed with the gate-in process. In addition, FMTs are not installed in the forklifts that load and unload empty containers onto/off trucks and the gate-out process has to be performed in the gatehouse by the office staff once the empty container has been loaded onto the truck. This situation is aggravated by the fact that transport operators are allowed entry at the depot with poorly or insufficiently populated dehire notifications, that is, the depot consents to this inefficient behaviour by amending the errors in the dehire notifications.

Third, the scores obtained by Chain 2 and 3 concerning stock management are 2/3.5 and 1.2/3.5 respectively. In contrast to the depot in Chain 1, both container parks do not participate in the alignment of active export bookings to available stock so as to prevent futile trips. In the event of shortage of stocks, they behave reactively by allowing shipping lines to gain control of this task and thus managing stocks on a notification basis, that is, by leaving the export bookings open in the system and reacting to collecting trucks once the online pick-up notifications have been made by transport carriers by way of removing the notifications from the pending movements screen. This may lead, in some instances, to transport operators arriving at the depot to be advised of the unavailability of stocks.

We may thus infer that the utilisation of the tools and resources provided by this IT application to manage stocks is fairly deficient since they exclusively monitor stocks subject to the truck arrivals displayed in the pending movements screen with their assigned time windows. This reactive behaviour reveals significant operational inefficiencies, stemming, for the most part, from poor and undisciplined management practices which may be excessively tolerant towards negligent attitudes on the part of some chain members. Thus, this disengagement, whether voluntary or not, points to an inefficient synchronisation of chain operations as well as deficient forward operational planning which result in severe operational inadequacy.

CHAPTER 6: CONCLUDING COMMENTS: IMPLICATIONS OF IT ON EMPTY-CONTAINER CHAINS IN THE PORT OF MELBOURNE

6.1 Concluding remarks

In its *2012-2013 Containerised Trade (in TEU)* Statistics Report, Ports Australia (2015) disclosed that in the port of Melbourne, full import containers greatly exceeded full export containers, indicating that the port had become a major surplus container location experiencing difficulties to manage trade imbalances. Further, port-related trade has steadily grown in the last decade and it is projected to increase in the foreseeable future. By 2025, the containerised freight traffic is expected to increase to 4.7 million TEUs (PoMC 2015a). This growth in port-related trade creates capacity constraints on container parks' facilities and landside transport infrastructures resulting from increased truck movements in and around the port of Melbourne.

As specified by the ACCC in the *Statement of Reasons* in 2011 (ACCC 2011), these capacity constraints at container parks stemmed from, first, the random nature of truck arrivals, which caused depots to alternate periods of low truck traffic activity with periods of excess demand that generated lengthy queues that spilled out on to the neighbouring streets causing undesired delays and adversely affecting residential amenities of adjoining properties. In addition, these lengthy queues posed a serious problem for depots as it curtailed their liability as 'loading managers' to manage heavy vehicle driver fatigue subject to the Chain of Responsibility Legislation. Second, transport carriers often arrived at container parks to be notified of the unavailability of stocks to attend to empty collections, that is, futile trips occurred on a regular basis.

In line with these statement, the Victorian Freight and Logistics Council (2005) issued the *Business Activity Harmonisation Study (BAHS)* in 2005, in which it had already acknowledged the need to implement a VBS at container parks as a way of delivering enhanced visibility and efficiency gains for the empty-container chain in an effort to address the capacity challenges already experienced in and around the port of Melbourne.

In light of this growth in international freight volumes, an increasing number of firms are pursuing to integrate operations intra and inter organisational boundaries in an effort to generate performance gains. IT systems allow for collaboration and the exchange of data that provide the means for operational and strategic efficiencies across the chain. IT has thus attained a key role in orchestrating and integrating upstream and downstream trading partners (Frohlich & Westbrook 2001; Gunasekaran & Ngai 2004).

Clearly, a considerable amount of literature has been published on the importance of IT in the logistics and supply chain-related literature and this study has noted a wide range of approaches. Previous research findings have evidenced the importance of adopting IT systems in order to streamline the operations of container parks and container terminals. The study conducted by Giuliano and O'Brien (2007) validates the notion that IT applications may contribute to enhanced container chain operations and deliver superior chain efficiency. Our review has uncovered, however, that there has been little discussion on the empty containers' critical function in ports characterised by acute disequilibria in containerised trade flows by way of integrating the supply of empty containers generated by import flows with the demand for export containers, whether in the form of export cargo or empty repositions.

This thesis sets out to test the proposition that the implementation of IT solutions can deliver operational gains for the individual firm as well as across the chain. For that purpose this research explored, in a detailed case study, the adoption of the Containerchain IT software by some of empty-container parks in the port of Melbourne with a view to put an end to the challenges the empty-container chain was confronted with. In particular, this thesis sought to shed light on the impacts this innovative IT solution is having on the integration of chain activities and operational chain efficiency given differentiated empty-container parks and empty-container chains.

In order to do so, the operational efficiency/integration relationship is defined in terms of three fundamental management capabilities. Capacity management or the ability to allocate slots in the system so as to regulate truck arrivals, and hence, obtain a constant flow of truck moves across the operating day is regarded to be the basic capability. A second level attribute is to do so within an environment free of paperwork – paperless environment, resulting from timely and accurate information flows, strict disciplines in place and advanced technology deployment as a means for ensuring reduced truck turnaround times. And third and highest-level attribute denotes the ability to effectively manage stocks – stock management, this complements the notion of capacity management in that it ensures the availability of stocks for empty collections, which is the ultimate indicator of slots in the system, with a view to eliminate futile trips.

Further, to fully understand operational efficiency we have devised a template which quantifies the level of operational efficiency found in the three chains under study. It constitutes a framework for the presentation of findings and classification of empty-container chains as highly integrated, moderately integrated or disintegrated subject to the score obtained. It also provides the basis for comparison for the analysis and cross-referencing of data among the three empty-container chains examined.

On the one hand, Chain 1 obtained an overall operational efficiency score of 9/10; it is thereby regarded as highly integrated chain. On the other hand, Chains 2 and 3 obtained 6.1/10 and 4.4/10 scores respectively; hence, these are regarded as moderately integrated and disintegrated chains. We will thus present an outline of the results of the case study pursuant to the operational efficiency template noted above.

First, the average operational efficiency scores obtained for capacity management by Chains 1, 2 and 3 are 2.5/3.5, 2.1/3.5 and 3/3.5 respectively. Surprisingly, this reveals that Chain 3 exhibits the highest percentage – 86% – of time windows in which truck traffic falls within the band of capacity management, that is, maximum capacity – or 100% of capacity – and 40% of capacity. While in Chains 1 and 3 truck arrivals seem to be fairly apportioned across the operating days with minimum delays, Chain 2 shows constant delays and bottlenecks, which lead to irregular and random truck arrival patterns across the days examined that typically fluctuate between high demand periods and periods of low truck activity.

This raises the question, why does the depot in Chain 1 not display the highest score at this level if it is the most operationally efficient container park in the present study? This is due to the high levels of unutilised capacity, that is, during 25% of the time windows the truck traffic task is low. Alternatively, the average unutilised capacity for the sample days amounts to 46%. This reveals that the depot's capabilities to process arriving trucks – or supply of slots – greatly exceeds the present transport operators' demand for capacity in the system making the imposition of a quota on maximum capacity unnecessary. Further, from a capacity management standpoint, it is preferred to have unutilised capacity in the system than delays that cause undesired bottlenecks, which adversely affect residents living in close proximity to the container park. The grounds for this statement lie in the fact that delays are the main issue at hand, while unused capacity is the formula to put an end to congestion issues.

Similarly in Chain 3, 38% of the average capacity is not utilised. These high levels of unutilised capacity show that both container parks have the resources and the capabilities to attend to further truck moves should the demand arise. This high percentage of total unused capacity in the system may shed light on the grounds for restrictions on truck arrival times being more theoretical than practical at the depot in Chain 3, that is, trucks are allowed access regardless of the time window allocated to their notifications. As noted above concerning the high levels of unmet demand in the system faced by depot in Chain 1, we may argue that the depot in Chain 3 does not need to restrict maximum capacity since a large number of slots in the system are unused and delays are unlikely to occur resulting from scarce demand for capacity.

Conversely, in the depot in Chain 2 maximum capacity is exceeded during 32% of the time windows for the three days analysed. This suggests that delays and bottlenecks at the container park occur on a regular basis, resulting in irregular and random truck arrival patterns that typically oscillate between high demand periods that generate undesired queues and periods of low truck activity. Also, the average capacity utilised across the three operating days is 87.3%, this indicates that transport carriers' demand for capacity is practically exhausting the depot's supply for slots and, thus, the depot's capabilities to attend to arriving trucks.

Second, the average operational efficiency score resulting from the paperless environment for Chains 1, 2 and 3 are 3/3, 2/3 and 0.2/3 respectively. Chain 1 provides a fully paperless environment, that is, a setting entirely free of paperwork interchanges between parties, in which information is transferred electronically and with minimum human interaction. The depot staff verifies the transport operators' notification details from the gatehouse and trucks may proceed to the loading or unloading area. These paperless transactions result from, on the one hand, the full electronic exchange of EDI communications between the depot and its customers, the shipping lines. And, on the other hand, the accurateness required in all the online notifications made by transport operators as well as the use of FMTs in all the forklifts that gate empty containers in and out of the container park. In similar fashion, in Chain 2 there is a full 2-way electronic reporting between their only customer and the depot, contributing to a depot free of paperwork exchanges. Collections are, however, not completely paperless for verification purposes and, thus, truck drives need to proceed to the gatehouse on their way out. FMTs are also installed in all the forklifts for the gate-in and gate-out of empty containers. Yet, a number of transport carriers may arrive unannounced, in which case the time savings obtained by way of more expeditious truck turnaround times may be curtailed to a certain extent. Unquestionably and in spite of allowing this inefficient practice in Chain 2, we may infer that, by and large, an environment free of paperwork provides the means for an enhanced chain. Further, depots have reduced truck turnaround times as well as increased their capacity – slots in the system – to gate additional containers since the implementation of Containerchain. That is, the fact that trucks are serviced more promptly since the adoption of the Containerchain IT solution, has given rise to additional trucks being processed during a time window and, by extension, across the operating day.

Instead, in Chain 3 there is only a full electronic compatibility of EDI communications with one – out of the five – of the shipping lines. Dehires pertaining to that shipping line are hence paperless as long as the transport operators correctly populate the online dehire notifications. As indicated by the depot, the other four shipping lines that do not send EDI dehire notifications are not interested in so doing, in which case truck drivers have to attend to the gatehouse with the physical delivery orders so as to proceed with the gate-in process. As the paperless environment has been imposed in the various container parks, some transport operators are not willing to carry delivery orders with them, in which case issues may arise regarding the verification of the ownership and returning location of the empty container should this physical document be required. In similar fashion to the depot in Chain 2, empty collections at the container park are not entirely paperless; yet, the causes differ. The container park does not use FMTs in the forklifts that load and unload empty containers onto/off trucks, thus, the gate-out process has to be performed in the gatehouse by the office staff once the empty container has been loaded onto the truck. This inefficient scenario may be further heightened by the fact that transport carriers are admitted at the container park with inaccurately or poorly populated dehire notifications – that is, the depot consents to this inefficient behaviour by amending the errors in the dehire notifications.

Third, the scores obtained by Chains 1, 2 and 3 in relation to stock management are 3.5/3.5, 2/3.5 and 1.2/3.5 respectively. In contrast to Chain 1, both depots in Chain 2 and 3 do not engage in the alignment of active export bookings to available stock so as to prevent futile trips. The behaviour adopted towards the management of stocks is fairly reactive since shipping lines are the ones that, in actual fact, control the stocks at the container park on the basis that empty containers are their assets; hence, export bookings are left active in the system and, thus, issues arise in the instances of dearth of stock to attend to collecting trucks. That is, when export bookings are left active in the system, transport operators may make online pick-up notifications, which may result in futile trips if there is no available stock at the depot to service trucks. In these instances the way the depots proceed so as to prevent futile trips is by deleting the pick-up notifications from the pending movements screen following the instructions issued by the shipping lines; yet, it may be too late if trucks are on their way to the depot. The management of stocks, thus, occurs on a notification basis by way of reacting to collecting trucks once pick-up notifications have been made. We may thus conclude that the utilisation of the tools provided by this IT application to manage stocks is rather inadequate since these container parks exclusively monitor stocks subject to the truck arrival times displayed in the pending movements screen.

This practice contrasts with the effective proactive management of stocks conducted in Chain 1, in which the depot correlates the pick-up date of export releases with available stock by way of advance workload and resource planning. This may involve modifying the ready date if it anticipates the unavailability of stocks to cover those export bookings on the initial date, preventing transport carriers from making pick-up notifications and ensuing futile trips. This practice entails the engagement of the container park in the mitigation of the negative effects of the practice of overbooking by means of prioritising notifications and pushing the ready date back. In this regard, the viewpoints adopted by the depot in Chain 1 and the depot in Chain 2 significantly differ. While the depot in Chain 1 actively engages in the management of stock issues resulting from overbooking practices by shipping lines; the depot in Chain 2 distinctly refuses any participation in this task, indicating that shipping lines have to manage their own stocks. Similarly, the depot in Chain 3 is of the opinion that shipping lines should control their own empty container inventories as a result of their thorough understanding of the SOH. We may yet question the efficiency in allowing shipping lines to gain control of this task since, first, containers parks have been provided with the tools to effectively manage stocks by way of Containerchain adoption and, second, having an exhaustive understanding of the depot's capabilities for the day so as to cover the maximum number of active export releases is intrinsic to the container park business.

Thus, the active engagement of the container park as a stock manager by means of effectively aligning export releases to available stocks delivers value to the chain by providing the means for operational gains for the focal firm and across organisational boundaries.

Hence, the proactive participation of the depot in Chain 1 in the management of stocks, the provision of a setting free of paperwork as well as the introduction of capacity disciplines so as to regulate truck moves is key in achieving whole-of-chain operational efficiency. And this calls for the implementation of disciplined management measures by the container park in engaging chain members to exhibit integrative endeavours so that operational benefits are derived by way of effectively utilising the tools provided by this IT application. This disciplined business behaviour contrasts with the poor management practices displayed in Chains 2 and 3, which are excessively permissive towards negligent attitudes on the part of some chain members resulting in serious operational inefficiencies across the chain.

The results of this study suggest that this web-based IT software – the Containerchain IT solution – offers the means and capabilities to deliver integrated chains and streamlined operational efficiency across the chain; yet, reactive management behaviours by way of deficient forward operational planning, lax introduction of parameters in the system and over-tolerant approaches towards inefficient attitudes and expressions of self-interest seriously hinder higher levels of integration and integrative efficiency across the whole range of chain participants, giving rise to silo-oriented supply chains. This IT application, thus, provides the platform for enhanced operational linkages between chain players in terms of superior capacity and stock management practices as well as the provision of a paperless environment. Yet, the depot needs to exhibit integrative and disciplined measures to effectively engage other chain members – transport operators and shipping lines – to actively contribute towards chain efficiency by way of timely and accurate data transfer in the form of EDI reporting and accurate online notifications.

6.2 Future research

This research has thrown up many questions in need of further investigation. First, meaningful insights would derive from broadening the scope of the present study by analysing the implications of the Containerchain IT solution in terms of integrative chain efficiency on further participants' groupings pertaining to the extended empty-container chain – Port Community System, that is, freight forwarders, stevedores, cargo owners – importers and exporters, 1-Stop and packers. Second, as noted in Chapter 4 – section 4.4.4, the implementation of the Autogate system is anticipated to effectively quantify truck turnaround times at container parks, thus, further investigation into the these times would provide further insights into the effectiveness of the paperless environment over time. As specified throughout the thesis, the appropriateness and accuracy of the maximum and optimum capacities and whether these parameters effectively mirror the gate and forklift capacities is not in question; hence, further research would help us to establish a greater degree of accuracy on these matters. Ideally and last, we would have liked to explore the strategic or long-term efficiency implications resulting from the Containerchain implementation. However, given strict time constraints of a master's thesis, there was a need to focus and limit the present study. Further, long-term efficiency would be measured in financial terms including Return on Investment, Return on Assets and added costs to chain players.

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APPENDIX 1

Containerchain: A Background Note

Containerchain: a Background Note[1]

APPENDIX 1. 1 – Emerging concerns about empty-container chains in the port of Melbourne

Over a decade ago, Jays Corporate Services Pty Ltd (2004) identified in *NSW Import Export Container Mapping Study* several issues affecting landside container movements in New South Wales, which, if not addressed, would become more prominent as the trade imbalance between imports and exports increased in favour of imports. Additionally, it claimed that the container chain was disjointed as a result of the lack of information on container movements and, to achieve the required level of chain efficiency, a significantly higher degree of cooperation and information exchange would be required. Accordingly, a VBS was proposed as one of the viable measures to improve these inefficiencies.

One year later, the Victorian Freight and Logistics Council (2005) issued the *Harmonisation Study* (*BAHS)* report, in which it was acknowledged in stage 1 of the report that 'supply chain visibility, transparency of information and the adoption of common standards were highlighted across the board as being a fundamental component to delivering efficiency gains for the industry'. In stage 2 of the report several challenges on the efficient management of empty containers were identified. These included depot capacity constraints, inefficient gate activity capacity leading to truck queues and congestion, lack of container supply chain information, depot equipment failures and visibility issues in the empty-container chain.

Two of the solutions proposed to address these inefficiencies were a time slot system and an IT application providing visibility on container availability for the parties involved.

Again, in 2008, the Victorian Freight and Logistics Council (2008), suggested in its *Truck Optimisation Plan (TOP*) the implementation of an on-line VBS for transport

[1] This appendix is included to provide insights into the adoption of the Containerchain IT solution at the port. It suggests the process was not simple!

operators to notify empty-container parks of truck arrivals so as to plan their labour and equipment more effectively to handle demand and potentially extend opening hours if required. The extension of working hours had been a subject of disputes in the container industry for various reasons. On one hand, stevedores and transport operators had been transitioning towards 24/7 operations to service the inbound and outbound containerised flows through the port of Melbourne, thus creating a widening gap with the working hours of depots. On the other hand, container parks obtained their revenue by gating containers in and out of the park, storing empty containers and conducting ancillary services such as repairs, upgrading of containers and maintenance tasks. Consequently, given this throughput-based revenue, there was very little incentive for depots to extend hours or acquire additional equipment to handle the same volume of empty containers through their gates. In addition, repairs were performed offshore as a result of labour being less costly, reducing the range of value-added activities that depots could undertake.

Thus, this report underscored the importance of developing an IT solution that could provide visibility across supply chain participants, as well as assisting in facilitating real time traffic information which could better link the operations of transport operators with that of empty-container parks. It claimed that these streamlined information flows would be pivotal in achieving the desired truck optimisation in the port-hinterland.

APPENDIX 1. 2 2009 – The impacts of the GFC

From mid-October 2009 into the first quarter of 2010, that is, the trade peak season, empty-container parks were subject to significant truck queues and congestion through their gates.

This congestion occurred in the height of the GFC when demand for shipping space plummeted and shipping lines were not repatriating enough containers to overseas locations. In addition, international shipping lines were importing high volumes of containerised freight in the lead up to Christmas, resulting in depot capacity being severely constrained with empty containers stacked ashore awaiting an increase in demand for containerised export trade. Various shipping lines could not reposition empty containers offshore as their storage areas in their regular ports of call overseas were already congested (Victorian Transport Association & Shipping Australia Limited 2010).

APPENDIX 1. 3 Post-2009 and the 'Chain of Responsibility' Legislation

In November 2009, the Victorian Road Freight Advisory Council (VRFAC) meeting was held a VicRoads Offices. The VRFAC is 'an advisory body that provides advice to VicRoads on the development, planning, regulation and operation of road freight services in Victoria' (Victoria Police 2011). The VTA raised the matter of the congestion at empty-container parks and claimed that regulators should bring action against the depots to find a solution to these delays.

On the 19th of February 2010, a briefing by the Enforcement Liaison Committee (ELC) was delivered so as to jointly address the issue of congestion at parks. Members of the ELC include Victoria Police, VicRoads, WorkSafe Victoria, VTA and Transport Workers Union (TWU). In this briefing, parks were informed that, under the Chain of Responsibility Legislation they were defined as 'loading managers'[2] and, as such, they had to efficiently manage vehicle driver fatigue resulting from delays at empty-container parks so as to maintain truck turnaround times under 30 minutes. Thus, an online truck arrival notification system was proposed by the ELC as a potential solution

[2] Under the Chain of Responsibility Legislation, 'loading managers' must take 'all the reasonable steps to ensure that loading and unloading of vehicles will not contribute to causing a driver of a heavy vehicle to drive while impaired by fatigue or drive while in breach of his or her work rest hours option. Examples of reasonable steps include agreement of time slot systems for loading/unloading, or providing a system of reporting delays, managing late arrivals and providing rest facilities. The non-compliance with this legislation includes sanctions such as improvement notices, supervisory intervention orders, prohibition orders and criminal sanctions' (Victoria Police 2011)'A 'loading manager' is a person who manages or is responsible for the operation of premises at which usually on a business day at least 5 regulated heavy vehicles (12t Gross Vehicle Mass and above) are loaded or unloaded. Alternatively, it could be a person who directly or indirectly supervises, manages or controls the loading or unloading of fatigue regulated heavy vehicles at the premises' (Victorian Transport Association & Shipping Australia Limited 2010).

to address the issue of the lengthy queues, which on occasions reached 6 hours of waiting time. In this briefing the parks claimed that they could not proactively manage truck queues and capacity at parks given the impossibility to know in advance the number and time of truck arrivals.

The ELC stated that this was not an acceptable excuse to avoid responsibility under the new legislation and that container parks had to take all the reasonable steps to put in place the required disciplines so as to comply with the Chain of Responsibility legislation; otherwise, they would face the legal consequences. Additionally, VicRoads clarified that truck queues had to be efficiently dealt with since these posed an unsafe environment for residents and road users (Port Melbourne Containers Pty. Ltd. 2011b).

On the 10th of March 2010, the VTA and the SAL in collaboration with the PoMC hosted the 'Empty Container Management' meeting for industry stakeholders. Participants included representatives and members of the VTA, SAL, PoMC, VicRoads, Department of Transport, Tradegate Australia, Maximas Pty. Ltd., the Customs Brokers & Forwarders Council of Australia (CBFCA), empty-container parks and Victoria Police.

In this meeting, The VTA identified the lengthy queues and operational delays as the main challenge in the efficient management of empty-container parks. It claimed that these added costs could not be absorbed by the transport operators. Additionally, it argued that congestion contributed to driver fatigue and that, under the Chain of Responsibility Legislation, depots were identified as 'loading managers' and thus were responsible to address this issue. In addition, it pointed to an increase in road safety risks and reduction in local amenity resulting from truck queuing (Victorian Transport Association 2010).

The main matters discussed and considered in the meeting were:

- An appraisal of the current empty container storage capacity and future capacity needs for the port of Melbourne given increased trade volumes
- An assessment of the viability of extending working hours of empty-container parks in a commercially viable manner

- Efforts to enhance the visibility and transparency of data in the empty-container chain. Thus, an electronic information exchange solution was proposed as a viable solution

- Initiatives to improve the operational performance of depots such as the management of truck queues and equipment reliability

- The repatriation rate of empty containers by shipping lines. As previously mentioned, fewer empty containers were being repositioned to deficit locations – mainly Asia – while the trade imbalance in favour of imports was becoming more severe

- The need for collaborative action and joint objectives across the participants of the supply chain to efficiently address congestion, delays and other inefficiencies

An agreement on container detention fees was also sought. The congestion at empty-container parks resulted in delays incurred by transport operators to return empty containers to their respective parks. The VTA thus called on shipping lines to demonstrate their *bone fides* by considering a *moratorium* on container detention charges. The landside stakeholders – importers, exporters, trucking companies, freight forwarders, etc. – claimed that shipping lines needed to have a more reasonable approach towards the imposition of detention charges stemming from the late return of empty containers due to the congestion at empty-container parks. These players also demanded the adoption of sound disciplines and protocols to escalate requests for the extension of 'free time' for empty container dehire when compelling reasons were raised either by the importer or the transport operator.

Port-hinterland players called for the 10 days' free time to be counted as business day. In response to the previous claims, the SAL highlighted that importers were ultimately responsible for returning the shipping lines' empty containers to the nominated parks in the given free time window. The SAL also stressed the need to promptly communicate to shipping lines the delays occurring at empty-container parks that may result in detention fees, instead of indicating these delays one week or one month later, which was common practice among consignees. Furthermore, SAL noted that when delays were promptly reported to the operations department of shipping lines, they responded either by redirecting the transport operator to another park or by agreeing to an extension of the free time. Nevertheless, SAL emphasized that the most important factor was the timely communication of these delays as this led to prompt action on congestion issues (Victorian Transport Association & Shipping Australia Limited 2010).

APPENDIX 1. 4 2010 – The emergence of IT solutions

The main outcome of the March 2010 meeting was the establishment of two industry-level working groups, which would be chaired by the Port of Melbourne Corporation:

- Information Visibility & Exchange Working Group (IV&EWG); and
- Container Park Operations Working Group (POWG)

On the 6th of May the first meetings of the IV&EWG and POWG took place and they met on numerous occasions throughout the second half of 2010.

The IV&EWG established the following objectives in its Terms of Reference (Information Visibility & Exchange Working Group 2010):

- Determine the demands of the empty-container supply chain players for improved empty container management through the use of IT solutions
- Monitor the various IT solutions and assess technology trials
- Provide feedback to technology providers on the demands of the empty-container chain
- Provide feedback to stakeholders on the various technology options available
- Not about "picking winners" – the market will rule which is the best fit so as to deliver chain efficiency
- Consider the ramifications of an IT solution implementation at a national level

In this process, the IV&EWG was not a decision-making body. It acted as a mediator among industry participants so as to facilitate the information on how the various IT solutions may contribute to chain efficiency.

The POWG established the following roles and aims in its Terms of Reference (Container Park Operations Group 2010):

- Facilitate a platform for the exchange of views among industry participants so as to enhance empty-container park operations
- Assess the commercial viability of extending container parks' operating hours
- Assess container park performance and seek ways to improve it
    - Reduce truck queues
    - Shorten truck turnaround times
    - Ameliorate Occupational Health and Safety (OH&S) at parks
    - Assess park capacities
- Design cost indices for container parks. The development of cost indices provided a benchmark of the true costs of container park operations. These cost models were useful in the negotiations between depots and shipping lines in relation to additional operating hours, equipment and labour. As Cheryl Valneris stated (Victorian Transport Association & Shipping Australia Limited 2010), 'in 1987 container park rates were higher than in 2010, which makes it very difficult for parks to make new investments'. Thus, there were growing pressures from the industry to boost park efficiency, however, not additional revenue coming in.
- Develop metrics to measure park performance

On the 10th of June, the IV&EWG selected four IT solution providers to make presentations of their services. Maximas Pty.Ltd/Containerchain was the first to present its software on the 24th of June and it was followed by 1-Stop, Tradegate and Global Software Systems.

In July 2010, the VTA Container Group raised concerns in a survey regarding the flexibility of the truck VBS. They categorically rejected a strict time-slot system to be adopted at container parks, which is the booking system implemented in the terminals. The VTA claimed that the collection and return of containers at depots was significantly different from the ones performed at terminals. This claim was based on the fact that, in the terminals, there was more certainty as to the availability of containers for the collection of imports or the dehires of exports over a specific time interval and this allows this task to be accurately planned in advance.

Unlike the terminals, the availability of empty containers at depots was less predictable, leaving fewer options for forward planning of resources. Further, there were eleven parks servicing the trade task in Melbourne, as opposed to the two terminals. This added to the complexity in concurrently managing strict truck arrivals in all these depots (Victorian Transport Association 2011b).

Additionally, some VTA members represented in the stakeholders groups were unsure on the potential benefits derived from a strict time slot booking system from a cost structure standpoint. First, the imposition of a transaction fee for every container to be collected or returned. Second, the need for more administrative staff to handle dehire or pick-up notifications. Last, additional transport costs resulting from the double handling of containers that would need to be transited through transport yards (VTA Container Group 2010).

In August 2010, the majority of container parks announced their intentions to go live with the Containerchain portal. Consequently, the VTA sought industry-level talks with depots and Containerchain to discuss the implementation process and the design of the system.

On August 23th the Combined IV&E and PO's Working Groups meeting was held to discuss the extension of working hours, implementation dates for the booking system and heavy vehicle driver fatigue issues under the Chain of Responsibility Legislation. It was resolved that a smaller implementation group, Empty Container Park Working Group (ECPWG), comprising representatives from the two working groups would be formed. This group would include representatives from each container park, three VTA members, two SAL members and one from CBFCA. The objective of the formation of this group was to design ways to streamline the empty-container chain in Melbourne. This group held meetings in September and November 2010 to discuss a twelve-month trial to start in January 2011 to extend operating hours. Meetings were also held in March and April 2011 to deliberate on implementation dates to go live with the Containerchain system.

Two months later, in October 2010, Containerchain rolled out a messaging system by which container parks could inform transport operators of any operational issues such as equipment failures and lengthy queues. This service was free of charge and was well received among transport operators, who voluntarily subscribed to it.

In the first quarter of 2011, the VTA designed a “Must Haves” document, in which it outlined the conditions of use that it deemed fair and acceptable for the Containerchain system. The main requirements of this document were the incorporation of a “Notification” system, as opposed to a strict time slot system by which transport operators would be locked into time windows. It also required the system to not impose penalties on both depots and transport operators (Victorian Transport Association 2011a).

This document led to further discussions on an industry level Memorandum of Understanding (MoU) in relation to the Containerchain initiative. This MoU sought to address, first, several issues concerning the structure of the system so as to streamline operational efficiency in container parks. Second, the adoption of a consultative process in the event of substantial changes to the system. Third, the assessment of container parks’ performance through the introduction of key performance indicators (KPIs). And last, the implementation of continuous improvement strategies to efficiently manage the empty-container chain in the port of Melbourne (Victorian Transport Association 2011b).

The first container park which attempted to introduce the Containerchain system was Port Melbourne Containers (PMC). On the 16th of May it was announced it would go live on the 23rd of May; however, it was decided to postpone this date to deal with concerns within the industry regarding the implementation of this software and its conditions of use.

APPENDIX 1. 5 The ACCC, Federal Regulation and Containerchain

On the 25th of May, PMC lodged an exclusive dealing notification with the ACCC and between the 24th and 30th of June, the ACCC received eight additional notifications from Victorian Container Management (N95450), Oceania Container Services (N95450), Container Logistics (N95452), Chalmers Industries (N95453), Allied Container Services (N95454), Melbourne Reefer Services (N95455), Melbourne Container Park (N95456) and CC Containers (N95465) for similar conduct. This was a voluntary process referring matters to the ACCC to solve any concerns arising in the industry with the anticipation that issues would be dealt with in a timely manner and with a positive outcome for all the parties interested.

The proposed conduct noted that 'if a transport company wishes to use the services of the XXX container park, then one of the terms of use will be that the transport company must prebook space via the nominate website which will include the transport company accepting the applicant's Terms of Use' (Port Melbourne Containers Pty. Ltd. 2011a). Thus, it was open to question whether this arrangement contravened section 46(7) of the Competition and Consumer Act 2010 pursuant to the concerns raised by the VTA and Toll Transport Pty. Ltd.

Predominantly, the container parks argued in their notifications that 'the only market affected by such conduct would be the market in which the forced goods or services compete. In this particular case, this would be the market in which the services provided by Containerchain compete' (Victorian Container Management Pty Ltd 2011).

On the 29th of June, the ACCC informed the interested parties to participate in a public consultation process inviting these parties to make a submission on the 'likely public benefits and effect on the competition, or any other public detriment, from the proposed conduct.'(ACCC 2011a).

Some of the companies presented their submissions and on the 12th of July the ACCC wrote another letter seeking responses in relation to the issues raised in the consultation process.

The main issues were, first, the potential double handling of containers and additional storage of containers in transport yards. Some trucking companies pointed out that this generates additional fees on customers – IWD Pty Ltd. – and further inefficient empty container movements to ensure adherence to the allocated time slots. In contrast, CC Containers and PMC argued that the unnecessary movements of empty containers through transport yards would significantly decrease arising from the visibility to better forward plan their assets and make informed decisions on the basis of daily fleet resources, truck failures, road network congestion, collections and returns at cargo owner's premises, slots bookings at cargo terminals, etc.

Second, the extension of container parks' gate hours. Various stakeholders participating in the consultation process hinted at the mismatch in the operating hours between container parks and other members of the empty-container supply chain and the subsequent need for container parks to extend working hours. They also claimed that additional gate hours would be the most efficient initiative to eliminate the queues and delays experienced at the gates of empty-container parks since transport operators would be able to dehire and collect containers for a prolonged period of time. Conversely, depots maintained that the problem was the lack of efficient use of the time they were open and that truck queues resulted form the unavailability of disciplines to better manage truck arrivals. Additionally, they argued that the extension of operating hours had no relationship, whatsoever, with the random nature of truck arrivals which were the real cause of congestion at container parks. Further, they suggested that extending working hours would be an alternative but only once capacity had been properly utilised throughout the operating day (CC Containers Pty Ltd 2011; Port Melbourne Containers Pty. Ltd. 2011b). In early 2011, both Melbourne Reefer Services (MRS) and CC Containers implemented the extended container park hour's trial; however, the utilisation of these hours was extremely poor and queues still formed; experiencing, again, alternating periods of unutilised capacity with periods of excessive demand.

Third, another of the issues raised in the consultation process was the flexibility of a VBS. Several interested parties were concerned that the system to be implemented would be similar to the one used by the stevedores where transport companies prebook a container slot twenty-four hours in advance, making it almost impossible to combine the tight narrow time windows of the wharf with those of container parks. In response to this, depots noted that dehire and pick-up notifications could be made just prior to the truck arriving at the container park. They also remarked that the introduction of a notification system was to encourage the desired behavioural change in the way that transport companies operate with depots and, thus, conform to the Chain of Responsibility Legislation.

Last, the Containerchain fees also raised concerns among the interested parties. Some participants argued that these should be negotiated between container parks and shipping lines as both share a commercial relationship by which shipping lines nominate the container park transport operators have to attend to collect or return an empty container. Instead, the container parks noted that, if transport companies entered into a commercial relationship with container parks through Containerchain; it would provide them with the desired visibility and value added benefits long sought to address the operational inefficiencies at container park gates. In addition, transport operators manage their own truck fleets and organise truck arrival times; consequently, by imposing a fee on them they are made accountable to fulfil their responsibilities of arriving at the container park when notified through Containerchain. Furthermore, if transport companies are the main beneficiaries of a service through reduced queues, enhanced truck utilisation and improved visibility of information; then, it would be appropriate to assume that transport companies should be charged for this fee. Conversely, if this fee was levied on shipping lines, the purpose of the scheme, which is the behavioural change so as to comply with the Chain of Responsibility Legislation, would be lost. As noted above, the Chain of Responsibility Legislation affects transport operators and container parks, but not shipping lines.

In addition, depots claimed that the fees may be passed on to the transport operators' customers and not absorbed by them.

On the 26th of August, the ACCC released the *Statement of Reasons* which is a thorough analysis of the course of action followed by the ACCC in reaching a decision based on the submissions presented in the public consultation process and the issues raised in this process. The ACCC noted that the 'likely benefit to the public from the notified conduct will outweigh the likely detriment to the public.' The categories of 'public benefit' identified by the ACCC that may arise were superior efficiency, efficient investment and efficient management of driver fatigue.

In relation to the efficiency improvements resulting from the implementation of Containerchain, the ACCC pointed to; first, an increase in the throughput capacity achieved through the evenly spread of truck arrivals across the operating day and the automation of internal tasks at container parks. Second, the ability for container parks to plan the workload ahead and to better utilise their resources such as labour and equipment. Third, the superior visibility in relation to unmet capacity at container parks, which could potentially result in additional working hours should transport operators' demand for slots increase. Last, chain efficiency as a result of all the stakeholders being interconnected through streamlined information.

On the subject of efficient investment, the ACCC was of the opinion that the implementation of Containerchain would likely result in greater incentives for investments at container parks that would increase competition among empty-container parks by means of attracting more revenue through improved performance. Second, transport operators would have access to more accurate information to make informed decisions regarding fleet investment requirements. Third and most importantly, Containerchain would become a powerful tool in assisting container parks in complying with their obligation as 'loading managers' to effectively manage heavy vehicle driver fatigue by reducing queues and congestion at container parks.

Conversely, the ACCC also found several potential detriments arising from the proposed conduct. First, the potential loss of flexibility in the event of shifting from a notification system to a strict time slot system similar to the VBS introduced in the terminal. However, the ACCC noted that this would only occur if the required behavioural change expected from transport companies did not take place and this was a matter already being negotiated in the MoU.

This potential loss of flexibility under a strict time slot system would likely create costs associated with the staging of containers through transport yards. These costs would include additional vehicle kilometres travelled (VKT), fuel and lifting and storage costs. However, the ACCC also noted that if the system allowed bookings to be made with limited notice, these staging costs could be avoided.

The go live dates with the Containerchain system for the empty-container parks in Melbourne were as follows:

08/09/2011 PMC; 19/09/2011 Container Logistics; 22/09/2011 Victorian Container Management (VCM); 27/09/2011 Oceania Container Services (OCS); 03/10/2011 Allied Container Services; 05/10/2011 MRS; 17/10/2011 Melbourne Container Park (MCP); 21/10/2011 CC Containers; 12/12/2011 Chalmers Industries; 16/07/2012 Patrick Port Logistics; 03/12/2012 ANL Container Park; 01/07/2013 Qube Victoria Dock.

APPENDIX 1. 6 Containerchain alternatives and legacy systems

1-Stop: 1-Stop was first established in 2002 to provide DP World and Patrick – the two main Australia's stevedores – with IT software solutions. Since then, 1-Stop has expanded the services it offers to the sea freight chain in Australia. Currently, there are more than four thousand registered companies that use the system and over ten thousand individual users of services such as the VBS, Gateway, ComTrac and ComPay. 1-Stop is a Port Community System (PCS) that provides visibility and reliability across the chain. A PCS is an IT application that streamlines the chain by means of maximising its resources and operational efficiency by linking partnering organisations through enhanced visibility and consistency of data. 1-Stop is a web-based portal used 'to perform business transactions in a unified and structured way'. The PCS offers a 'single administrative window' where freight chain transactions can be performed in a secure environment (1-Stop connections Pty Ltd 2010a).

1-Stop products and services included a VBS; customs reporting; messaging hub; 1-Stop Gateway; Maritime Security Identification Card (MSIC); ComTrac; payments and invoice solutions.

(VBS)

VBS schedules the pick-up and drop-off of containers from a container facility in which transport operators prebook time slots electronically to return or collect containers.

Container facilities monitor the number of trucks that arrive at their gates by setting the number of time slots available per hour. This number of truck arrivals can be modified in a ‘time slot template’, which is a preset number of time slots in an operating day. Container facilities can have as many templates as they want, however, common practice would be to allocate a template to each operating day of the week. 1-Stop also allows the container facility to classify various types of transport operators and assign a number of time slots to each type. Further, there are various types of fees imposed through 1-Stop, the ones related to the booking of time slots, monthly subscription fees, no show fees and wrong zone fees which apply when a truck arrives late for a time slot allocated to it.

1-Stop provides the container facility with a broad range of rules that they can apply (or not); thus, the flexibility of the system to be implemented is subject to the rules the container facility deems appropriate to apply. These rules can be easily customised, switched on or switched off as required. In relation to the management of time slots, container facilities may allocate time slots to transport carriers; cancel time slots and lock and unlock time zones. Container facilities may also access the history of a time slot in terms of where it was booked from, user who booked the time slot, date and time and user who confirmed the time slot (1-Stop connections Pty Ltd 2010a).

Customs reporting

This is a service that facilitates the reporting of imports and exports to the Australian Customs and Border Protection Service for shipping lines and depots. It is an online service in which an electronic form is populated, translated and sent off to Customs (1-stop connections Pty Ltd 2010c).

Messaging hub

The messaging hub is the backbone of how all the 1-Stop services operate by linking supply chain participants through the sharing of timely and enhanced information. It provides a platform for the efficient transfer of EDI messages among freight chain participants. The information is received from many parties in any format, then, it is transformed – or translated – into a compatible format before it is sent out to the interested parties. This transformation of information responds to the very important task of adding value by providing consistency among chain players (1-Stop Connections Pty Ltd 2010b).

The following graph represents the messaging hub and the informational interactions among chain players.

Figure 1.1 Messaging Hub Overview
Source: 1-Stop connections Pty Ltd (2010), *Messaging Hub Overview*

1-Stop Gateway

1-Stop Gateway streamlines the transfer of data among parties. This service facilitates, first, access to precise and timely vessel information such as vessel arrival, departures, cargo cut-off and import storage start times. Second, it confers the desired container visibility by providing the status of any container arriving or leaving the stevedores premises in Australia, what vessel it is on, when it will arrive, when it is expected to depart and from what terminal. Third, container chain participants can be notified of any container movements through email or Short Message Service (SMS). Fourth, the 1-Stop platform may be used to automatically populate the information from the vessel schedules to submit the Pre Receival Advice (PRA). Last, the status of an import container may be monitored according to the information received from Australian Customs and Border Protection Service (1-Stop connections Pty Ltd 2010d).

Maritime Security Identification Card (MSIC)

This is a national recognised card that entitles their holders to enter and develop their working activities in a secure area of the port, ship or maritime facilities, that is, this card demonstrates compliance with Australian maritime security. 1-Stop provides both the MSIC and the required access card to enter any container terminal facility – Patrick, DP World and AAT terminals – in Australia for a period of 2 or 4 years (1-Stop connections Pty Ltd 2010g).

ComTrac

This is a service by which information is automatically sent to the customer software system regarding vessel schedules and container status. Vessel schedules are updated every two hours and include the following information: vessel name, voyage and Lloyds numbers; estimated and actual arrival and departure times; terminal operators and ports of call and discharge; export receival start and cut-off dates and import availability and storage start dates. In relation to import container status, the customer may access the container arrival date, discharge date from vessel and return date to the empty-container park. The status of export containers such as the export receival start and the date it is loaded on to the vessel can also be known by checking the system (1-stop connections Pty Ltd 2010e).

Payments and invoice solutions

ComPay is an online payment service platform from which payments may be effected. As soon as a payment is made, the payment statement is emailed to the payee so that the freight may be released.

This service may be used to pay shipping lines for freight – that is, to get the Electronic Import Delivery Order (EIDO); to pay any invoice or to pay for storage to terminals (1-stop connections Pty Ltd 2010f).

Tradegate: Tradegate was created in 1989 as a not for profit organisation specialising in technology applications for cargo owners and their service providers. From 1991 up to 2006, Tradegate held the exclusive contract for e-commerce services with Australian Customs. It is currently governed by a board of directors including representatives from its own members – importers, exporters, shipping lines, forwarders and customs brokers (Tradegate Australia Ltd 2010a).

Tradegate is an IT software platform for the electronic exchange of data across chain participants. In order to address the issue of truck queuing and congestion at container parks, this platform needs to be integrated into other depot management software application such as Containerchain or DepotPro with which it interchanges data seamlessly (Tradegate Australia Ltd 2010b).

The Tradegate portal proposes to chain participants the following improvements:

- Park visibility
- Electronic communications
- Container/vehicle bookings
- Infrastructure improvements

Concerning park visibility, Tradegate presents data relative to park TEU capacity as well as anticipated empty container activity volumes based on vessel arrivals and truck bookings of time slots. Also, notifications regarding changes in the condition of parks –

e.g. equipment failures, staff shortages, site works, capacity – as well as modifications in the time slots are promptly communicated to transport operators.

The electronic communications are performed in the web-based PortBis portal. The two communications originating from the shipping lines are the CRA and export release. The first one – CRA – is a message that delivers information on containers that are expected to be returned to depots. The second one – export release – refers to containers that are expected to be collected from container parks. Transport operators also send out communications – Empty (MT) Return Advice – to container parks; these are messages informing the depots of the time an empty container will be dehired.

The control of lengthy truck queues and delays at depots is obtained through the implementation of a VBS. This initiative also offers, first, a control of the gate capacity by means of an enhanced visibility of truck arrivals. Second, it allows trucks to perform their duties inside the gates of container parks more expeditiously owing to the automation of the gate in process. Last, depots are better equipped to efficiently manage bulk runs to transfer empty containers from the depot to the container terminal.

The depot can control its operating capacity by setting the number of slots available per time windows in an operating day and, if required, they can change the fee imposed on trucking companies to access the depot. All of these measures assist depots in achieving the long sought behavioural change of transport operators.

Similarly, Tradegate provides various infrastructure improvements arising from the implementation of this IT software solution. Among its developments we may highlight the container redirects – redirection of empty containers from one depot to another – which result from shipping companies designating business rules to automate redirect approvals. These changes are made in real time and have an immediate impact on future container collections at container parks. Also, if an importer is going to reuse an empty container for an export, this action – triangulation – may be performed through the portal. That is, the transport company requests the container reuse through the portal and this request is approved by the shipping company (Tradegate Australia Ltd 2010b).

Thereby, container parks would have leeway as to enter into a contract with the IT software provider of their choice, to the extent these applications have been integrated with Tradegate and the systems ‘talk to each other’. The other parties – shipping lines, transport operators, port authorities, customs, etc. – would use Tradegate to send and receive notifications to/from other members of the empty-container supply chain.

The following diagram portrays the relationships among chain parties and their exchange of information flows:

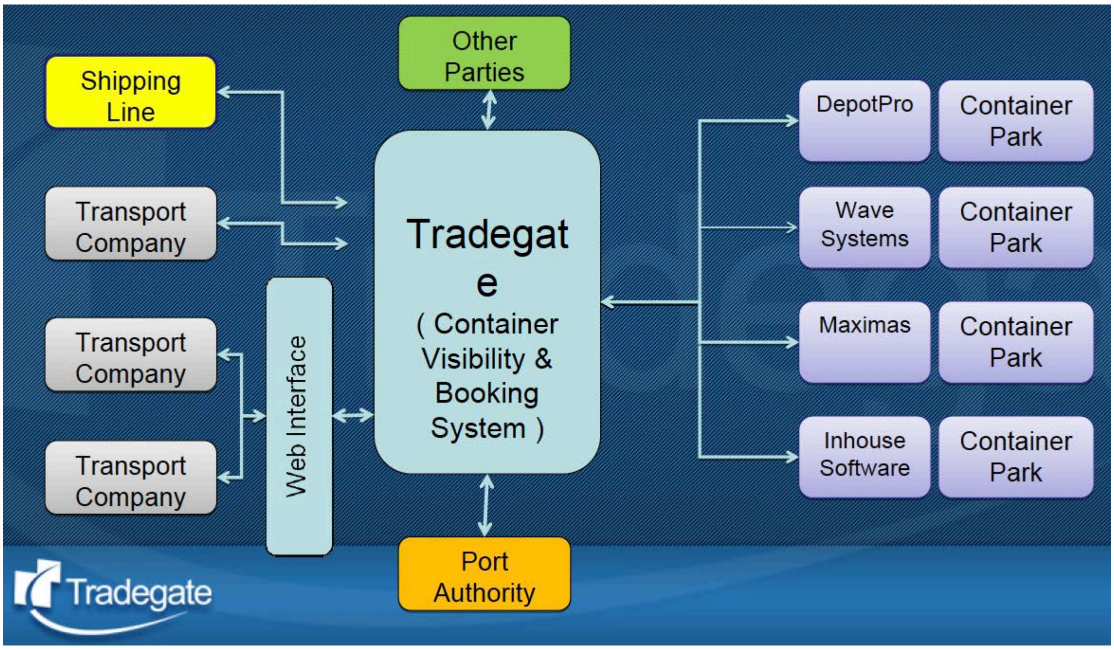

Figure 1.2 **Booking Design System**
Source: Tradegate Australia Ltd (2010), Information Visibility & Exchange Working Group-Presentation Tradegate, July 2010, Melbourne

The Tradegate Container Park Information Service (CPIS) was trialled for a duration of three months commencing in early 2010. This pilot trial was supported by the VTA and the SAL and the participants included six shipping lines – APL, COSCO, Hamburg Sud, Maersk, NYK, PAE –; six transport operators – ACFS, MG Barnes, Chalmers Transport, Extra Transport, Secon Freight Logistics, Westgate Ports – and seven empty-container parks – Allied Container, Chalmers, MCP, MRS, OCS, PMC and VCM. In the submission presented to the ACCC by Port Melbourne Container Pty Ltd during the public consultation process it noted ‘this process was voluntary. The system was very limited and provided little benefit to us. The trial dissipated without conclusion’.

Global Software Systems: Global Software Systems was established in 1981 as an IT software provider for the logistics industry. It offers a broad range of integrated production and logistics IT solutions – StorePro, Contrack, DepotPro, Webfreight and Freightrack. DepotPro is a depot management system that enables container parks to record container gate in and gate out processes, monitor yard services and track changes in container status as well as having access to container history – handling and storage of containers and calculate the fees for these services. DepotPro also sends repairs estimates and bills shipping lines, which obtain detailed reports on the depot activities performed on their assets. All of this results from the streamlined integration between the software and the EDI language, which is the language spoken by the majority of the shipping lines.

Like the other depot management IT applications, DepotPro may set capacity restrictions on the number of slots per time window, thus, allowing the depot to efficiently manage gate capacity. On the other hand, transport companies use the IT software Webfreight to prebook time slots to pick-up or dehire empty containers at depots (Global Software Systems Pty Ltd 2010).

The Containerchain IT Application Origins: Maximas Software Solutions

Maximas Pty Ltd is an IT solutions supplier established in 1998 which provides an extensive range of integrated technological solutions for the logistics industry – landside, dockside and ocean freight logistics. Maximas is a technological platform for the efficient exchange of data among the container chain participants. It delivers efficiency to chain members by means of enhancing visibility and automating commercial transactions across the chain. It is a one-stop solution where chain information is seamlessly integrated so as to expedite collaboration across organisational boundaries.

As noted above, Maximas offers logistics services to a wide range of companies involved in the container sector across the Asia Pacific region; however, we will focus in the services offered to the inland terminals/port sector.

The implementation of the Maximas software in the depots facilitates the forward planning of labour and resources through the reception of notifications on vessel arrivals and departures, container arrivals by rail and customs status of containers. It also allows for the efficient physical allocation and stack of containers to facilitate the next task and eliminates the unnecessary handling of containers. So as to conform to customs and quarantine requirements, Maximas has disciplines in place to proactively manage these requirements. The enhanced visibility of the system enables customers to determine the profitability of a job as opposed to having multiple disjointed systems that produce inaccurate and inconclusive data, and to monitor depot performance by establishing KPIs. Maximas also provides improvements to the system by automating the billing process that avoids late billing and the unnecessary debtor's days outstanding due to invoice disputes (Maximas Pty Ltd 2013).

In the development of software applications in the field of container landside logistics, Maximas became very familiar with the information gaps existing between container parks and transport operators. That is, Maximas extracted a deep understanding of the information these parties were in possession of and the operational inefficiencies stemming from the unavailability of timely information across the container chain. This, in conjunction with the findings and recommendations of the *BAHS* – namely, the adoption of a VBS that would provide for information visibility across the chain; gave rise to the elaboration of a software that would face the issue and intend to resolve the information gap in the container logistics supply chain. The outcome of these commercial efforts was the development of the Containerchain portal.

The Containerchain portal is an empty-container park management software solution whose interactions with industry would be different to the ones Maximas has with its partners and customers; thus, a new business entity, independent from Maximas, was created (Containerchain Pty Ltd 2010).

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