WELCOME

Welcome to the 16th Annual Logistics Research Network Conference which this year is being hosted by the Transportation Research Group (TRG) at the University of Southampton. TRG is one of the UK’s longest established and leading centres for multi-disciplinary transport teaching and research and has academic and industrial links across the University and southern England, and with other leading groups in the UK and overseas. Major activities have traditionally related to the development, application and understanding of Intelligent Transport Systems (ITS), with additional fundamental research in the areas of Traffic Management, Safety, the Environment and Sustainability, Public Transport Operations, Freight and Goods Movement, and Walking and Cycling. The Group currently consists of seven academic staff, sixteen research staff and approximately thirty Ph.D. and Eng.D. students.

The logistics sector is becoming ever more conscious of the need to maximise efficiency and ‘sweat’ its assets in order remain competitive. This requires businesses to be constantly aware of new opportunities e.g. the take-up of new technology for managing vehicle fleets, or using electronic market places to enhance the visibility of supply chain linkages and potential cross supply chain collaborations. The theme of this year’s conference, ‘Smarter Logistics: Innovation for Efficiency, Performance and Austerity’ directly addresses this area with a broad breadth of papers covering specific areas of logistics operation (ports and shipping, urban goods and their supply chains, medical logistics, warehousing), examples of ‘smarter practice’ (in reverse logistics, intermodal freight operations, shipping and road haulage, modelling), and some of the issues involved in trying to realise ‘smarter logistics’ in relation to managing risk and uncertainty.

Papers have been selected which not only present empirical results and case study evidence, but also to provoke thought on the future challenges the sector will face and how these can be addressed.

The annual Logistics Research Network conference has become a well respected forum for the dissemination of research findings, the generation and debate of novel concepts and ideas, and an environment where networking and future research collaboration can be enabled. We look forward to carrying on this tradition in Southampton and wish you a very pleasant stay in Hampshire.

Tom Cherrett, Ben Waterson
(University of Southampton)
July 2011
CONFERENCE TIMETABLE

Wednesday 7th September

09:00 PhD Workshop
12:00 Lunch
13:00 Welcome
13:30 Plenary 1
   “Reducing food miles through transport collaboration with your competitor”
14:15 Session A1 : CARBON 1
   Session B1 : MODELLING 1
   to
   Session C1 : LOGISTICS HUBS
   Session D1 : URBAN 1
15:15 Refreshments
15:45 Session A2 : SUPPLY CHAINS 1
   Session B2 : COLLABORATION 1
   to
   Session C2 : MEDICAL 1
   Session D2 : PORTS 1
17:15 Lunch
18:00 Closing Session

Thursday 8th September

09:00 Session A3 : RISK 1
   Session B3 : WAREHOUSING
   to
   Session C3 : COLLABORATION 2
   Session D3 : FOOD
10:30 Refreshments
11:00 Session A4 : PORTS 2
   Session B4 : ROAD HAULAGE 1
   to
   Session C4 : MODELLING 2
   Session D4 : RAIL
12:00 Lunch
13:00 Plenary 2
   “Ports, competition and innovation”
13:45 Session A5 : SUPPLY CHAINS 2
   Session B5 : SHIPPING 1
   to
   Session C5 : URBAN 2
   Session D5 : RFID
14:45 Refreshments
15:15 Session A6 : REVERSE LOGISTICS 1
   Session B6 : CARBON 2
   to
   Session C6 : RISK 2
   Session D6 : MEDICAL 2
16:45 Lunch
18:00 Closing Session

Friday 9th September

09:00 Session A7 : URBAN 3
   Session B7 : SUPPLY CHAINS 3
   to
   Session C7 : CARBON 3
   Session D7 : ROAD HAULAGE 2
10:30 Refreshments
11:00 Session A8 : SHIPPING 2
   Session B8 : INTERMODAL
   to
   Session C8 : MODELLING 3
   Session D8 : REVERSE LOGISTICS 2
12:00 Plenary 3
   “Three themes for the next phase of field service logistics”
12:45 Closing Session
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PLENARY SESSIONS

(Plenary 1 - Wednesday)

REDUCING FOOD MILES THROUGH TRANSPORT COLLABORATION WITH YOUR COMPETITOR - THE NESTLÉ AND UNITED BISCUITS EXPERIENCE

Richard Hastings, Nestlé Logistics

Rob Wright, United Biscuits

The Food Industry Sustainability Strategy (FISS) drawn up in 2006 between the Food and Drink Industry and DEFRA set a target for the industry to reduce its environmental impact by 20% by 2012. To do so the FISS identified 6 initiatives which, if adopted by all those committed to the strategy, would ensure success. One of the initiatives with the largest potential involves the industry promoting greater transport collaboration within not only the traditional manufacturer and retailer relationships, but also amongst competitors. This presentation lifts the lid on how one of the most successful transport collaborations between competing manufacturers Nestlé and United Biscuits came into being, how it works and how it could be a blueprint for future transport collaborations.

(Plenary 2 - Thursday)

PORTS, COMPETITION AND INNOVATION

Doug Morrison, Associated British Ports’ Port of Southampton

Doug’s presentation will give an insight into the current operating climate and how UK ports are utilising new technologies and methods of working to stay competitive whilst reducing their environmental footprint. This will focus specifically on some of the innovations at the port of Southampton where smart use of existing infrastructure coupled with the adoption of Information Communications Technologies have enabled the port to expand its operations without having the need for more physical land space. Doug’s presentation also addresses the key factors that will impact on the success of port operations in the period to 2020 and in what areas ports will need to adapt to remain competitive.

(Plenary 3 - Friday)

THREE THEMES FOR THE NEXT PHASE OF FIELD SERVICE LOGISTICS

Stuart Miller, ByBox Holdings Ltd.

Dan Turner, ByBox Holdings Ltd.

The field service logistics sector has changed over recent years, as the industry has developed from a premise of moving inventory around the supply chain towards more data and information management to maximise efficiency in service repair operations. This phase shift has also led to the increasing use of machines as they begin to replace the traditional field service engineer. This presentation will discuss what the next changes in the sector are expected to be including the ‘socialisation’ of the supply (sharing personnel and equipment), open application development (sharing costs and technology), and interception and cross-carrier shipping (sharing networks). The presentation will conclude with some discussion on how such changes will benefit customers in a climate of increased environmental awareness and in what ways the early adoption of these approaches can be encouraged.
### WEDNESDAY 7th SEPTEMBER

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THE IMPACT OF ELECTRONIC LOGISTICS MARKETPLACES ON CARBON EMISSION REDUCTION WITHIN THE UK’S GROCERY SECTOR

Yingli Wang, Logistics Systems Dynamics Group, Cardiff Business School, Cardiff University

Purpose: The primary aim of this research is to assess the current status of information and communication technologies (ICT) initiatives on carbon emission reduction and in particular, investigate the potential effect of a recent advance in technology, i.e. electronic logistics marketplaces (ELMs) on environment sustainability. Given that the UK’s food and grocery industry is well known for its reputation in technological and business innovations for efficiency gains and cost saving, it is selected as an exemplar sector for study.

Research Approach: The research adopts a case-study based on both secondary and primary data. Two leading retailers conducted within the UK’s grocery sector have been selected as case examples in assessing the current ICT developments in carbon emission reduction. A collaborative ELM is chosen as the third case example in order to study its potential on environment sustainability. Multiple data collection techniques are adopted including interviews, system demonstrations, site observation and the use of archival documents.

Findings and Originality: In the UK’s grocery industry, the negative environmental impact of distribution activities is seen as a major challenge to the manufacturers and retailers (Fernie and Sparks 2009). Logistics is the third highest source of direct carbon emission in grocery sector (Hollingsworth, 2004). Through a systematic review of the current ICT practices in the UK’s grocery sector and a study of two leading retailers, this research finds that the deployment of telematics based technologies has delivered tangible economic and environmental benefits. This is mainly achieved through the change of drivers’ behaviours and a better scheduling and routing of vehicles. The sector sees the practice of using ELM to facilitate transport collaboration between companies but its full potential is yet to be explored.

The analysis of the third case example, i.e. a collaborative ELM has demonstrated that the adoption of ELMs plays a significant role in facilitating efficient freight logistics provision by enabling horizontal (between shippers) and vertical (between shippers and carriers) collaborations between organisations, which then leads to a positive impact on reducing carbon footprint. The change of ownership model at the latter stage implies that there are significant barriers for a collaborative ELM to sustain in the long term. Those barriers include the lack of incentives for collaboration, technology immaturity and lack of unified performance measures for carbon footprint.

Research Impact: This study advances our understanding about the role of ICT in carbon emissions reductions and lays a basis for further investigation, as currently there is limited research which attempts to address this issue. Further ELMs have seen rapid developments in recent years but still far from being settled. In particular, the study of ELM’s impact on environment sustainability has been very limited. This study presents interesting implications for academics.

Practical Impact: The research provides valuable insights to practitioners on how to leverage the existing and emerging information technologies for environmental and economic benefits. Being aware of how ELMs impact on carbon emission reduction enables companies to attain both economic and environmental competitive advantages and avoid potential problems when using ELMs for logistics provisions.

Keywords: electronic logistics marketplace, transport collaboration, carbon emission reduction
Purpose: Light Goods Vehicles (vans) are an important and growing part of road traffic in both the UK and France. However, the growth patterns and the typical activity patterns differ somewhat. In both countries there are policy objectives to reduce the CO\textsubscript{2} emissions from transport. To date these initiatives have primarily focused on cars and Heavy Goods Vehicles. Given the continued growth in vans traffic it seems timely to consider the reasons for this growth and the scope for CO\textsubscript{2} reductions. By comparing growth patterns and CO\textsubscript{2} reduction opportunities in two countries we aim to identify some of the most important directions for policy.

Research Approach: This paper presents an assessment of trends in the use of vans in both the UK and France. This is largely based on an analysis of transport statistics. The paper continues by looking in more detail at the possible reasons for the growth in van traffic and activity in the UK and France and comparing the possible causes. The paper concludes by considering likely future CO\textsubscript{2} trends given the scope to use electric vehicles – preliminary research has shown that there are very different CO\textsubscript{2} reduction possibilities when comparing the two countries. A small number of qualitative interviews have also been carried out to support this research and a round table was held in London in February 2011. The UK research is based on an extension of a study carried out for the Commission for Integrated Transport (CfIT) while in the case of France it builds on work concerning energy and transport carried out by IFSTTAR. In both countries the analysis of the fleet, its mileage, consumption and emissions considers vehicles below 3.5 tonnes gross vehicle weight (i.e Light Goods Vehicles or LGVs).

Findings and Originality: Growth in van traffic is recognised but the underlying causes are not well understood – the analysis of two countries has helped to identify the important factors and to consider whether the factors are common or whether they are distinct. The review of the scope to reduce CO\textsubscript{2} is original and has not been carried out before. The review also benefits from the strategy of comparing the two countries because the CO\textsubscript{2} reduction possibilities are affected by the different characteristics of each market, the uptake of new vehicles, the existence of electric vans and the variation in the CO\textsubscript{2} benefits between France and the UK achieved by switching from fossil fuels to electricity. Survey methods for LGVs are reasonably comparable in France and UK; both countries have statistics on LGV fleet, its use, mileage, consumption and emission but the definition of vans among LGV is not quite clear in the statistics and some element of estimation is required.

Research Impact: The discussion provides insights into the opportunities to reduce CO\textsubscript{2} from this category of vehicles and the possible barriers. There has been limited research to date on the van sector and this contribution helps to address this gap. Given the continued search for strategies that will reduce transport CO\textsubscript{2} it is important to examine those sectors that are continuing to experience growth.

Practical Impact: The findings of this investigation have considerable practical impact for policy initiatives aimed at reducing CO\textsubscript{2} from transport. In addition, the results are relevant to companies manufacturing vans because they can be used to understand the requirements of the different sectors of van users and to consider how the different patterns of use have implications for the uptake of new vehicles.

Keywords: Vans, Traffic Growth, CO\textsubscript{2}, Electric Vehicles
EXPLORING THE POTENTIAL FOR NETWORK MODELLING OF THE IMPACT ON COSTS AND CO₂ EMISSIONS FROM INTER-MODAL FREIGHT SHIFT SCENARIOS

Nick Gazzard  FCILT, Leader CILT Sustainable Transport Strategy Group
Carlos Mena, Senior Lecturer, School Of Management, Cranfield University

Purpose: The fast moving consumer goods industry wants reduce GHG emissions, and improve supply chain efficiency. To achieve this research by McKinnon (decarbonising freight 2009) and Defra / FISS report 2007 indicate that sharing transport networks and modal shift have one of the highest available benefits.

To enable horizontal collaboration in networks, and to support a move of freight to rail and water, it is critical to demonstrate to management, potential benefits reliably and early. Thus a means to allow potential partners, operators and other parties to use a common tool and cost / CO₂ impact methodology to map their networks and calculate the capacity, resource requirements, cost and CO₂ reduction potential of any initiative without requiring huge resources, data provision or disclosure in the early stages would be helpful in evaluating and refining potential opportunities.

The CILT has been working within the DfT Low Carbon Transport steering group developing scope 3 road CO₂ allocation methodology, which has now been expanded to Water and Rail. In addition, further work under the aegis of the DfT / CILT has begun to develop an inter-modal model of the major UK freight corridors to enable simultaneous analysis of cost and CO₂ emissions from varying supply chain scenarios, using a load by location / flow / activity based bottom up model.

It is intended to use this model for evaluation of various scenarios for modal shift at a granular level, using data readily available to commercial companies, to evaluate the approach for use by the industry.

Research Approach: A group of companies (including ASDA, CHEP, Freightliner, DP Ports) has been assembled to participate in the development of a UK generic multi-modal model using a novel combined network mapping and modelling tool. The core UK roads, ports and rail corridors are being added to the map.

Each company is contributing a list of activities, energy consumption and cost data to the model, and these activities are being added to the locations and appropriate cost and the DfT Scope 3 CO₂ calculations are being developed, to be included at activity level. Existing work by the industry group Efficient Consumer Response on standard transport and warehouse activities are also being added to provide an activity based costing & CO₂ calculation capability for each location node in the network.

Once running (early stage is already working) the working group and eventually the DfT LCTSG will peer review and validate. Defra are also interested in the methodology, and this will be made available to them when completed. Once validated, the model can be used to evaluate and simulate a number of real mode shift and efficiency scenarios, which have already been identified, and the benefits compared by initiative.

Findings and Originality: Research is underway with completion due by September / October 2011. Most papers currently published examine macro shifts of freight by mode, applying meta level metrics and factors. This model is driven by real loads e.g. pallets on a truck, or TEU’s on boats, and builds up cost in relation to their movement along flows, and the impact of changes in distance / configuration etc. by activity, and I have found now published papers of this nature in literature reviews to date. The software being used for the model has not been featured in any academic paper previously, having only been launched in late 2009.

Research Impact: Potential to validate new DfT / Defra scope 3 CO₂ emissions methodology, and provide detailed insight into inter-modal cost & CO₂ behaviour. Quantify industry specific cost and CO₂ potential of inter-modal shift for FMCG industry.

Practical Impact: Provide a common methodology for UK industry for supply chain collaboration on reduction in cost and CO₂ emissions to support meeting UK GHG emissions reduction target.

Keywords: Supply chain, Collaboration, inter-modal, methodology, sustainability, industry best practise
(Session B1)

LONG TERM CONTAINER DEMAND FORECASTING: AVOIDING THE PITFALLS OF COMMODITY-BLIND MODELLING

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Purpose: The global trend for increased containerisation of freight necessitated the development of an appropriate forecasting model for South Africa’s container demand to inform infrastructure investments. In this paper the drivers of containerisation and the pitfalls of forecasting container demand are presented. An new container demand forecasting technique is proposed for South Africa as well as how to overcome the daunting data challenges. Lastly, the results of the forecast for South Africa are presented and proposals are made for further research.

Research Approach: The forecasting accuracy of international trade containers forecasts was investigated and significant deviations from actual demand were established. A desktop analysis was conducted to determine which container demand forecasting techniques were used internationally informing a new forecasting technique for South Africa. The new technique is driven by a 30-year forecast of commodity-specific import and export flows and the propensity to containerise these commodities in future.

Findings and Originality: The analysis of international forecasting techniques for the demand for trade containers revealed that commodity-blind models are the most common method used (i.e. container demand is forecasted without taking cognisance of the content of containers). Over the past decade, the forecasting accuracy of these models however proved to be quite poor, with a considerable deviation from actual demand in some cases (both under- and overestimating demand). This paper argues that the errors relate to the fact that the underlying commodity trends, causing limits to containerisation propensity, are not understood. A commodity-based model is proposed as a more realistic forecast of container demand. This could have a material impact on how large scale investment decisions are directed.

Keywords: Container demand forecasting, maritime containers, South Africa
PORT CENTRIC LOGISTICS: IS IT ONLY FOR SEA PORTS?

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Purpose: The ‘PCL’ concept was introduced due to an encouragement to locate distribution centres within port premises in order to cut down the empty movement of containers (Mangan, et al 2008a). This allows a faster turn round and savings of road miles. Mangan, et al (2008b) discuss the role of ports and their changing nature within the supply chain and suggest that port-centric logistic activities is a new/potential revenue earner for ports. Van Marle (2008) argues that due to the shift in global manufacturing patterns ‘PCL’ as a concept has emerged as a result. The challenges faced by the business community and by the world- at-large on account of climate change has resulted in ambitious targets being set by the UK government for carbon reduction. The PCL concept provides a solution not only for increasing efficiency within the logistics sector but also for reducing the carbon footprint. Reducing logistics miles by processing cargo at the port itself, rather than at a regional warehouse helps ports to increase asset utilization and the retailers to cut down on logistics costs and lead times. However, not all cargo comes in to the UK via the sea. Some of it which has a short shelf life may travel by air. As the PCL concept hasn’t been considered within the air sector, the research questions posed in this research are:

RQ1: Can the Port centric Logistics concept be applied for Airports?

RQ2: What are the variables differentiating Port Centric Logistics when comparing Sea Ports and Air Ports?

This research works under a premise that in the future airports with cargo handling facilities may want to increase the utilisation of their assets by providing additional services for processing perishables.

Research Approach: The paper presents a new area of work and hence the methodology at the outset is to be exploratory in nature. A structured literature review will consider the issue through various viewpoints and assimilate a better understanding of the two research questions. Data collected through respondents and secondary sources for cases (from both sea and air perspectives) will be analysed to get a practical insight into current challenges. The research will strive to create an insight for implementing the PCL concept with the air sector.

Findings and Originality: This research will present two new areas for consideration within the area of future and smarter logistics, provide an comparative perspective for implementing PCL within a sea and air freight sector and consider the variables that differentiate the PCL concept with Airports.

Research Impact: The outcomes of this research will help academicians and practitioners to gain insights into the PCL concept from two perspectives

Practical Impact: The output of this research is aimed to help the airport sector consider PCL as an important innovation within their perishable logistics chain. The comparative framework will provide the initial insight required for implementing PCL not only as a ‘smart and green’ initiative but also as a revenue earner through asset utilisation.


Keywords: Port Centric Logistics, green logistics, Smart logistics
ANALYSIS AND CLASSIFICATION OF LOGISTICS CENTRES IN GLOBAL SUPPLY NETWORKS

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Purpose: The purpose of this paper is to describe the role of logistics centres in global supply networks in today's ever increasing investments in logistics infrastructure. The globalization trend affects the replanning of logistics structures including production facilities, warehouses and distribution centres. This research focused on analysing the increasing logistics construction and investments and constructed a classification model of logistic centres at various stages of development.

Research Approach: This article is based on a research project conducted in 2010-2011. The research methods include both a literature and a statistical survey, and analyses of interviews with stakeholders involved in the development of logistics centres. The research included both examinations with a wider perspective at global level and local decision-making approaches. The research process focused on southern Finland, where some 200 logistics centre projects were found in various stages of development and with various, profiles and operating models. The classification of logistics centres was constructed by analysing this list of logistics centres by assessing planning processes, investor perspectives, operating models, markets, location in global networks and also infrastructure.

Findings and Originality: The main finding is that the location of a logistics centre is mainly market based although the authorities have a certain role in this process. The influence of a new port was also found to be a significant location factor. Investments in logistics centres are increasing and form attractive investment projects for local municipalities. Competition among municipalities is also recognized to affect the location of logistics centres. The originality of the results is seen in a new classification model of logistic centres.

Research Impact: This paper presents the new approach to the classification of logistics centres in terms of service level, extent, planning approach and location related to global logistics networks. The classification of logistics centres is divided into six different stages. In addition, these stages can to a certain extent be considered as a developmental path for logistics centres. The next phase in the research process is ongoing and evaluates opportunities to form new cost-effective and therefore competitive logistics service solutions by combining logistics centre networks.

Practical Impact: The study provides an assessment framework for developers and investors in logistics centres to evaluate the development stages of various logistics centres or related development projects. This model also brings out the role of municipalities and other authorities in the decision-making process related to the location of logistics centres or larger logistics areas. However, logistics infrastructure forms a significant competitive factor in the business environment of companies and therefore through better and more focused planning processes of location and facilities it is possible to improve the cost-efficiency of supply chains at global level.

Keywords: logistics centre, global supply chain, location decision-making
INVESTIGATING THE IMPACTS OF URBAN TRANSPORT POLICIES ON ESSENTIAL FREIGHT OPERATIONS

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Purpose: The EU Commission (2009) predicts that by the year 2050 the proportion of the EU population residing in urban areas will reach 84%. As a result of this growing level of urbanisation, the demand for goods and services to be readily available and accessible in urban areas is also on the rise, which requires an efficient goods distribution network. In the UK, responsibility for maintaining urban areas lies with local authorities, who appear to have little engagement with freight operators, particularly with regards to the impacts their actions may have on freight operations. This paper seeks to examine the views of both local authorities and logistics operators on current and potential urban transport policies.

Research Approach: The study described in this paper is based upon findings from two phases of semi-structured in-depth interviews with representatives from local authorities nationwide and the UK logistics and transport industry. Qualitative data from the interviews has been used to examine local authorities' understanding of urban freight flows, and their consideration of freight in local policy decision making.

Findings and Originality: The paper reveals the extent to which urban freight transport is under-valued by local authorities; highlighted by their poor level of knowledge and understanding of the issues, in addition to a limited amount of engagement with freight operators. The transport policies that hinder urban freight operations most significantly are identified from the interviews with logistics operators and discussed from the perspectives of both stakeholder groups.

Research Impact: With the majority of recent research in this field having focussed on identification and review of the problems associated with urban freight movements, and the suggestion of practical solutions to solve them, there still remains an apparent lack of consideration for freight in current transport policies. It is intended that this qualitative study will enhance the profile of freight with policy makers, and create awareness of the implications of policy decision making on logistics operations.

Practical Impact: This study examines the areas where policy makers and transport operators perspectives differ in terms of urban freight transport, and attempts to bridge the apparent gap in communication between policy makers and logistics operators. Results from the completed research aim to assist policy makers in the future by drawing their attention to the impacts that their policies may have on urban freight movements and operations, and help to develop more effective mechanisms for effective dialogue between the relevant stakeholders.

Keywords: Urban goods distribution, City logistics, urban transport policy, Local authorities
Purpose: The objective of this paper is to reveal the economic and environmental effects of the freight distribution generated by the extension of e-commerce, especially in large urban agglomerations.

Research Approach: The researches are realized on the Romanian e-commerce sector and the urban freight distribution, starting from an analysis of the survey data collected on this field.

Findings and Originality: The paper provides an overview on the evolution of e-commerce in Romanian business environment and the logistics solutions for the distribution of goods, generated by this kind of commerce. Based on the collected data, it had been realised a SWOT analysis regarding the e-commerce and distribution of goods, highlighting the strengths and weaknesses of the e-commerce. The study reveals, also, the possible harmful effects on the environment determined by the development e-commerce and the growing traffic in urban areas. More, the researches emphasize the reciprocal impact between the e-commerce and transport infrastructure.

Research Impact: The paper offers some information about trends in e-commerce and the impact of e-commerce on the urban environment for lack of adequate solutions for its development.

Practical Impact: The results of the study, especially those referring to the threats and opportunities in e-commerce, can be taken in account, not only by those direct involved in planning distribution of goods, but also by the other interested stakeholders, like local or regional authorities and transport operators.

Keywords: e-commerce, logistics, environment
THE PITFALLS OF PERFORMANCE MEASUREMENT: EVIDENCE FROM UK SUPPLY CHAINS

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Purpose: Performance measurement systems are vital to driving the business. Used efficiently they indicate effectively to the user how the business is operating, and hence identifying improvements to be made in order to achieve the overall objective. It is this critical element of performance measurement systems that has led to research saturation in paradigms of performance measurement systems, and the characteristics of a good performance measurement system. Within this pool of research however there is an opening in assessing some of the problems that exist within performance measurement systems, and which often lie undetected by the users of these systems. The aim of this research is to identify some of these common pitfalls, as a means to enhance the evaluation of performance measurement systems.

Research Approach: This research follows an inductive research process, drawing on evidence gained through the use of a structured auditing method (the Quick Scan Auditing Method or QSAM). The QSAM provides a detailed insight into a company's supply chain operations using a range of qualitative and quantitative research tools, but within a short period of time. For this research, there was a focus on examples from the UK where performance measurement was identified as a concern. The underlying issues were identified and, from this evidence base, a number of common pitfalls have been derived.

Findings and Originality: Six common pitfalls have been identified, including the incorrect calculation of performance measures, misalignment between different supply chain functions and low visibility of measures within the business. Through cause and effect analysis, these can be demonstrated to have a negative impact on elements of business performance. The accuracy of these pitfalls is then assessed against a further case study. In terms of originality, there has been abundant research published on performance measurement systems, focusing on the measures used and characteristics that generate a good system. There is however a gap in this research looking at the characteristics common in poorer or ineffective performance measurement systems.

Research Impact: An initial literature search has displayed a clear lack of research on the challenges faced in developing performance metric systems. Understanding such challenges can be very time consuming. The research in this paper identifies areas that researchers can focus upon when evaluating other supply chain situations, both in terms of potential pitfalls and also impacts on business performance.

Practical Impact: In the current climate which is forcing organizations to focus their efforts on improving their efficiency, there is a need to look more closely at the metrics that are driving such improvements. By assessing the performance measurement system against a list of common pitfalls, organisations can easily gauge how effective their system is and where further improvements or changes could be made.

Keywords: Metrics, supply chain auditing, evaluation.
**FACTORS AFFECTING THE SUPPLY IN BIOMASS-TO-ENERGY SUPPLY CHAINS – THE CASE OF FOREST FUEL**

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**Purpose:** In order to meet the targets of CO$_2$-reductions that are set up for 2020, it is often emphasised that a shift from fossil- to renewable energy sources is required. Among the alternatives is the use of forest fuel such as residues, stumps and roundwood. Forest biomass and especially forest residues are costly to collect due to the fact that they have poor transportation properties, contain a large share of moisture and have a high bulk-volume. The supply is furthermore often located far from consumption and is widely spread in small quantities over large areas resulting in costly logistics activities. This paper aims to identify the factors that affect the design of supply chains of forest fuel. The design of supply chains is in this paper delimited to the physical part of the supply chain; in other words, what resources should be used and how the structure of the physical network should be designed. Factors affecting the supply system are viewed as efficiency parameters and constraints that need to be taken into account.

**Research Approach:** Current research on biomass logistics mostly uses optimisation and simulation methods in order to minimise cost when designing biomass-to-energy supply systems. Through a literature review, the factors that are currently known as affecting the design of the supply system are identified. The paper continues by addressing the factors currently known within real-life supply chains of forest fuel. The paper has an inductive approach, using semi-structured interviews with logistics managers of forest fuel-, logistics- and energy companies.

**Findings and Originality:** The empirical data showed that the designs of forest fuel supply chains are dependent on the local context and a number of factors affecting the different stages in the supply system were identified.

**Research Impact:** This paper complements the current body of knowledge with factors that can be incorporated into optimisation models used to design supply systems of forest fuel.

**Practical Impact:** The paper concludes by presenting a theoretically and empirically supported framework that can assist actors in supply chains of forest fuel to improve the efficiency of the supply system.

**Keywords:** forest fuel, biomass, logistics, supply systems and efficiency factors
Drivers and Barriers of Eco-Logistics Services in France: Towards a Theoretical Model Integrating Offer (Logistics Service Providers) and Demand (Shippers)

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Purpose: Researchers agree today that logistics efficiency and performance objectives also include ecological and societal dimensions (Mollenkopf et al., 2010; Sanchez-Rodrigues et al., 2010; Carters and Rogers, 2008). Organisational innovations - like organizational sustainability (Paulraj, 2011) - seem to be a main contributing factor for these new challenges. Our research objectives include:

- to empirically analyse the gap between declared willingness and behaviour with regards to eco-logistical services, both at the offer (logistics service provider) and the demand (shipper) side in France.
- to develop a theoretical model explaining this gap. The particularity of this theoretical model is to integrate both offer and demand side, to consider both internal and external antecedents identified by the relevant theoretical literature.

Indeed, extant literature and empirical findings are anecdotic, controversial (Wolf and Seuring, 2010) and usually examine only one side of the dyad. Conceptualisation is mainly based upon literature review and usually stresses upon the external nature of drivers and barriers (stakeholder approach: cf. Seuring and Müller, 2006), thus neglecting internal ones, e.g. “enviropreneurial orientation” (Paulraj, 2011), related to a resource based view. Also, within the research issue of “ecological logistics”, the preferred relationship is that between the focal company and its suppliers and customers, whereas we analyze the dyad logistics service provider – shipper. Completing our empirical findings related to the demand side (2009-2010) by an offer side analysis (2011), our new research questions can be formalized as follows:

RQ1) Can we quantify the gap between logistics service providers’ declared willingness and their real behaviour with regards to eco-logistical services offered? This research question will enable us to measure the gap (diagnostics) on the offer side.

RQ2) What are the factors explaining the gap between the logistics service providers’ declared willingness and their real behaviour with regards to eco-logistical services offered? This research question will provide identification and measurement of - both internal and external - pressures, barriers and incentives on the offer side.

Research Approach: This research completes our quantitative research method conducted in 2009-2010 on the demand-side by a qualitative one focussing on the offer side: now, we conduct in-depth interviews with several logistics service providers in France. Indeed, the study team realises structured semi-directive interviews with industry observers and experts, primarily relating to the examination of our theoretical model. These interviews should provide exceptionally valuable opportunities to gather pertinent information and perspectives from a wide range of logistics professionals who have knowledge about their industrial sector and the study topics.

We have chosen the case study research as research strategy (Yin, 2003; Stuart et al., 2002), the logistics company being the unit of analysis:

- First, logistics service providers are asked to freely answer to our questions according to our structured interview guide. Potential antecedents for eco-logistics services had been developed using a theoretical framework combining ecological logistics literature with resource based view (Paulraj, 2011) as well as the stakeholder approach (Paulraj, 2009; Lee, 2008; Seuring and Müller, 2006; Preuss, 2005).

- Second, logistics service providers will be confronted with our recent research findings upon the demand side showing that shippers’ company-specific antecedents are far more important than relational aspects and regulatory constraints (Philipp and Militaru, 2010). Logistics service providers will be asked to comment these findings and to question their initial statements.

- Third, external validity will be guaranteed via expert interviews representing major stakeholders as well as international researchers in logistics and SCM.

Research Impact: This research contributes to theory-building, by clearly linking together performance and efficiency with green logistics, e.g. integrating sustainability and energy efficiency into logistics performance (Haldorsson and Kovacs, 2010). The availability of an explanatory research model, integrating offer and demand side, will enable corrective actions, maximizing the eco-friendliness of both logistics service providers’ and shippers’ behaviours and operations. In a next step, we will carry out an international comparison, as the research issue is relevant for an increasing number of industrialized nations.

Practical Impact: Our research results will contribute to orient the decision-makers choice between the alternative logistics modes in France, by guaranteeing coherence with both the offer and the demand side. Green logistics management practices will be communicated to a wide professional and scientific community.

Keywords: ecological logistics, offer, demand, integrated research model, empirical analysis, France
AN ANALYSIS OF THE OPPORTUNITIES FOR IMPROVING TRANSPORT EFFICIENCY THROUGH MULTI-LATERAL COLLABORATION IN FMCG SUPPLY CHAINS

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Purpose: In 2007, the UK government commissioned a study (known by the acronym FISS) to examine ways of reducing the external costs of food distribution in the UK by 20%. This study reviewed a broad range of measures and identified those likely to yield the greatest reductions. The Institute of Grocery Distribution (IGD), which runs ECR UK, encouraged its members to adopt these measures and over a 4 year period more than 120 million kilometres has been saved. However, over this period the relative priority given to the various external costs has changed, with greater emphasis now being placed on the reduction of CO₂ emissions. The earlier study also focused on individual company initiatives or did not model the potential benefits of collaboration across the supply chain. ECR UK has recently commissioned a new study to assess the potential for further transport efficiency improvements which more explicitly models the opportunities for vertical and horizontal collaboration in FMCG supply chains. The paper summarises the results of this study.

Research Approach: An initial pilot study was completed using comprehensive UK transport data from five FMCG companies. It used a network design model to validate the company data sets and test a series of strategies for reducing vehicle-kms and emissions. This indicated that there would be significant industry benefits to be realised from a fuller study. ECR UK then commissioned a larger survey to which 27 major food retailers and manufacturers have contributed by providing data for one month of their UK transport operations. This data was analysed to evaluate scenarios for individual companies and groups of companies. These involve minimising empty backhauls, using higher capacity vehicles (double-deck and longer semi-trailers), developing new multi-company consolidation centres and combining flows on intermodal corridors. The results of this analysis will help companies and the industry as whole to set strategic priorities for their logistics operations.

Findings and Originality: The project, based on data from the 27 companies, identified savings in vehicle-kms of 8% from improved backloading and a range between 1% and 14% from consolidating deliveries, depending on the method used. Use of double deck vehicles could reduce cost and emissions by up to 25% and longer trailers by up to 10%. The outcomes from the full study were presented to the ECR Sustainable Distribution Group in June 2011.

Research Impact: The study has analysed 8% of all road freight movements in the UK and has been described by ECR UK as ‘the biggest distribution study of its kind’. It represented an outstanding opportunity to assess the extent to which multi-lateral logistics collaboration within the FMCG sector can cut costs, congestion and emissions.

Practical Impact: The study will provide benefits at three levels:

- Network overview – It will help individual businesses to find opportunities for efficiency improvements within their own networks
- Opportunities for collaboration – It will identify the most promising areas for joint initiatives
- Strategic overview – It will help to establish logistical priorities for the FMCG sector as a whole to increase efficiency and cut carbon emissions.

Keywords: Sustainability, multi-lateral collaboration, FMCG sector, freight transport, UK
A SURVEY OF HORIZONTAL COLLABORATION PRACTICES IN THE LOGISTICS INDUSTRY

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Purpose: The purpose of this paper is to report on survey findings on the utilisation of horizontal collaboration in the logistics industry. This paper specifically provides a review of logistics providers that are, or have been, involved in horizontal collaboration initiatives. The paper provides an overview of the types of initiatives that are being undertaken in the logistics industry and the types of resources that are being shared. The comparative perceived effectiveness of these types of collaboration and resource sharing initiatives are then considered. This research also obtains the views of logistics providers on how they believe the way horizontal collaboration is undertaken in their company will change over the next five years.

The research builds up a picture of the operational and organisation features that influence the perceived effectiveness of a horizontal collaboration initiative.

Research Approach: The primary methodology was the application of a survey of logistics providers in the UK. The analysis of this data was supported by the use of a series of detailed interviews and from the use of relevant secondary data.

Findings and Originality: The results reveal that horizontal collaboration is a well established practice with 83% of respondents indicating that they are involved in some form of horizontal collaboration. Respondents have indicated that horizontal collaboration has been undertaken in the logistics industry for many years with the average number of years respondent companies have been involved in horizontal collaboration being 6, however individual respondents have indicated that they have been involved in horizontal collaboration for up to 35 years.

The most popular of these initiative types is the sharing of services with the consolidation of complementary freight flows also being undertaken by over 50% of respondents. However respondents indicated that joint ventures were perceived as the most effective type of horizontal collaboration.

No significant relationship was found between form of collaboration and perceived effectiveness. Length of time the company had been involved in collaboration, number of partners and resources being shared were also found to have no significant impact on the perceived effectiveness.

Research Impact: The research points to further work that needs to be undertaken in order to address the challenges that obstruct successful adoption of this innovative collaborative approach to business improvement.

Practical Impact: The paper provides pertinent advice to logistics providers embarking on, or considering, collaborative ventures with companies providing the same or similar services.

Keywords: Horizontal collaboration, Logistics, Co-opetition
A PILOT STUDY IN THE UK BIO-ENERGY INDUSTRY TO IDENTIFY MAIN CHARACTERISTICS IN SUPPLY CHAIN INTEGRATION AND PERFORMANCE

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Purpose: This paper presents the findings from a pilot study which sought to identify the main characteristics of integration in UK-based bio-energy supply chains. In turn, the pilot study will form the basis of classifying main features and contribute to building a decision support tool that will enable policy makers and stakeholders to build appropriate scenarios with which to measure supply chain performance. This approach could provide a tool to allow companies entering the bio-energy industry to identify and thus prioritise areas in which they need to concentrate resource, in order to become productive and profitable.

Research Approach: Throughout 2010 and the first part of 2011 companies involved in the UK bio-energy industry from biomass sources (upstream) to production, logistics and distribution (downstream) were given a short questionnaire. Their responses will contribute to building an ontological reference tool intended to help users to define the components of a bio-energy supply chain and thus help simulate how such a business will perform across its respective supply chain. The method utilises the semantic web. Underpinning this approach applies Bayes Theory of Probability and Decision Theory. The method is advantageous due to its ability to use both quantitative and qualitative data and locating relationships between main attributes and sub-attributes of characteristics in bio-energy supply chains. The results could potentially be used to develop a decision support tool that will help optimise supply chain performance and integration.

Ontology building using the semantic web has not been tested on bio-energy let alone supply chain performance but has been used in generating a common framework for differing and diverse disciplines. This industry has yet to be properly defined, particularly in relation to identifying main characteristics from each domain and its respective properties within each domain. However, decision support systems are explored using a range of methodologies but are limited in that they tend only to be applied to one specific area of the bioenergy supply chain.

Findings and Originality: Models that simulate the whole bioenergy supply chain and measure its integration have dealt with just one aspect of the bioenergy system. The literature shows that these have polarised between upstream and downstream activities in the supply chain. Whilst the literature has explored a range of methods to map such processes, these can only be acquired if there is a common framework of understanding from supply chain, logistics, policy makers, bioenergy perspectives. In order to ascertain the common terms and which functions dominated these divergent viewpoints a pilot study was developed and issued to respondents who worked within these areas of bioenergy. Participants came from CHP bioenergy plants in production and operations, stakeholders and policy makers, CHP boiler manufacturers, logistics managers and procurement specialists in sourcing biomass. The areas covered in the pilot study could be typical to any given supply chain and logistics distribution and comprised eight areas: supply chain planning and logistics, logistics functions, organisational role, user satisfaction, impact of use, organisation performance costs, IT applications and waste management operations. Participants were required to rank in order of preference on a scale 1-5 on areas that were most or least important to bioenergy. The results taken from respondents from different disciplines and functions in the supply chain ranked some areas higher than others in the questionnaire.

Participants ranked some attributes very highly These included: Supplier selection, storage of materials, site location, partnerships and costs.

Attributes ranked off lesser importance were: Information and Communication Technologies (ICT) and marketing in the context of impact of use and communications

Research Impact: Semantic web applications does provide an advantage because it relies on Bayesian approaches, particularly where there are inconsistencies and gaps in knowledge. The pilot study questions were heterogeneous by nature utilising both qualitative and quantitative data to build a holistic view of supply chain factors. Applications of semantics of information even from the same source can be perceived differently. Large information sets such as those found in supply chain management, logistics and bio-energy may prove challenging to establish the true relationship between each domain and its properties.

Practical Impact: Application of the semantic web will help build a decision support tool and has considerable potential for planning and development decisions in bioenergy organisations. Evidence shows that decision support systems are critical to aiding decision makers in this respect. This approach will provide a means for organisations in bioenergy to plan and model their supply chains, and to assess the relative importance of differing factors and thus optimise attributes within that chain.

Keywords: bio-energy ontology, semantic web, biomass CHP, supply chain integration and energy policy.
Purpose: Blood is a perishable and scarce commodity. This paper evaluates how sharing on hospital level can facilitate an efficient use of blood resulting in less time expired wastage. The paper identifies the key drivers, success factors and barriers for horizontal stock sharing in the blood supply chain in the UK.

Research Approach: A case study approach was chosen with two cases targeting 8 hospitals sharing stock and 8 hospitals not sharing stock. Within case analysis and cross case analysis was used to reduce the data and identify key themes.

Findings and Originality: The case studies show that sharing stock can reduce the wastage of the highly perishable commodity blood and allows a more efficient use the scarce resource and hence increases the effectiveness of inventory management. The research shows that trust between hospitals is an essential driver for the successful sharing of stock. Another essential driver is the management and validation of the cold chain during the entire process. The paper validates the concept of stock sharing in the blood supply chain from a practical perspective.

Research Impact: The paper proves the concept of stock sharing on the example of the UK blood supply chain. Further research should look into other sectors with perishable products such as the grocery, food or service industry in order to appraise its applicability.

Practical Impact: The research provides a basic framework for hospitals with drivers, success factors and barriers for sharing stock in the UK blood supply chain and provides practical advice and recommendations for successful implementation of stock sharing practice.

Keywords: Inventory management, stock sharing, supply chain management, blood supply chain
THE INTERNET OF THINGS FOR EFFICIENT MEDICAL LOGISTICS: A BEST PRACTICE REVIEW

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**Purpose:** This paper explores how supply chain management in the health care sector is being, and could be made more efficient through the use of active and passive tagging technologies, operating through the medium that is ‘the Internet of Things’ (IoT). The research forms part of the initial scoping review of a 4-year Engineering Doctoral research project sponsored by Transport for London in association with Great Ormond Street Children’s Hospital. There are a range of information, communications technologies (ICT), such as RFID, GSM based smart tags and barcodes available to logistics providers which can expedite the processing of inventory at key stages along the forward and reverse supply chains. However, the evolution of GSM based tags means that one can now embed sensors and transmitters into objects enabling them to be addressed ubiquitously by Internet protocols through which they can sense and report on their environments and communicate with users and other objects. IoT applications are not just limited to power-hungry and often near-field technologies. By using significantly cheaper, more accessible and easily integrated 2D bar coding such as QR (Quick Response) Codes or the up-and-coming ‘bokodes’ which can be scanned using smart-phone camera technology, visibility of inventory paths and transport schedules can be achieved at source by practitioners. QR codes can also act as read/write tags where, through a smartphone, the user can leave messages on a database linked to the tag. The paper outlines some key case study example of platform, designed to allow interrogation of networks of sensors (e.g. CENSE, Pachube).

Such innovation is helping to drive efficiency within the logistics sector, increasing the opportunities for potential collaboration across supply chains through the enhanced visibility of inventory, transport options and client requirements.

**Research Approach:** The paper uses the findings from a worldwide literature review of IoT enabled technologies across the health care sector along with focussed surveys of health care managers in the UK to identify current best practice and areas where the IoT could be targeted to bring about quick-win efficiencies.

**Findings and Originality:** This review focuses on the central role the Internet of Things (IoT) is expected to play in the innovation of logistics technologies and applications. The IoT is the term for when everyday objects become connected to the internet, primarily using RFID tags and/or sensors. FedEx’s SenseAware is an example of its application where a browser-based collaboration platform is coupled with RFID technology and multiple sensors to measure light, motion and temperature on board vehicles and around specific objects (e.g. packages, dangerous cargoes, hazardous materials). One of the benefits gained by this system is that should a shipment of perishable goods be delayed to the extent that it is unlikely to reach its destination within the expiration period, it can be automatically re-routed to a destination which requires/uses the products, before the inventory expires, with another shipment dispatched to the original delivery address.

As well as best practice case studies, the review discusses the many issues which currently limit IoT implementation, such as: the consumption of power, band-width and capacity, and the volume of data generated by potentially millions of ‘things’ that could communicate via the Internet. The legal liability resulting from changes of state brought about by remote sensors communicating with devices e.g. controlling environmental conditions of perishable shipments and in some test cases the monitoring of patient conditions within healthcare; and the need for standards that support such technologies by allowing data to flow freely among and between sensors, computers and actuators (person-to-device; device-to-device; device-to-grid).

**Research Impact:** The IoT represents an important development for healthcare logistics. By connecting everyday objects and patients to the Internet, there is the added potential to:

- gather information with which to analyse and thus enhance decision making, facilitated through tracking behaviours from products embedded with sensors. The acquisition of information also has important implications for products requiring regular servicing (e.g. certain specialist medical equipment) and by using networked sensors, proactive maintenance schedules are possible, reducing unplanned downtime
- monitor resource consumption and replenishment schedules of medicines and consumables.
- Oversee patient care in the community through remote monitoring of conditions (e.g. Chui (2010) suggested that checking for congestive heart failure through automated sensors could reduce hospitalisation and treatment costs by a billion dollars annually in the U.S.)

The paper informs academics and practitioners of where this technology is evolving.

**Practical Impacts:** The practical impacts of this review are to identify the ways in which the IoT and related technology can enhance visibility of opportunities within existing, and between competing supply chains to improve integration and flexibility, reduce costs, increase productivity and improve customer service. This may enable greater collaboration between supply chains and logistics providers to reduce the overall transport footprint associated with the healthcare sector.

**Keywords:** Internet of Things (IoT), RFID, QR Codes, Pachube, CeNSE, medical supply chains, reverse logistics.
AN EXAMINATION OF REVERSE LOGISTICS SYSTEMS IN THE NHS PHARMACEUTICAL SUPPLY CHAIN: A MULTI-CASE STUDY OF PRACTICE AND OPERATIONS STRATEGY

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Purpose: The logistics of managing returned unused, unsold or damaged goods back into the upstream supply chain and associated activities of handling, consolidation and disposal such products is becoming of increasing interest in reducing costs and maximizing efficiencies (Cherrett et al 2010). Within hospital pharmacy as part of the larger National Health Service (UK), there is a strong emphasis on contributing to the efficiency targets through reductions in waste and drug spending, as well as better practices (PharmaTimes online, 2010). The NHS Supply Chain asserts that they are committed to a sustainable future by meeting objectives of improving energy efficiencies, reducing emissions and pollutions, increasing recycling and reducing use of natural resources The operational strategy within the NHS Supply Chain is the specific decisions and actions that play a key role in achieving these objectives, The construction of the operation strategy requires inputs from the four perspectives, including top down management, bottom up activity (staff input), market requirements (the customers, patients) and operational resources (again staff) (Slack et al, 2010).

The purpose of this study is to examine reverse logistics practice within the NHS Pharmaceutical Supply Chain (PSC), and more specifically hospital pharmacy, and the operational strategy which drives such practices. The focus was the impetus behind recycling activity, resource allocation, governance, outputs and benefits/obstacles to effective practice.

Research Approach: The scope of this study is a review of reverse logistics practice across the North West Regional Pharmaceutical Operational group. This group encompasses 20 members representing hospital pharmacies in the North West of England. The terms of reference for this group include sharing best practice, coordinating critical information e.g. product shortages and contract appraisal/renewals. This party therefore is very successful in supporting an effective PSC in this region. An electronic survey was circulated to the participants via the group chair. The survey examined the practices across all stages in the reverse logistics system, including reduction, recycling, inspection, reuse, and disposal.

Findings and Originality: A survey of this scale has not been completed before. Previous studies of this nature have only focused on one case subject e.g. Ritchie et al (2000) and Xie and Breen (2010). The findings indicated the commonality in the outcomes, but the means by which the same objective was achieved differed, such as the operational strategy adopted, the resources employed, and the training and disposal methods etc.

Research Impact: From a research point of view there is much learning to be gained from having a greater understanding of reverse logistics systems and practice across a large geographical location and disparate groups.

Practical Impact: The results will provide the industry with an up to date review of reverse logistics practice within the NHS PSC which is largely generalisable due to the scale of the population surveyed.

Keywords: Pharmaceutical supply chain, reverse logistics, operational strategy.
A MARKET SCAN OF FOOD CLUSTERS AT NORTH SEA REGION: INTERREG IVB (NSR) FOOD PORT PROJECT

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Purpose: This paper presents the initial findings of a market scan of food clusters at North Sea Region (NSR), which is part (work package 5.1) of the Food Port Project, operates under the umbrella of the INTERREG IVB NSR Programme (www.food-port.eu). The project aims to develop the NSR as the best food cluster and hub in Europe for food products delivered via efficient and sustainable transport systems e.g. green transport corridors.

Research Approach: The market scan is guided by a data collection protocol developed by the University of Hull Logistics Institute. Data from existing databases and publications about agriculture, manufacturing, transportation and storage of food from Yorkshire and Humber, the South East of Scotland Transport Partnership, West Flanders, Västra Götaland, Møre and Romsdal County, and Southern Denmark are collected and analysed. SWOT analyses for each supply chain components (farming, manufacturing, transport & storage, import/export and retail) and region are performed.

Findings and Originality: Major food clusters in the NSR are fish & seafood, meat & dairy, crops & grains, vegetable, alcohol bottling clusters, animal feed clusters, and retail groceries. SWOT analyses of each food supply chain components reveal in general high cost, high competition, lack of intermodal infrastructure, lack of logistic skills, lack of integration and collaboration as main weaknesses. Most food products are transported by road involving many cross-borders food flows. Six modal shifts opportunities and the use of green corridors are identified. There is some opportunity for the use of identification, location and communication (ILC) technologies to keep track of food origins and food flow and maintain food conditions to meet customer requirements.

Research and Practical Impact: The market scan exercise is a very crucial step towards the mapping of food flows across the NSR (work package 5.2) and the realisation of modal shift pilot projects and green corridors (work package 3) under the Food Port Project. It provides better information on potential for modal shift and also the cluster effects within the identified food clusters at the NSR. It helps logistics researchers to better understand the clusters and flows of food within this region. The realisation of potential modal shift and green corridors would significantly contribute to the move to reduce greenhouse gases emission and energy consumption.

Keywords: Food supply chain, Food clusters, North Sea, Ports, Green Corridor
AN ASSESSMENT OF HUB-PORTS COMPETITIVENESS AND ITS IMPACT ON THE MEDITERRANEAN CONTAINER MARKET STRUCTURE

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Purpose: The aim of this paper is to assess the competitiveness level of hub-ports and to analyse the impact of inter-port competition on the Mediterranean container market structure and port selection criteria from the shipping lines perspectives.

Research Approach: In order to assess the competitiveness level of the main container terminals and hub ports in the Mediterranean the research shall follow the inductive concept of the Industrial Organization (IO) and the Structuralisms (Harvard school) methodology that analyses the market condition, structures, conduct and performance of market players.

Findings and Originality: The elements that shall be used to assess inter-port competition in the Mediterranean container market are qualitative elements that include terminals location, Accessibility, throughput (productivity), market share, ports' infrastructure in terms of terminal length, Depth, number of berths, storage capacity and terminals' superstructure that include number of handling, transfer and stacking equipments.

Research Impact: the research focuses on assessing the competitive position of the main hub ports as well as the potential hubs in the Mediterranean region. The research will evaluate and benchmarking the present competitiveness level of the defined ports and its impact on the port selection criteria from the shipping lines perspectives throughout analysing the market contestability and structure. The research shall also apply Herfindahl index technique to measure the market concentration for the last five years in order to examine the market behaviour and its tendency to move towards monopoly or to pure and perfect competition (PPC).

Practical Impact: By evaluating the present competitiveness of the existing and potential hub-ports in the Mediterranean container market, the research shall introduce new factors to the shipping lines passing the Mediterranean could assist them to optimize their operating cost. Either they choose, for example, one or two hub ports serving the region by using the mega carriers (8000 TEU) and above or they choose a number of hub ports with vessels of smaller capacity. Such an optimization process might have a profound effect on increasing the vertical integration among the market players and accordingly reshape the market structure.

Keywords: Port competitiveness, Hub-ports, Container market, Industrial organization, monopoly.
THE EFFICIENT RELATIONSHIP BETWEEN MARITIME PORT SECURITY RESIDUAL RISK AND SECURITY INVESTMENT

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Purpose: The purpose of the research is to discover the efficient relationship between residual security risk and security investment for maritime port facilities.

Research Approach: The research undergoes an adaptive cross-disciplinary research strategy to generate the residual security risk-security investment efficient frontier using portfolio optimisation. The paper examines empirical data collected from six port facilities owned by Dubai Ports World on the performance of their port security systems: access control, biometrics and detection. The subjective assessments of the security systems’ performance and their costs are combined with data provided by a specialist terrorism underwriter from Lloyd’s of London on terrorism event probabilities and insured loss scenarios to estimate the relationship between a port facility’s security investment and its residual security risk. A simulation is run to calculate the 210 theoretical portfolios in which the three security systems from the six port facilities can be combined in order to calculate the residual security risk – security investment efficient frontier and a sensitivity analysis is performed to compensate for the relatively small dataset.

Findings and Originality: The research calculates the 6 actual and 210 theoretical portfolios of security systems, their performances and costs and using this data plots the efficient frontier. In terms of originality, no research has previously collected and analysed empirical data of this nature on the performance of port security systems.

Research Impact: The research contributes to the literature on port security, specifically in terms of empirical research and contributes new definitions of port security, port security risk and port security risk management.

Practical Impact: The contribution which the research makes is in terms of modelling and measurement of the impact of the introduction of new port security technology, changes in background port security threat levels and for the planning of port security in Greenfield sites. Furthermore, the adaptive approach of the research is generalisable to all nodes in the supply chain and is not limited to port facilities alone.

Keywords: Security; port security; port security risk; port security risk management; terrorism; efficient frontier; portfolio analysis; ISPS Code; port facility security officer; company security officer; residual security risk.
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Uncertainty and FMCG distribution network performance: A UK/South Africa comparison | Grant, Butcher. Implementing pick-to-voice technology in warehousing | Kotcharin et al. Understanding logistics collaboration practices: A case study | Mangan et al. Identifying logistics channels to market for Irish SME food exporters |
| 10.30 | Kiperska-Moron, Klosa. Innovative suppliers as a source of risk for manufacturing companies | Pandian, Backhaus. Application of cross-docking distribution as a smart logistics system in the German chemical industry | Karia et al. Analysis of the bundling effects of resource-based logistics: A survey of Malaysian logistics service providers | Li et al. Multimodal transportation planning in food service industry with carbon control policy |
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| 11.00 | Feng et al. A comparison of factors influencing port performance between the Humber estuary and Xiamen ports | Isaksson et al. The challenge and adoption of green initiatives for transport and logistics service providers | Waterson et al. Analysis of mean bin weight data to monitor best practice at household waste recycling centres | Roso. The role of dry ports for viability of short haul rail in Australia |
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(Session A3)

UNCERTAINTY AND FMCG DISTRIBUTION NETWORK PERFORMANCE: A UK/SOUTH AFRICA COMPARISON

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Purpose: Several studies have measured the effects of unexpected events on the performance of logistics operations (McKinnon et al. 2009, Sanchez-Rodrigues et al. 2009). The focus of these studies has been on developed countries, and particularly the UK where FMCG logistics practices are highly efficient. By contrast, there is a need to examine the extent to which these findings are context specific. In this sense, there has been little cross-comparison between emergent economies and developed countries in terms of how freight transport networks are set, plan and executed and how networks in these two type of economies can be affected by uncertain events and how they respond to these events. The paper aims to address this shortcoming, focusing on the UK and South Africa as comparator countries.

Research Approach: A series of eight focus groups were run in the UK and South Africa to identify the main causes of uncertainty affecting FMCG road freight transport operations at a macro level. From this, we study the micro level in more depth, with four case studies – two from the UK and two from South Africa. In the UK, a primary distribution network run by a logistics provider and a secondary distribution network run by a retailer were examined. In South Africa, the FMCG distribution networks included in the study were a secondary network and a manufacturer-to-store distribution network, both run by a South African logistics provider. In all the case studies, the focus was to identify the main causes of uncertainty that affect the road freight transport operations of the four distribution network studied, and also to study how these operations respond to uncertainty and what factors influence their responses. Performance data was collected from archival data and by observing the operations studied. The focus was on cost and environmental impacts. Also, a number of semi-structured interviews with key managers from the four case study companies were undertaken to verify the findings. A cross-comparison of the findings from the four case studies was undertaken to identify relevant similarities and differences.

Findings and Originality: At a macro level, the findings from the focus groups undertaken in the two countries were very similar. In this sense, the causes of uncertainty that affect more the performance of freight transport operations are: delays, variable demand and/or inaccurate forecast, delivery restrictions and insufficient supply chain integration and coordination. In both countries, delays seem to be the most important cause of uncertainty. In the case studies, the uncertainty causes affecting South African FMCG freight transport operations are slightly different to the ones affecting this type of operations in the UK FMCG sector. Variable demand and/or inaccurate forecast was the most important uncertainty cause found in the UK primary distribution operation and in the two distribution operations from South Africa managed by logistics providers. Communication and coordination barriers within was considered to be the root cause of this problem in these three case studies. On the other hand, in the UK FMCG distribution operation, the main cause of uncertainty found was delays due to unexpected traffic congestion and inefficiency in the unloading process at store bays.

In logistics research, a very few benchmarking studies between developing and emergent economies have been undertaken. This paper can inform future research studies that aim to compare distribution networks from the UK and other emerging economies.

Research Impact: The findings in this paper provide further insights into the impact of uncertainty on logistics operations. Although the findings are specific to the FMCG sector, the method used to collect the data can be considered generic and therefore transferable to other operating environments, be that in other sectors or other countries. There is also a lack of publications relating to logistics operations in South Africa and therefore this research highlights operating practices there.

Practical Impact: This study can inform future decision-making at the four case study companies and identify benchmarking opportunities between them. It can also guide policy that is aimed to reduce traffic congestion in both countries. Moreover, it can be used as a benchmarking tool to compare road freight transport operations in the FMCG sectors from the UK and South Africa.


Keywords: Uncertainty, FMCG, road freight transport operations, benchmarking
RISK MANAGEMENT AND THE STRATIFICATION OF LOGISTICS SERVICE PROVISION

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Purpose: The academic world of logistics outsourcing defines several iterations and the stratification of logistics and supply chain outsourcing solutions. There are many service offerings and the nature of the industry allows for bespoke solutions with an eagerness to avoid a one size fits all option. Commentators are prescriptive in their responsibilities for customers of service providers to control and specify their businesses successfully and the ongoing role they have in managing the outsourced relationship. It is not clear what degree of risk each service offering entails for both the customer and the service provider.

Research Approach: Research was undertaken during the period 2007 to 2011 and involved two case studies of outsourced logistics solutions, 14 interviews with logistics leaders and a Delphi survey. The three round Delphi survey used the contact database of the Outsourcing and Procurement forum of the Chartered Institute of Logistics and Transport, as the initial Delphi panel and the three rounds generated over 12,000 pieces of data and 600 text comments from 381 responses.

Findings and Originality: The findings from the research lead to the development of a model where an hierarchy of service provision is balanced against the risk to the customer in terms of fulfilling outsourcing objectives and the risk to the service provider in both being able to generate value internally as well as for the customer.

The findings build on the collaborative approach to outsourcing espoused by Vitasek et al (2010) in which both customers and service providers are encouraged to work together on a what’s in it for we approach, by balancing risk on an holistic basis with service provision. The principle of co-makership described by Christopher (2010) based upon the mutually beneficial relationship between supplier and buyer is also engaged within these findings.

Research Impact: The outsourcing and risk hierarchy links the traditional stratified models of outsourcing service provision and asset management with a risk profile to both the customer and the service provider. In this context, risk is the term given to the potential of failing to generate value and / or creating loss on behalf of the customer or service provider. This is a new avenue of research.

Practical Impact: Customers and service providers alike should consider their outsourcing objectives and the risks of failing to satisfy them. This approach works outside the traditional stratified models of service provision and adds risk assessment process into the decision making process.

Keywords: Outsourcing performance; risk assessment; service provision,
INNOVATIVE SUPPLIERS AS A SOURCE OF RISK FOR MANUFACTURING COMPANIES

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Purpose: Even though there is a rich stream of literature investigating risk in supply chains, there has been little research applied to the precise risk that exists with inbound supply at manufacturing companies. Research in risk and its management deals with the level of inter-organisational relationships. External suppliers represent diversified levels of innovations concerning their products and/or technologies; they are often classified as “innovative suppliers”. Certain degree of innovation was clearly identified as a source of risk and uncertainty in supply chains. Also the relationships between manufacturers and their suppliers may be based on partnerships or they may demonstrate more opportunistic behaviour of engaged parties. The purpose of the research presented in this paper is to analyse the problem of impact of innovative suppliers on technological and behavioural risk in manufacturers’ supply chains.

Research Approach: Data used for the research was extracted from the database built on the basis of international survey of manufacturing companies applying the questionnaire of the Global Manufacturing Research Group (GMRG). The data base included around 124 companies from several countries. Using variables describing manufacture’s most important suppliers, those cooperating with companies providing latest products or manufacturing technology have been selected (i.e. innovative suppliers). Those companies were further segmented according to low or high level of perceived technological and behavioural risk. The main research question was: what pattern of cooperation with supplier is applied by manufacturers, depending on their perception of technological and behavioural risk connected with their innovative suppliers?

Findings and Originality: The completed research provided slightly new insight into mutual relationships between manufacturing companies and their innovative suppliers. Manufacturers mostly perceive behavioral and technology risk connected with innovative suppliers as low, which seems to be too optimistic in the light of further problems that appear in their cooperation processes. Manufacturers try to mitigate the risk through signed contracts and specific clauses, however, from the perspective of risk probabilities, the results of that are still problematic. Despite all efforts the most common risk sources result from poor technical performance and logistics problems of late deliveries. Unfortunately it was difficult to identify the difference in practices applied by manufacturers in the four clusters representing various levels of technical and behavioral risks. Legal contract do not seem to be a proper tool for risk mitigation. Also operational practices require many additional communication and agreements extending beyond formal contract clauses. Probably effective and efficient cooperation with innovative suppliers, due to the extreme complex nature of such relationships, cannot be easily subject just to legal regulations.

Research Impact: Research highlights the problems of innovation factor not only as the element of support for competitiveness of manufacturing companies but also as a source of uncertainty and risk in supply chains. This research could be an outgoing point for further investigation cooperation with innovative suppliers.

Practical Impact: Research results might be of importance for decision makers and managers in manufacturing companies operating in dynamic supply chains. It could help them to understand some behavioural aspects of relationships with innovative suppliers.

Keywords: Innovative suppliers, technological and behavioural risk, risk management
IMPLEMENTING PICK-TO-VOICE TECHNOLOGY IN WAREHOUSING

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Purpose: Warehousing is still a major concern in the logistics and supply chain process due to increased global supply chains, continuing discrepancies in transportation and delivery activities, growing and ever-changing customer expectations, and increased competition. Firms strive to improve warehouse operations through innovation to differentiate themselves and provide increased customer service through on-time, in-full and error-free deliveries. Warehouse owners and operators have addressed these challenges by introducing various technological innovations such as computerization and robotics. Different tools are also available for warehouse picking operations including radio frequency (RF) bar-code scanning systems, paper-based/label systems, radio frequency identification (RFID) tag scanning systems, 'put-to-light' and 'pick-to-light' systems, and 'pick-to-voice' technologies. The latter technology is considered a laggard from a survey by the Supply Chain Consortium and motivated this study to investigate the phenomenon of pick-to-voice technology (PVT) in warehouse picking, which has not been widely studied to date by academics. This paper discusses in-progress findings from an exploratory study of PVT in warehousing as an innovation measure for the firm and also considers PVT’s impact on the firm and its workforce regarding process change issues.

Research Approach: The research approach is qualitative as the phenomenon is relatively under-researched; thus the empirical study comprised key informant interviews across firms in Europe and Australia. The study’s objectives include PVT’s overall impact on firms, their workforces, and downstream partners regarding process and change implementation issues such as workforce and partner resistance to change. Data collection involved face-to-face, telephone and e-mail semi-structured interviews as well as observations regarding the operator-systems interface using the cognitive walkthrough method. Data were analysed with content analysis using within case and cross-case techniques.

Findings and Originality: Findings from analysis conducted to date indicate that PVT does not vary the fundamentals of picking operations; however employees believed PVT enhanced their working environment and increased job satisfaction. PVT’s three most innovative and advantageous features appear to be hands-free and eyes-free operations and real-time information; thus VT is a useful innovation for diminishing pick errors while augmenting warehouse output. Safer working conditions, reduced training time and usability in difficult environments like freezers were also highlighted by most respondents. Many also noted that workforce involvement in the pre-implementation process is vital to avoid business disruptions. Further considerations include PVT benefits having a ‘snowball’ effect to customers downstream and suppliers upstream, and successful implementation requiring thorough up-front preparation as regards process and performance measurement.

Research Impact: The paper provides an appreciation and understanding regarding the difficulties and impacts of PVT implementation. The study addresses this gap in the literature as noted in the purpose above and enhances knowledge regarding the successful implementation and general impacts of PVT in the warehousing domain.

Practical Impact: There are several different approaches available for PVT innovation and implementation related to project size, span and purpose, for example an authoritarian approach without workforce involvement or conversely a very participative approach. Thus far it appears that firms should involve their workforce and relevant labour unions in the decision stage of PVT adoption to attract full support, help think through the picking order process and tasks, and perhaps associate PVT with slot optimization tools to further maximize its capabilities. Lastly, it also appears at this stage that PVT is inappropriate for use in smaller warehouses or depots due to its high infrastructure and start-up costs and the likelihood that smaller operations may not gain much efficiency due to extant staff expertise and abilities.

Keywords: Warehousing, innovation, technology, pick-to-voice, customer service
THE IMPACT OF ECONOMIC AND SUPPLY CHAIN TRENDS ON BRITISH WAREHOUSING

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Purpose: Warehouses are key nodes in many supply chains and typically represent over 20% of logistics costs. However, other than property market studies, there has been relatively little research on warehousing, particularly as regards how trends in warehouses may relate to changes in such parameters as wider economic and supply chain factors. The purpose of this paper is to examine this area in order to explore how trends in warehousing may relate to existing warehousing and supply chain theory so as to facilitate further research into the relationship between warehousing and “smarter” logistics strategies and efficient supply chain performance.

Research Approach: The paper is based on a longitudinal study examining the take-up (i.e. occupation) of new large warehouses in Great Britain over the past 16 years covering some 700 records. For the purposes of this study, large warehouses are classified as those over 100,000 square feet (9,290 square metres) in area. These trends, together with those of total warehouse stock, are then related to national statistics, warehouse surveys, supply chain changes and other relevant data over that period.

Findings and Originality: This is a rare longitudinal study of this subject. It is found that, until the recent recession, the total warehouse stock, as well as the take-up of large warehouses, has been increasing and this can be associated with such factors as economic growth, retail spending and globalisation. Both the footprint and height of large warehouses has been rising and this may be due to such factors as network economies and warehouse technology. The locations of warehouses are becoming more dispersed, possibly due to the growth in e-commerce and port-centric logistics. In addition, it was found that large warehouses have been increasingly taken up by retailers and manufacturers rather than logistics companies.

Research Impact: This paper examines the possible influence of economic and supply chain trends on warehousing in Great Britain. As well as testing existing theories, the data provides a sound foundation for future research. For example, there have been conflicting evidence in previous research regarding economies and diseconomies of scale and this discussion can now be set against trends in warehouse footprint and height.

Practical Impact: The paper provides a better understanding and basis for decision making by planners, developers, funding corporations, operators and end users. For example, topics such as size and height of buildings are examined, as well as trends in port-centric logistics, rail connections and e-fulfilment. The changing nature of warehouse designs in terms of wider economic and supply chain trends is particularly important for practitioners as warehousing costs are to a large extent determined at the design phase and have a major impact on the effectiveness of the overall supply chain of which they are a part.

Keywords: warehouse property, warehouse design, longitudinal study
APPLICATION OF CROSS-DOCKING DISTRIBUTION AS A SMART LOGISTICS SYSTEM IN GERMAN CHEMICAL INDUSTRY

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Purpose: The purpose of this paper is to investigate the application of cross-docking (CD) systems in German Chemical Industry.

Research Approach: The research undertakes an exploratory study to identify the application of CD systems within the German chemical industry. Attempts are made to gain a theoretical insight into the application of CD in the German chemical industry. In this research, four independent case studies are analysed. In order to increase the understanding of the research theme and to get a deeper insight into the application of CD systems within the German chemical sector, semi-structured interviews were adopted. Each semi-structured interview represents a business case that gives a deep insight into the application of CD in different chemical companies and thus the adoption in the sector.

Findings and Originality: The CD distribution is described as a smart logistics concept applicable to many different industry sectors and in many different ways. Therefore, the advantages and disadvantages of adopting CD distribution system are mostly discussed from a general point of view, without focusing on the chemical industry, an industry that is characterised by unique features. Although CD is analysed and critically discussed in existing literatures, the illustrated literature review shows that there is a lack of information about the adoption of CD within the chemical industry in general and Germany in particular. No work has so far been undertaken to study the use of CD concepts and systems in the chemical industry. In this respect, this research fills up the gap in existing literatures that mostly focus on non-chemical industries. This research confirms that CD, as a distribution system, has already been implemented as an element of smart logistics system in German chemical industry to improve performance and efficiency.

Keywords: cross-docking distribution, performance, efficiency
UNDERSTANDING LOGISTICS COLLABORATION PRACTICES: A CASE STUDY

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Purpose: Organizational collaboration can improve firm operational performance in several areas and successful logistics supply chain collaboration is still rare. The purpose of this paper is to focus on cross-functional collaboration and, in particular, logistics collaboration practices between manufacturers and logistics service providers in order to understand the fundamental key elements and impact of collaboration and to explore cross-functional collaboration practices.

Research Approach: A review of prior studies plus the resource-based view and the relational view of the firm are used to frame a conceptual model. This study employs an explorative case study using qualitative methods to understand the key elements of logistics collaboration practices and their collaborative benefits and to explore cross functional collaboration practices. Semi-structured interviews were used to investigate each key elements of collaboration and as well as the benefits of collaboration. The case study features a company with a wide scope of both vertical and horizontal collaboration which operates in a volatile market with a short product life cycle. The key informants are department managers from across the company and the use of a variety of key informants helps to increase the internal consistency of data.

Findings and Originality: The results revealed that logistics activities such as distribution, warehousing and transport can be better optimized through collaboration. In this case study, internal collaboration (cross-functional collaboration) and external collaboration with a logistics service provider required a cross-functional working team to collaborate with partners and resulted in improved inter-organizational relationships and innovation. The cross-functional working team not only worked with partners to share goals and information but also needed mutual benefits as well as open and clear communication. Thus, the important elements of logistics collaboration are highlighted in this paper. The case study is a good example for logistics and supply chain managers who want to implement logistics collaboration since it study provides useful insights into how managers collaborate with partners and align collaborative culture and collaboration practices to achieve corporate goals.

Research Impact: The case study provides understanding about logistics collaboration and provides confirmatory evidence of the conceptual model prior to large scale empirical testing.

Practical Impact: Cost reduction, improved service level and supplier relationship development can be achieved through logistics collaboration. Collaborating partners should have similar collaborative culture such as open and communication, information sharing and the sharing of risks and as well as benefits. A cross-functional working team plays a significant role in implementing and controlling/auditing collaboration practices. However, the team has to set its operational scope in dealing with partners, sharing their knowledge, working jointly and investigating or auditing for improvements to enable innovation.

Keywords: Logistics Collaboration, Information Sharing, Case study
Purpose: Despite the fact that cooperation is commonly mentioned as important in the greening of supply chains, interaction between logistics service providers and shippers are rarely investigated in green logistics literature. Moreover, the knowledge of how green factors are taken into consideration in relationships on the logistics market appears to be very limited. The purpose of this paper is therefore to analyse how green factors are taken into account in relationships between logistics service providers and shippers.

Research Approach: This paper is based on a multiple case study, where four dyads between logistics service providers and shippers are researched. Logistics service providers as well as shippers are selected based on their environmental ambitions in logistics as well as in a more general sense. Both a single-case analysis and a cross-case analysis are conducted, based on evidence primarily from interviews with employees that are involved in the specific studied relationships. Relationship dimensions are investigated in order to analyse similarities and differences in matches and gaps of various green categories in the relationships.

Findings and Originality: Contrary to previous research, this paper sheds light on how green factors can be taken into account in specific relationships between logistics service providers and shippers. Matches and gaps between green offerings and green demands are identified and explained by relationship characteristics that appear in these specific company interactions. Four propositions are developed and it is suggested that the closeness of a business relationship has an impact on the inclusion of green factors in that relationship.

Research Impact: This research provides a first indication that relational factors are of importance for the success of “green relationships”. It would be fruitful to extend the research to cover a longer period of time to understand how the inclusion of green factors in logistics market relationship changes over time. Moreover, given that the case studies provide a description of relationships on a national logistics market, it would be beneficial to study other countries’ logistics market as well.

Practical Impact: The findings of this paper apply to both logistics service providers and shippers who have an ambition to green their logistics operations. Both actors can benefit from knowledge about which relationship dimensions that may be of importance in order to succeed with the greening of logistics service provider-shipper relationships.

Keywords: Logistics market, green logistics, collaboration
ANALYSIS OF THE BUNDLING EFFECTS OF RESOURCE-BASED LOGISTICS: A SURVEY OF MALAYSIAN LOGISTICS SERVICE PROVIDERS

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Purpose: The increasing trend of logistics outsourcing has forced logistics service providers (LSPs) to more effectively leverage their resources for the sustainable competitive advantage. The current logistics literature has identified some strategic logistics resources or resource-based logistics (RBLs) and their performance impacts but there is a lack of knowledge on the combined effects of such resources. Building on existing logistics literature and resource-based view (RBV) theory this paper develops and tests a model of RBL bundling that enhance LSPs’ customer service innovation (CSI) and cost leadership (CL).

Research Approach: Based on a survey data of 123 Malaysian LSPs we performed an exploratory factor analysis (EFA) to identify logistics resource (RBLs) variables developed from existing literature and an interview. Further multiple regressions (simple then stepwise regressions) are performed to examine the bundling (and mediating) effects of RBLs on CSI and CL.

Findings and Originality: The results of factors analysis and reliability confirm the measurement items for RBL components made up of tangible resources include physical and technology and intangible resources include organization, relational and managerial expertise resources; and for logistics performance, customer service innovation (CSI) and cost leadership (CL). Furthermore stepwise analyses regressions suggest CSI was enhanced when organizational (OR) and technology (TH) resources were bundled together; these two resources mediated the relationship between physical, relational and management expertise and CSI. Similarly, the analyses suggest that CL was enhanced when organizational (OR) and management expertise (ME) resources were bundled together; these two resources mediated the relationship between technology, physical, and relational resources and CL.

Research Impact: This paper develops constructs and measures of RBLs. It provides empirical evidence for the impacts of five logistics resources (RBLs), consistent with resource-based view (RBV) expectation. More importantly, it clarifies how RBLs are bundled together to enhance CSI and CL. It proves that bundling of resources and capabilities are important for the creation of value for LSP and the determination of logistics performance. Particularly, the paper proves that OR and TH resource can be bundled together to enhance CSI whilst OR and ME resource can be bundled together to improve CL. These bundles of resources are costly to imitate and likely to provide sustainable competitive advantage for LSPs. The paper concludes that organizational, technology and management expertise resources play a significant role in mediating the effect of other RBLs on logistics performance.

Practical Impact: This research highlights the emerging significance of the resource-based logistics in enhancing LSP performance. The findings carry significant practical implications for managers: LSPs should focus on developing the priority and important of RBL. LSPs should acquire physical and relational resources to support their technology, management expertise and organizational resources to enhance LSPs competitive advantage and superior performance. Organizational resources are the most critical resources for LSPs to generate competitive advantage because they are difficult to imitate by other players. Logistics managers should bundle organizational resources with technology resources to enhance their customer service innovation while organizational resources shall be bundled with management expertise resources to enhance their cost leadership. In addition for improving customer service innovation LSPs should acquire high physical, relational and management expertise resources for developing their organizational and technology resources and for cost leadership, LSPs should acquire high technology, physical and relational resources for developing their organizational and management expertise resources and capabilities.

Keywords: Resource-based view, Third-party logistics, Logistics service providers, Performance.
IDENTIFYING LOGISTICS CHANNELS TO MARKET FOR IRISH SME FOOD EXPORTERS

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Purpose: The indigenous food production sector plays an important role in Ireland’s economy. The export earning potential of the sector has come under renewed focus recently given the country’s current economic difficulties. Many SME food producers in Ireland however lack logistics capability and knowledge. This paper reports on a multifaceted work programme which sought to equip such food producers with the knowledge necessary to identify and define logistics channels to export market for their products.

Research approach: The project comprised a number of distinct stages, each of which is described in the paper:

1. consultation with Irish food producers;
2. analysis of data on transport costs to market;
3. identification of appropriate logistics service providers (LSPs) both in Ireland and in destination markets, and identification of logistics platforms in the latter;
4. identification of sales and marketing distributors (SMDs) in destination markets who could partner with Irish food exporters.

Findings and Originality: The research effort was the first, concerted effort to identify and define logistics channels to market for Irish SME food exporters. New data and listings of various service providers (including both LSPs and SMDs) were generated in the research. Costs of logistics services were obtained and compared. Logistics platforms for key European retailers were also generated, and a logistics requirements checklist was developed to aid exporters. From a practical perspective the study raises the issue of whether Irish food exporters can collaborate in order to compete (the so-called practice of ‘co-opetition’). For example can exporters self organise to leverage LSPs, and if so who will take the lead among these LSPs?

Research and Practical Impact: The research is of obvious benefit to current and potential Irish SME food exporters, and those who partner them in their endeavours. The approach to identifying both LSPs and SMDs is also of particular interest to researchers and others interested in this topic. The research also contributes to the (currently quite sparse) literature dealing with how export food SMEs define and manage logistics channels to market.

Keywords: logistics channel, logistics service providers, food, SME, Ireland.
MANAGING DISTURBANCES IN SUPPLY CHAINS OF PERISHABLE FOOD PRODUCTS – EMPIRICAL FINDINGS

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Purpose: Supply chain robustness refers to the ability of companies to successfully manage disturbances along their supply chains (SC), (Tang, 2006). These companies are able to detect relevant disturbances, have information on underlying causes and know how to respond. Limited research has been done on SC robustness that considers specific SC design characteristics and the business environment. Due to specific characteristics related to product and companies (van der Vorst et al., 2005), food SCs are increasingly vulnerable to disturbances in sourcing, especially international chains (cf. Wagner and Bode, 2006; Deep and Dani, 2011). To expand the field of literature we present an empirical research that focuses on the following research questions:

1. what are the relevant disturbances of (SC) in sourcing perishable food products (PFP) from international and domestic suppliers?
2. what are the main redesign strategies that are used in these chains in order to manage disturbances?
3. are SC of PFP with international suppliers more vulnerable to disturbances in sourcing than chains with domestic suppliers, and, if so, why?

Research Approach: To investigate these questions we used a case study approach. We used the case study protocol, consisting of questions related to company, disturbances, vulnerability sources and redesign strategies. As measures of disturbances and vulnerability sources, we used: frequency, impact to performance and easiness of detection. These elements were assessed in a qualitative way. The scale is used to estimate Risk Priority Number (RPN) for occurrence of disturbances and vulnerability sources. We used triangulation of data collection methods: semi-structured interviews with SC managers in the food industry in Serbia, personal observations in companies and available records. Following the recommendation of Eisenhardt (1989), we used theoretical sampling to select three cases. As representative cases, we selected RSCs that belong to two leading companies. The sample cases include varied sourcing types and their characteristics to increase external validity. To reduce extraneous variation that may come from company differences, two polar cases from the same company (Case 1 and Case 2) were selected. A third case replicates the second case.

Findings and Originality: Our results show that: 1) Disturbances of SCs in sourcing of PFPs from international and domestic suppliers differ according to their impact on vulnerability level. Vulnerability level depends on characteristics of the SC, e.g. product characteristics, SC structure, lead time, strictness of requirements for suppliers, availability of information, organisation and contextual factors. Moreover, for a given RSC setting, SCs in all three cases showed to be more vulnerable to procurement than inventory related disturbances. 2) Selection of redesign strategies depends on characteristics of disturbances and particular vulnerability sources. Analysis results indicate dominant use of reductive principles in case 1, corresponding to many partially controllable vulnerability sources. Analysis of case 2 and 3 shows use of both preventive and reductive principles, indicating a higher level of control in the sourcing process. 3) SCs of PFPs with international suppliers are more vulnerable than chains with domestic suppliers, because purchasing and sourcing processes involving international suppliers result in higher uncertainty regarding delivery time, quantity and quality. However, low RPN values and vulnerability levels indicate robustness of the chains, i.e. adequate redesign strategies have been adopted to manage disturbances.

Research and Practical Impact: This paper contributes to SC management literature by using empirical research to identify robustness and vulnerability levels of SCs of PFPs in a specific SC setting and business environment, as well as identifying dominant disturbances, underlying causes and successful redesign principles and strategies to manage disturbances in sourcing.

Keywords: Supply Chain Robustness, Process Failure Mode and Effects Analysis (PFMEA), Comparative case studies
MULTIMODAL TRANSPORTATION PLANNING IN FOOD SERVICE INDUSTRY
WITH CARBON CONTROL POLICY

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Purpose: Multimodal transportation planning is an important topic of research and practice because it plays an important role in improving logistics service efficiency and reducing impact on the environment. Multimodal or intermodal transport uses a combination of transportation modes in a single transport chain. The chain is operated without a change of container for the goods, and also considering minimised road transport at the beginning and end parts of the chain. As transportation industry is a main contributor of greenhouse gases that gives direct impact to the environment, this study will focus on optimisation of multimodal transportation planning routes and strategies for food service industry with forward-looking impacts of various carbon emissions control policies in and beyond the UK on the logistics services. Liverpool Produce Terminal (LPT) is used as a case study.

Research Approach: An optimisation modelling is used for analysis purposes of food service network in the UK and Europe. A mixed integer programming is formulated in order to get the optimal solutions of quantity, destinations and environmental impacts. Data is collected from case study.

Findings and Originality: The research has been using Liverpool Port as a case to investigate logistics networks for the UK food markets. Felixstowe Port which is the biggest container port in the UK is normally used as a main distribution point. However, considering the location of Liverpool Port in the middle of the UK Island, redesign of the logistics network within and beyond the UK would improve the efficiency and reduce the carbon emissions. In terms of operational cost, current finding shows that re-allocation of importing fruits between the main transport chains (Cape Town to Liverpool through Rotterdam and Cape Town to Felixstowe) would save significantly. With consideration of carbon emissions cost, reallocation of the food between the main transport chains is also expected to be more effective. To design sustainable logistics and supply chain networks, business activities should be evaluated from both economic and environmental perspectives. Therefore, a consideration of carbon emissions policies has been given in this research as a driving factor for multimodal transportation planning. The simulation of the logistics network operations through the optimised multimodal transport planning has showed some initial promising outcome.

Research Impact: This research will investigate the impact of the carbon emission policies on operations of food service industry and propose optimisation model for food service industry in the UK. An optimal network design approach for food service industry under carbon emissions control is proposed. The research outcome has a good generic contribution to multimodal transportation planning with constraints of the environment policies and perishable food quality requirements. The research will also significantly contribute to government policy making in carbon emissions control.

Practical Impact: To minimize the carbon emission while maintaining the operations efficiency of the logistics operations, is a great challenge. To control carbon emission, policies have been set up at different levels from global agreement, nation-wide policies to local councils’ regulations. It is expected that different policies and trade prices will have different impact on business decisions in the logistics networks. The research develops optimal multimodal transportation solutions for logistics service providers. The developed transport chain routing integrate operations planning and carbon emissions control constraints to provide forward-looking view for practitioners in the impact of different government policies on their options of operating perishable food logistics chains.

Keywords: Multimodal transportation planning, carbon emission control policy, optimisation.
A COMPARISON OF FACTORS INFLUENCING PORT PERFORMANCE BETWEEN THE HUMBER ESTUARY AND XIAMEN PORTS

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Purpose: As a consequence of globalisation, port performance has become increasingly important for international trade. Different port regions perform differently. The aim of this research is to identify factors that determine port performance in a comparative study between two case ports in the UK and China. Specifically, this research aims to examine differences between these two ports; to identify the key factors that drive port performance; to investigate the differences in importance and performance among the factors; to analyse how the importance and performance of factors varies for different ports; and to illustrate the usefulness of key findings for port managers.

Research Approach: The construct of importance factors is based on the literature. The research methodology was that of mixed methods to collect both qualitative and quantitative data in two port regions (China and UK) and was carried out in two phases. Phase one comprised semi-structured in-depth interviews. Phase two consisted of questionnaire-based surveys to validate the factors influencing port performance. The questionnaire surveys were distributed to port experts from 500 organisations and had a 50.8% response rate. Methods for analysis of the data from the questionnaires included descriptive mean comparison, and importance-performance analysis (IPA). IPA was used as the main technique to identify key factors in two different port regions.

Findings and Originality: The findings of this research suggest that ports wishing to outperform competitors can do so by improving the factors that are of high importance but currently perform poorly. Each region has its own important factors by analysing mean, urgent factors against their port performance, different salient factors against their bench markers' performance, and different basic factors against their implicit importance measurement. Shipping services and cost have a critical effect on port performance.

This research is a first cross-culture empirical study to compare factors influencing two port performances in UK and China. It is an empirical research to apply importance-performance analysis (IPA) in the port sector to improve service quality.

Practical Impact: The results provide some implications for port managers in formulating effective strategies to improve their port performance. The outcomes are expected to aid port managers that have direct or indirect power over port performance to focus attention on improving relevant factors in order to compete more effectively.

Keywords: comparison, port performance factor
CONTAINER PORT EMISSIONS: WHAT IS INCLUDED AND JUST HOW BIG ARE THEY?

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Purpose: Much has been written in recent years regarding the emissions from international shipping. The port sector acts as the commercial interface between the host nation and the rest of the world for goods imported and exported, and as such it occupies a unique and important position in the supply chain. When considered in the context of total supply chain CO₂ emissions, the ports’ contribution appears to be small, but almost invariably the emissions from ships at berth are not considered as part of a port’s emissions inventory, even though they occur in the port environment. It would appear that the scale of at berthing emissions is considerable in the context of the port. An initial estimate based on a recent study by Hulskotte and Denier van der Gon (2010) and using the Port of Rotterdam’s quoted emissions of 17.5kg CO₂ per TEU handled suggests that if berthing emissions are included as part of the port’s inventory, the actual CO₂ emissions figure for container operations could be more than 50% higher than currently reported. Although emitted in the port, these emissions do not appear in the port’s emissions inventory. The question arises as to whether they should be part of the port’s inventory. In the longer term, if shore-side power (cold-ironing) becomes widely available for berthing vessels, the question of ownership of these emissions will most certainly arise. The paper sets out an agenda for future research to estimate both the overall scale of port emissions and their variance for the UK’s ports.

Research Approach: This piece of research forms part of the EPSRC funded project EP/H020179/1, ‘Decarbonising the Maritime Supply Chain: Assessing the Contribution of Shippers’. The project seeks to determine the influence that the shipper has on carbon emissions through the logistical decisions he makes. Part of this work requires the establishment of a baseline, which includes port activity. Contact has been made with the key personnel in all of the UK’s major port operators. A semi-structured interview approach is being employed to scope and scale of port emissions. A mixture of primary and secondary data will be collected from the port operators and used to estimate emissions associated with port activity and those arising from vessels at berth. The results of this analysis will help both port operators and the shipping industry as whole to understand the scale of port-side emissions and set strategic priorities for their allocation.

Findings and Originality: There has been very little material published on emissions from ships at berth in the UK. This paper will present a view of port and berthing emissions for all of the UK’s major ports. The outcomes from the full study will be available in June 2011 and reported in the full conference paper.

Research Impact: The study includes all of the UK’s major container port operators. It presents an excellent opportunity to assess the scale of carbon emissions generated by a key industry in global supply chains. It also raises the issue of ownership of CO₂ emissions from berthing vessels, which are currently not subject to any emissions targets.

Practical Impact: The study will provide benefits at three levels:

- Emissions: It will provide estimates of emissions occurring within the port environment that includes those arising from vessels at berth.
- Allocation: It will raise the issue of ownership and allocation of port-side emissions, which will undoubtedly grow in importance as and when international shipping becomes subject to CO₂ emissions targets.
- Collaboration: It will help to establish an opportunity for port and ship operators to collaborate in order to increase efficiency and cut carbon emissions.

Keywords: Sustainability, CO₂, emissions, port, container, allocation, berth, UK
THE CHALLENGE AND ADOPTION OF GREEN INITIATIVES FOR TRANSPORT AND LOGISTICS SERVICE PROVIDERS

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Purpose: The role of logistics service providers (LSPs) has started to change both when it comes to content and complexity and LSPs have been identified to have potential to become more value-adding actors in supply chains. This applies when LSPs begin to transform their operations and strategy to become more effective from a green perspective. In response, the purpose of this paper is to develop a base for further investigations of green initiatives carried out by LSPs and analyse if the green initiatives implemented are dependent on firm characteristics of the LSPs, as well as drivers and barriers experienced.

Research Approach: A questionnaire survey has been launched and it is still ongoing. The survey investigates a sample of LSPs operating on the Swedish and the Italian market. The questionnaire is derived from the researchers' earlier research projects based on case studies and literature reviews. Data and information collected through the questionnaire allow identifying current and future green initiatives, influencing factors (drivers and barriers) and firm characteristics. The analysis suggests how these dimensions depend on each other.

Findings and Originality: The survey is still ongoing and the paper will present the first results of the research. The first results discern different green initiatives and the type of drivers and barriers affecting these companies. Prior research has focused on the perspective of the buyer of green logistics services and little attention has been paid to the role of green initiatives in the strategy of LSPs, their impact on customer relationship and performance, the role of ICT as well as drivers and barriers affecting such initiatives.

Research Impact: The expected contribution of this paper is to illustrate and give a deeper knowledge of how LSPs respond to changing market conditions when it comes to green pressures from society. This study may provide a broad base for further research on LSPs' continued strategy development and adaption to future green requirements both from customers and government.

Practical Impact: The paper will describe the way LSPs have started to adopt and manage green initiatives into their operations. Furthermore, the study will also provide a deeper understanding among practitioners of how logistics green services can be approached and also what drives and inhibits that process.

Keywords: logistics service providers, green initiatives, questionnaire survey
(Session B4)

CHALLENGES FACING THE DISTRIBUTION OF PETROLEUM PRODUCTS IN NIGERIA

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Purpose: The distribution of petroleum products by road freight has grown to become one of the most important sectors in the Nigerian economy, following the breakdown of the pipeline network. The road infrastructure is ill-equipped to handle this traffic, with issues such as inadequate maintenance and misuse due to vehicle overloading. Further, many imports come through Lagos, where there is severe congestion due to the city having the highest concentration of traffic in Nigeria. Thus, the aim of this study is to investigate, identify and highlight the uncertainty in the distribution activities in Lagos due to non-value added time spent on the road or at the unloading depots. As well as quantifying the extra time, it also brings to fore the cost implications of uncertainty in the supply chain.

Research Approach: A case study method was used to investigate cost and environmental implication of uncertainty in the freight transport operation of a company in the Nigerian downstream oil sector. In particular, there is a focus on traffic flows for kerosene between the port in Apapa and Lagos airport. In total, 311 trips over a 3 month period were analysed, based on data collected from the waybills that accompanied each trip. This recorded the time of departure from the port, the arrival time at the unloading point and the departure time from the unloading point. This data was cross-checked against logs kept at the departure and arrival points. The data was manually entered into an Excel spreadsheet, before being compared against the expected times for the journey and unloading. From this, it is possible to calculate the additional, non-value adding time throughout the whole journey. The data is complemented by interviews and observations from the traffic office, to aid the analysis process.

Findings and Originality: This study clearly showed the main causes of uncertainty in this supply chain as being due to: delays at customer facility while waiting to discharge, exogenous events such as congestion, and control systems because there is no visibility in the entire supply. Thus this research has shown how ‘extra time’ in transportation and unloading leads to uncertainty in the supply chain. However, the research also indicates that the root cause of many of the issues is the comatose pipeline network. The cost of uncertainty is calculated at over $1,000/month. The originality lies in examining the challenges facing logistics operators in a crowded, developing world metropolis, and extended further the examination of uncertainty in freight transport operations.

Research Impact: The research findings will give further insights to researchers on the challenges facing logistics operators in the developing world, an emerging area for logistics research. There will also be relevance to those researching the petroleum products supply chain. The method adopted is easily transferable to other environments, to enable wider comparisons and the transfer of best practice.

Practical Impact: The implication for managers is that there is a need to identify the causes of uncertainty in supply chains and look for ways to eliminate or reduce them. For instance, rather than build redundancies into the system to accommodate the uncertainties, the case company could adopt competitive best practices observed elsewhere in the supply chain. An implication of this study for policy makers is the need to constantly maintain and not neglect critical facilities in a supply chain. With functional pipelines, trucks would only be needed for “last mile” transportation of petroleum products. In the absence of the pipelines, a more direct approach to solving the problem of congestion and hence reducing or eliminating uncertainty could be to improve the road network in Lagos or restrict truck movements to certain times.

Keywords: Uncertainty, oil, congestion, pipeline
ANALYSIS OF MEAN BIN WEIGHT DATA TO MONITOR BEST PRACTICE AT HOUSEHOLD WASTE RECYCLING CENTRES

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Purpose: This paper describes a modelling approach used to investigate the significance of key factors (vehicle type, compaction type, site design, temporal effects) in influencing the variability in observed nett amenity bin weights produced by Household Waste Recycling Centres (HWRC). Understanding such variability is a prerequisite to achieving best operational practices, to minimise the number of vehicle movements between each HWRC and disposal sites, and achieve consequential environmental and traffic benefits. The method described can help to quickly identify sites that are producing significantly lighter bins, enabling detailed back-end analyses to be efficiently targeted and best practice in HWRC operation identified.

Research Approach: Using weigh ticket data for vehicles servicing HWRCs across West Sussex, UK, this research set out to:

1. Develop an analytical framework to explore the variability in amenity waste bin weights between different HWRCs.
2. Identify the potential causes of the remaining variability found between similar sites using a range of visitor surveys and waste audits.

A model was developed to identify and quantify the relative impacts of key factors which influence the variability in observed nett bin weights across a sample of HWRCs. The model was used to calculate predicted nett weights for each amenity waste bin across nine HWRCs in West Sussex along with the deviations between actual and predicted nett weights. Significant sources of remaining variability were then investigated through detailed visitor surveys and waste audits at three HWRC sites. Identifying such traits could help a Local Authority better understand the impacts of HWRC design and operation on recyclate recovery, identify best practices and thereby reduce the amount of potential recyclate (recycled material to be used to form new products) going into the amenity stream.

Findings and Originality: Tested on weigh ticket data obtained from nine HWRCs across West Sussex, the model suggested that compaction technique, vehicle type, month and site design explained 76% of the variability in the observed nett amenity weights. For each factor, a weighting coefficient was calculated to generate a predicted nett weight for each bin transaction and Bognor Regis, Crawley and East Grinstead were identified as having similar characteristics but returning significantly different mean nett bin weights. Waste and site audits were then conducted at the three sites to try and determine the possible sources of the remaining variability. Significant differences were identified in the proportions of contained waste (bagged), wood, and dry recyclables entering the amenity waste stream with significantly less contained waste and dry recyclables observed in the amenity waste bins at Bognor Regis.

Research and Practical Impact: The development of a model for investigating the significance of key factors influencing the variability in observed net bin weights produced by HWRCs has made several advances:

- HWRCs with similar characteristics but producing significantly different mean bin weights of the same material type can be easily identified, enabling resource intensive back-end analyses to be effectively targeted.
- Additional value can be gained from the weigh ticket data to improve the HWRC monitoring and management process and identify examples of best practice between sites. This has lead to more effective and efficient material recovery, directly influencing recycling targets across West Sussex.

Keywords: Waste logistics, HWRC’s, Bin weight analyses
QUANTIFYING THE EFFECT OF ORDER-SIZE MISMATCH ON DELIVERY TIME: A CASE OF INTERNET RETAILERS

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Purpose: Merge-in-transit (MiT) is defined as a distribution process that brings together at a consolidation centre multi-product order components, coming from different origins, consolidates them into a single order, and then ships it for final delivery to the end customers.

This paper addresses the issue on how is the delivery time to customers affected by the number of items in the multi-item order.

Research Approach: A conceptual model representing the typical operation of an Internet Retailer delivering multi-item orders was developed for experimentation. The model was translated into a Discrete Event Simulation (DES) model for the quantitative analysis of lead times.

Findings and Originality: Results for the three scenarios of demand being higher than expected, as expected and lower than expected show that the average time in system for the case of orders with demand higher than expected is almost double. This means that delays registered when demand is higher than expected are hundred percent longer on average than for the other types of demand.

Research Impact: MiT has been researched by Kopczac (1995) in qualitative research to give examples of successful partnership between manufacturers and logistics service providers. Cole and Parthasarathy (1998) looked at MiT to integrate a prototype of network optimization algorithm. Croxton et al. (2003) developed mathematical formulations and solution methods to find optimal solutions to deterministic scenarios of MiT. Ala-Risku et al. (2003) developed an applicability roadmap to help managers to decide whether MiT can be suitable. Karkkainen et al. (2003) explore the effects of MiT distribution on delivery costs. In summary MiT has not yet been researched concerning the stochastic behavior of the system. Order size is one of the stochastic phenomena in MiT that we address in this paper.

Practical Impact: Internet retailers like Amazon, Dell, Charles Tyrwhitt among others have a business model that is based on strict control of the product delivery time for customer satisfaction. Results can be of interest to internet retailers that wish to estimate the delivery time offering to customers. Internet retailing initially was almost exclusive for standard products like books, however it has evolved to include configurable products like computers or personalized items like shirts. Consumption patterns change in society and some of them offer an opportunity to internet retailing and its corresponding product delivery.

Keywords: Internet Retailers, Delivery Time Analysis, Simulation.
THE ROLE OF DRY PORTS FOR VIABILITY OF SHORT HAUL RAIL IN AUSTRALIA

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Purpose: A close dry port - intermodal terminal with direct rail connection to a seaport - is a potential solution for seaport terminal congestion as well as for better seaport inland access based on short haul rail. The purpose of this paper is to investigate the viability of rail on short distances through use/implementation of close dry ports.

Research Approach: Data for the case studies on Sydney and Melbourne ports and their existing and potential close intermodal facilities where collected through phone and face-to-face interviews, likewise literature review have been carried out in order to accomplish the purpose. In addition, a number of secondary sources were used such as reports and internal documents.

Findings and Originality: Rail on short haul is heavily argued between academics; the idea behind this study is to contribute to better understanding of viability of rail/intermodal transport on short distances and the role dry ports play in that. The cases of ports of Sydney and Melbourne, with its close intermodal terminals, show viability of rail on shorter distances and as such offers a new area for research. However, the findings show that clear policy direction needs to be established in order to develop and implement an intermodal terminal strategy.

Practical Impact: The paper highlights the potential of rail on short distances that might be obtained through use/implementation of dry ports in seaports immediate hinterland.

Research Impact: Data for the case studies are collected at ports of Sydney and Melbourne, and its close intermodal terminals. A more comprehensive view of the problem could be obtained through additional case studies on other countries seaports and their intermodal terminals.

Keywords: Intermodal terminal, Dry port, Short haul rail, Australia
IMPROVING THE UNDERSTANDING OF RAIL FREIGHT ACTIVITY AND PERFORMANCE: INNOVATIONS IN RESEARCH METHODS

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Purpose: For a variety of reasons, for example relating to environmental impact, cost-effectiveness and corporate social responsibility, logistics professionals and policy makers have been demonstrating an increasing interest in modal shift from road haulage to rail freight. A good understanding of the current situation is essential when trying to establish the best ways in which to increase rail’s role. While providing a sound overview of the rail freight market, official statistics are of limited use when attempting to identify rail freight activity and performance at a disaggregated level. Particularly in this time of austerity, however, the possibilities of incremental improvements that may lead to a greater rail mode share are important to identify and implement, but the data shortcomings hamper this process. Further, given the likelihood of more limited research funding in the foreseeable future, it is important to consider low-cost ways in which the understanding of the rail freight market can be enhanced in a cost-effective manner.

Research Approach: This paper presents an assessment of the usefulness of research methodologies that have been applied in recent rail freight research at the University of Westminster, together with the identification of additional methods and data sources that may offer scope to better understand the rail freight market and the potential for incremental improvements in activity levels and performance. The benefits of certain of these methods, such as those based on observational surveys, in overcoming the difficulties in gaining access to sensitive commercial information are also discussed.

Findings and Originality: The understanding of rail freight activity at a disaggregated level is not particularly strong. The discussion and analysis in this paper provides an original assessment covering, in some cases, generic rail freight issues and, in other examples, more specific examples (e.g. relating to the increasingly important intermodal sector, for which there is currently relatively little official information).

Research Impact: The discussion highlights ways in which relatively low-cost methods can be adopted to gain a better understanding of the nature of rail freight activity. The consideration of these alternative sources of data, particularly in developing a better understanding of more specific issues than is typically the case with aggregate level freight modal split modelling furthers the research agenda in relation to the role for rail freight in economic development and sustainable logistics.

Practical Impact: The findings of this investigation have considerable practical impact, focusing on better understanding and categorising existing rail activity and related performance issues. Given the long timescales and considerable funding typically required to increase rail network capacity to be able to run more trains, the more detailed identification of potential incremental performance improvements may be significant in practical terms.

Keywords: Rail Freight; Modal Shift; Freight Transport Efficiency; Freight Survey Methods
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<td>Nieuwenhuis. Capital investment decoupling points in agile manufacturing; An automotive case study</td>
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<td>Schneider, Reise. Slow steaming – Technical and economical aspects</td>
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<td>Björklund et al. Greening city logistics, the challenge of measuring and presenting environmental gains</td>
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<td>Miragliotta et al. Does RFID fit the apparel industry? The case of a prominent Italian company</td>
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<td>Chang et al. Information and physical risk management in container shipping supply chain</td>
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CAPITAL INVESTMENT DECOUPLING POINTS IN LEAGILE MANUFACTURING; AN AUTOMOTIVE CASE STUDY

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**Purpose**: To explore the need for an additional decoupling point within the leagile paradigm, particularly within certain high capital investment value chains, such as the automotive sector.

**Research Approach**: A detailed review of the existing leagile literature is used to explore the scope of the existing two decoupling points. In the leagile literature, two types of ‘decoupling point’ are identified, the ‘material’ and the ‘information’ decoupling point. This is followed by a brief analysis of key elements of the automotive value chain, particularly its ‘lumpy’ investments, whereby there is a mixture high and low capital investment phases. This is followed by an illustrative case study of the French microcar industry.

**Findings and Originality**: This study relates leagility to the automotive value chain, where another decoupling point may also play a role: the ‘capital investment (CI) decoupling point’. The automotive sector is characterised by two very high capital investment processes, namely internal combustion engine production and all-steel body production. These are best served through a lean approach, yet particularly for the latter, its lack of agility (despite Toyota’s best efforts) is a problem. This is linked with a case study of the French micro-car sector, where by a mixture of strategies involving on the one hand the avoidance of certain high capital investment technologies and on the other the moving of the CI decoupling point further up the value chain, beyond the boundaries of the firm, minimum economies of scale in engine and body are reduced or avoided, making this sub-sector viable at a scale far below conventional mass car producers.

**Research Impact**: This work enhances the existing leagile literature by extending the concept of decoupling points with an additional parameter, one that is particularly pertinent to certain value chains, where there is a mixture of on the one hand high capital and low labour phases, and on the other low capital and high labour phases. With one being more amenable to lean approaches and the other more to agile approaches.

**Practical Impact**: the work enhances the understanding of leagile value chains, particularly in the automotive sector, but it has equal value in other, similar value chains.

**Keywords**: Leagile, automotive industry, micro factory retailing
THE UNKNOWN UNKNOWNs OF SUPPLY CHAIN DISRUPTIONS: FROM CORE TRIGGERS AND CONTRIBUTORY FACTORS TOWARDS GENERATIVE MECHANISMS

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Purpose: The aim of this paper is to conceptualise factors that help managers to address the so-called ‘unknown unknowns’ of supply chain disruptions.

Extensive globalisation of sourcing strategies and distribution networks has contributed to improvement in operational efficiency and competitive position. Experience shows, however, that improved performance has not materialised without increased complexity of the managerial task.

Coordination (planning and control) of supply and demand – the management of known unknowns – must today be complemented with greater understanding of how disruptive events – the unknown unknowns – can be seen as an integrated feature of managing global supply chains. This paper raises two fundamental concerns about this scenario that have lead to the abovementioned research objectives.

First, use of controllable performance objectives as decision criteria does intuitively let managers believe that the subsequent execution can be managed. The rationale behind decisions that re-define current design of operations processes and supply network structures refers commonly to a set of decision criteria over which the focal company has direct control, such as cost, time and flexibility. However, when companies move from strategies to execution they discover distances in terms of e.g. geography and culture makes these performance objectives less controllable. As experience with these strategies accumulates, it has been observed that disruptive events at one level in the supply chain have had significant impact on other up-stream suppliers or down-stream customers.

Second, theoretical frameworks have been developed to inform decision making in an industrial context that has been shaped by excitement of a steady growth on large number of consumer markets, where the many concern about non-controllable that have influence on company’s performance have been reduced down to the power positioning relative to competitors, customers and suppliers. Abundance of natural resources and the relationship with the natural environment have hardly been problematized. Recently, however, both research and practice have raised serious concerns about the ability of supply chain solutions to absorb the potential negative consequence of disruptive events. Although these events are non-controllable, it is important for managers to understand the nature of these.

Research Approach: Categories of contributory factors are developed and explained with reference to actual events, and broken further down into generative mechanisms. The causal explanation provided suggests that generative mechanisms do shape the discrete event (disruption) that leads to the impact (loss) observed by e.g. managers and news media. A number of actual disruptive events that can be associated with ‘supply chains’ are analysed through a heuristic, interpretive approach.

Findings and Originality: As results, a set of four potential generative mechanisms is proposed: 1. Emerging vs. immediate disruptions, i.e. unknowns explained in terms of passing of time. 2. Elements of a causal power that reside in supply chain strategies. 3. Network effects, and 4. Inter-relationships of contributory factors (or ‘competing risks’). Implications for further research and practice are proposed.

Research Impact: Researchers must develop a critical mindset towards the robustness of the theoretical principles that are informing practice. Based on the empirical findings, current body of knowledge within supply chain management should revisit the design principles that are currently regarded as robust.

Practical Impact: A better understanding of events that have major business impact, but remain outside the attention of managerial mindsets and theoretical approaches. This allows managers to assess the robustness of their strategies during developmental phases, and avoid expensive trial-and-error experience during the actual execution.

Keywords: Supply chain risk; disruptions; contributory factors; causal power
Purpose: Slow steaming is a new method for shipowner to reduce their operating costs since the global economic crisis in 2008. They operate their vessels more slowly so that they can save fuel. Nowadays world’s economy recovers very quickly. Most vessels are operating now and are not going on roadstead anymore. The question is, if the market is growing more and more and fuel price rise does it make sense to operate the vessels in slow steaming mode furthermore.

Research Approach: Beside economic aspects this paper also observes technical impacts. The data is based on series of experiments in the MSCW (“Maritime Simulation Centre Warnemünde”) where different speed modes were analyzed. The analysis was influenced by interviews with different companies, e.g. the GL (“Germanischer Lloyd”), ISL (“Institute for shipping economy and logistics”), Wärtsila, MAN, etc. The paper work was also influenced by present literature.

Findings and Originality: While driving in slow steaming mode there is a great efficiency to save fuel in comparison with the speed reduction. It is possible to save 75% of fuel while reducing the speed only by 25%. At first this seems to be a good opportunity, but what is with technical impacts and results? Most main engines were not built to use them on such an efficiency factor. Engine and machine parts are not working properly anymore. The temperature of the exhaust gases is too low so that there are negative consequences. Beside the economic aspects these ones are also important. There are no longtime studies regarding vessels which operate in slow steaming mode and what parts of the machinery are affected.

Research Impact: This paper demonstrates the economic and technical consequences of slow steaming. Different types of fuel and cost saving models are observed in this study and also technical impacts. There is mentioned what parts of the machinery are affected and why they are affected. Furthermore there are different ways to avoid some negative aspects. Basically slow steaming makes sense in case of rising oil prices if there is enough slot capacity and vessels to keep on time with the schedule.

Practical Impact: This research shows that not only the key figures are important regarding money saving. Most main engines were not constructed for slow steaming modes and negative effects occur if these engines are running in slow steaming mode for a long time. Parts of the machinery will be damaged and their durability decreases unavoidable.

Keywords: Slow steaming, Efficiency factor, Main engine, Fuel / Cost saving, Economic / Technical aspects, Durability, Economic crisis, Oil price
LOW CARBON SHIPPING: DRYBULK MOVEMENTS AND THE UK

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Purpose: Increasing global concern regarding carbon emissions from international shipping is focused on the most polluting ships. This paper queries the extent to which dry bulk movements, in the second most polluting ship-type, impact the UK currently and are likely to do so to 2030. This work is a shipping economics input to Work Package 4 (WP4) of the UK Engineering and Physical Sciences Research Council funded Low Carbon Shipping: A systems approach project. This project is developing the first holistic model of shipping which will in turn guide the development of technologies and operational strategies for the reduction of shipping’s CO\textsubscript{2} emissions, engaging major industrial partners and UK universities at University College London, Newcastle, Plymouth, Hull and Strathclyde.

Research Approach: WP4 is researching the economics of ship production and operation, and the economics of shipping markets, which exhibit unique characteristics such as regular boom-bust cycles and their impact on future requirements and market structure. Secondary data sources to identify ship movements involving the UK include European Union and British government statistical sources and specialist studies. The volatility of market trends for bulk movements including coal is discussed.

Findings and Originality: The paper presents an overview of recent dry bulk movements involving the UK, drawing on sources including those of the Department for Transport and other databases. Issues of spatial unit and sampling processes are encountered. A review of forecasts to 2030 is presented, although movements involving coal, grain, iron ore and other bulk products are highly speculative given the volatility of these markets.

Research Impact: Analysis of the data presented offers insights into the extent of movements of the second most polluting types of ships involving the UK. Within the unique systems framework specified this data assists validation of the holistic model and thereby contributes to the process of optimising the specific combinations of technologies and operational strategies required to minimise shipping CO\textsubscript{2} emissions.

Practical Impact: Only when the extent of dry bulk movements affecting the UK is known is it possible to assess the likely operational impacts and effectiveness of any regulatory or fiscal instruments proposed to reduce carbon emissions arising from international shipping. Using this information, extant data detailing the elasticity of dry bulk freight rates in relation to bunker prices can be input to assess the impact of for example carbon trading or bunker fuel levies on sourcing and logistical systems.

Keywords: Low carbon shipping, dry bulk shipping, sustainable logistics, shipping economics, systems approach
GREENING CITY LOGISTICS, THE CHALLENGE OF MEASURING AND PRESENTING ENVIRONMENTAL GAINS

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Purpose: City logistics, defined as freight transport in urban areas, is associated with e.g. congestion, noise, and outlets. Many west European cities plan or have implemented actions in order to decrease these nuisances such as time-access regulations and vehicle restrictions. Several pilot studies have also been accomplished in order to investigate the environmental and economical potentials of changed city logistics structures. This paper aims at describing and analysing the potentials of decreasing the environmental impact from urban freight transport. The objective of this paper is threefold: (1) To identify and present different initiatives taken in order to green city logistics; (2) To elaborate on how the performance of city logistics initiatives are measured and described; (3) To identify important aspects to consider when measuring and documenting city logistics progress in order to e.g. facilitate increased knowledge and guidance from, and comparison between, initiatives. The role and relevance of different stakeholders is an important aspect considered throughout the paper.

Research Approach: This paper takes its point of departure in a literature review focusing the intersection between city logistics and environmental logistics. Secondary empirical data from Swedish city logistics projects are studied. Cross case analyses provides an understanding of different ways to describe and measure the environmental gains as well as the roles different actors have in the measuring.

Findings and Originality: This study provides insights to how cities can embrace the need to green their logistics. Despite large environmental potentials, city logistics is seldom studied in the green logistics area. In this paper we aim to bridge these two fields.

This study map out ways environmental gains is measured and presented in city logistics project, indicating the lack of standard way to describe the environmental gains made. A comparison of how the environmental impact is measured and communicated provides an important point of departure in the development of more standardise quantitative and qualitative analysis framework.

Research Impact: This paper contributes to literature by providing empirical evidence on the latest developments in greening city logistics. The motivation to and results of city logistics project is commonly described in environmental terms. However, these achievements are not as easy to communicate and measure as economical gains. The study identifies shortcomings in the measuring approaches used and provides a future research agenda.

Practical Impact: This paper should be of interest for different practitioners since city logistics are of relevance for number parties such as logistics service providers, logistics purchasing firms located in cities, shops and services, city authorities and founding bodies for city logistics project. Due to the lack of more standardised ways to describe, report, and measure actions taken, it is complicated to compare and benchmark different city logistics projects and to identify actions with largest potentials. Despite the exploratory nature of the paper, important aspects to consider in the design and use of environmental measurement framework are suggested.

Keywords: City logistics, Urban freight, Green logistics, Environmental measurement.
THE ROLE OF URBAN LOGISTICS IN CUSTOMER-DRIVEN AND COST-EFFICIENT SUPPLY CHAIN PLANNING

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Purpose: Urban logistics is the part of the companies supply chains and supply chain planning. The purpose of this paper is to describe the elements and trends of efficient and sustainable urban logistics. Urban freight traffic has grown and continues to grow rapidly and E-commerce has also facilitated the fast growth of the small package delivery business. Increasing numbers of trucks on the road are running below capacity or even empty. New operating models and assessment of environmental impacts and transport systems in urban logistics are therefore needed. The study discusses the development prospects of urban logistics and how to make urban logistics more efficient. The focus in this study is especially on customer-driven and cost-efficient supply chain planning and strategic level decision-making processes. Rapidly changing supply chain challenges and needs, such as just-in-time deliveries, are increasing. The challenge is to combine customer needs with cost-efficiency in the most sustainable way. The study discusses the development options in transport systems.

Research Approach: The article is based on a research project started in 2010 and continuing to 2012. The main research methods are a literature survey on urban logistics and logistics optimisation systems, and case studies. The study explores the possibilities to use different kinds of logistics optimisation systems in order to develop strategic logistics networks in urban areas. In the case studies the various urban logistics operating models in particular cities are examined. The case studies also include interviews with experts in order to find out the most important elements in supply chain planning related to urban logistics. In one specific case, Tampere Region in Finland with about 400,000 residents, the aim is to model distribution networks and describe the distribution channels examined. One approach in this study is to collaborate with a project for developing the idea of a Tampere city logistics centre.

Findings and Originality: The importance of urban logistics as a research area is increasing. The main finding is that urban logistics plays an important role in customer-driven and cost-efficient supply chain management. Strategic level decision-making processes are in a key position and logistics optimisation systems offer a supportive tool to plan sustainable urban logistics and supply chain networks.

Research Impact: This paper presents new approaches for combining elements in urban logistics, supply chain planning and logistics optimisation systems. The evaluation of future trends and models in urban logistics forms the framework for planning supply chains in a customer-oriented and cost-efficient way.

Practical Impact: The study presents methods for planning urban logistics through customer-oriented and cost-efficient supply chains. The study also presents practical information on the development needs and potential in urban logistics and supply chain planning.

Keywords: supply chain management, transport system, urban logistics
DOES RFID FIT THE APPAREL INDUSTRY? THE CASE OF A PROMINENT ITALIAN COMPANY

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Purpose: during the last years companies belonging to the apparel industry have paid increasing attention to RFID technology, attracted by the possibility of tracing single items as they move along the supply chain. High product value and technological barriers lower than in other industries (i.e. no liquid, limited metal) makes item level tagging an already feasible scenario. Therefore, RFID seems a really promising tool to address the new challenges related to increasing supply chain complexity and virtuality. This technology has the potential of enhancing supply chain performance not only through higher productivity, but also through increased information availability and accuracy. For all these reasons, numerous pilot projects have been launched (e.g. American Apparel, Serafini and Ferragamo just to name a few). However, although the adoption rate proved to be faster than in other industries, the absolute level of adoption is still lower than expected, with just a few widespread implementations. In this sense, a better comprehension of the real benefits enabled by the technology becomes a key factor in fostering the adoption path. With regard to the case of a major Italian apparel company, the paper explores the value of RFID in this supply chain.

Research Approach: the analysis is based on an in-depth case study carried out with the collaboration of a major Italian apparel company. About 15 face-to-face interviews have been done, and data triangulation has been assured by accessing company’s internal reports and documents. Technological tests have been performed in the RFID Solution Center of Politecnico di Milano and at the company’s facilities in order to verify the reliability of the suggested RFID solution, thus supporting the process re-design. The impact of RFID on operational performance indicators (e.g. shipping accuracy, lead time) has been assessed using an activity-based approach, whereas a more strategic analysis has been carried out to evaluate the impact of RFID on the whole supply chain, in terms of benefits (e.g. image, supply chain integration), and technology-enabled opportunities and constraints.

Findings and Originality: the quantitative analysis allowed to identify the activities of the company’s distribution centre mostly affected by RFID, i.e. sorting, sample controls, with positive implications on shipment accuracy and management of contentious issues, and some additional specific activities (e.g. management of flawed products). However, the evidence is that productivity benefits within the distribution centre, although noticeable, cannot justify alone the introduction of RFID. Instead, RFID requires a pervasive technology shift in which profitability stems from a combination of benefits arising in a large number of processes (i.e. logistics, brand protection, product presentation, store management). The strategic analysis provided in the paper provides a contribution in this direction.

Research Impact: the quantitative assessment model presented in the paper is of general validity, and enlarges the set of analytical models available in the literature to evaluate the benefits of RFID in the apparel industry. Moreover, the strategic analysis helps identify future research directions.

Practical Impact: the case study presented in the paper is interesting not only for the analysed company, which could assess the economical feasibility of the described RFID project, but also for other companies in the apparel industry, which can calculate the achievable benefits using the illustrated assessment model. Moreover, the study highlights the importance of considering the combination of the numerous benefits enabled by an RFID pervasive project in order to reach a positive return on investment.

Keywords: Radio Frequency Identification (RFID), apparel, model.
Purpose: Radio frequency identification (RFID) has changed logistics processes in many companies and has reshaped supply chain management strategy within short time. But how successful have such adopters of RFID technology really been? Some advocates regarded RFID technology to be one of the biggest technological revolutions of the last years, one that will have a dramatic and positive impact on global industry and commerce. Although some experts are treating this technology like the Holy Grail, very strong criticism from a considerably large community of critics should not be ignored as successful implementation of RFID technology seems to depend heavily on the context of its application which will further outlined in this contribution.

Research Approach: Based on multiple-case study methodology, reports about recent RFID projects were employed to identify factors that influence the success of companies who have already implemented or are currently implementing RFID technology. From an initial sampling frame of more than 4,000 cases mainly provided by IDTechEX and RFID Journal, two professional institutions which are specialized in the elaboration of a resource pool for RFID implementations, 20 cases provided enough data concerning RFID technology specifics (e.g. tag capabilities or whether tags were reused or not) as well as financial measures like investment volume, tag prices and return on investment (ROI) for further analysis.

Findings and Originality: So far, such a systematic analysis of success factors for RFID implementation is missing. Despite a rather small sample size, this multiple case study approach to analyse success factors of RFID implementation offers striking clear results. 3/4 of the companies in the sample used passive, read-only or read-write RFID tags, 3/2 reused them and 19/20 of the surveyed implementations were closed-loop systems without further collaboration efforts with business partners. Furthermore, costs were US$ 13 on average per active RFID tags and 2.60 US$ for passive ones with an average investment volume of US$ 483,074, and 3/4 of the companies reached a positive ROI within two years. Moreover, positive ROI was achieved much earlier on average, when tags are reused (14.8 months) than when they are only used once (23.4 months). This gives also a clear indication that environmental friendly behaviour really pays off.

Practical Impact: This research will hopefully contribute toward a further understanding of why some companies benefit from implementing RFID technology while others are not.

Keywords: RFID technology, implementation strategies, success factors, multiple-case study analysis
REDUCING THE COST OF SUPERMARKET RETURNS

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Purpose: This paper looks at how a major supermarket retailer could reduce the costs associated with managing in-store and online non-food returns. Literature suggests that non-food sales in UK supermarkets (and their online sites) will increase from £11.6bn in 2010 to £16.2bn by 2014. In Europe, the consumer can typically return any defective product to the retailer within 14 days and request a replacement or a credit. With online sales, the product doesn't have to be defective and so the major consumer areas generating returns are non-food products, particularly electrical items sold in-store and online and with liberal ‘no quibble return guarantees’, the scale of the returns problem is set to rise.

The costs of retail returns are becoming more important both in terms of the profitability for retailers and the need to manage down the transportation, warehousing and handling costs associated with these large-scale returns operations. A fundamental issue therefore is to understand how better to manage returns processes, with improving the way returns are managed thought to be able to reduce costs to retailers by up to 15%.

Research Approach: Between 2009 and 2010 the studied supermarket retailer received approximately 300,000 returns which produced an average yield of 13% following their gate-keeping process (where returns are checked to determine their value and next stage in the returns process). Qualitative and quantitative assessments of the existing returns processes were undertaken using a month’s worth of returns data (19,629 items from over 800 stores) to investigate the returns paths following the gatekeeping process. The research set out to determine how individual non-food returns are logged from the moment they were returned, the logistical and handling mechanisms used for the returned products from the customer to centralised returns facilities, the types of vehicles used for the transportation of returns (and the associated costs) and potential approaches for reducing costs throughout the process.

Findings and Originality: The analysis suggested that 60% of products sold online were returned either because they were unwanted or the customer simply gave no reason, with 28% being reported as damaged, faulty or of poor quality. The findings demonstrated that reducing the number of returns in the first instance, through better product information was a key factor but it would be difficult to draw hard conclusions from technical appraisals of customer’s stated problems.

Practical Impact: The operation for transporting returns across the supply chain was found to be relatively efficient but there remained a general lack of visibility. The literature also supported the concept of a central validation process for returns which would drive consistency and lower costs. The paper identifies how retailers can maximise the value of returned products through engaging in various dispersal channels, designed to maximise yields and profitability e.g. the use of jobbers and staff-only returned product sales.

The paper therefore suggests ways in which the returns process for retailers could be better managed including:

1) Reducing the reliance on jobbing
2) Distinguishing between branded and non-branded returns processes
3) Better categorisation of returns within the gate-keeping process
4) The need to better audit and review 3rd party returns handling activity
5) Recognising the importance effective in-store handing procedures are for effective returns management
6) Identifying new disposition markets

Keywords: Reverse Logistics, Returns, Gate-keeping, Dispersal
Purpose: Oxfam operates a complex ‘take-back’ logistics operation across several separate vehicle fleets, servicing its UK stores (650) and bring-banks (1300). The annual transport costs are considerable and savings (financial and environmental) could be gained through i) optimising the use of the current regional and local transport fleets ii) utilising local markets and treatment facilities for recyclate and waste management iii) looking at joint working with other charities in reverse logistics. This paper investigates the role played by the ‘man-with-van’ logistical layer, servicing collection banks and shops within a defined operating region, and quantifies the transport impacts relative to the stock generated across the collection infrastructure. Based on operational data from the Bournemouth region, routing and scheduling software is used to demonstrate the transport benefits of various alternative operating scenarios and suggest ways in which remote bank-fill monitor technology could be used to better inform collection frequencies.

Research Approach: The research was primarily informed by field work carried out at the Oxfam Central Distribution Centre at Winton, Bournemouth. This involved a week’s activity audit of the local ‘man-with-van’ activities with the aim of evaluating the efficiency of the current bank and shop servicing schedule in the Oxfam W14 region. Bring-bank performance was quantified by relating the proportion of saleable stock taken from each bank against the transport impacts (financial and CO\(_2\)) of servicing them. DPS International’s LogiX optimisation software was used to derive alternative collection scenarios to reduce operating and environmental costs.

Findings and Originality: This study provides original analyses of ‘bring-site’ bank performance as part of a major charity’s donations infrastructure. The audit of logistics activity serving 32 clothing, book and music banks and 21 shops across the Bournemouth area identified the differences between sites in terms of weight collected but also the quality of stock derived (% saleable) which can be linked to the characteristics of the local area (demographics, level of affluence etc). Of real interest is the extent to which the findings can aid a deeper understanding of the relationship between bank yield, percentage saleable stock and the transport footprint ‘per-bag’ of collection.

The proportion of saleable stock from banks ranged between 2.8% and 62.5%, with 68% of the banks recording saleable stock of between 30-50%. In general, book and music banks produced higher proportions of saleable stock. Based on the valuations of one day’s bank collections, the average value of all stock collected was £1.24/kg with the mean value of stock accepted for sale being £3.55/kg. Optimising the daily collection and delivery rounds, could realise transport savings of 41 miles (10.7%). Improved scheduling (allowing collections and deliveries to occur on different days) could realise savings of 72 miles (18.9%) over the current operation. Remote bank-fill monitor technology has been identified as a possible avenue for use by Oxfam, potentially saving wasted journeys to banks and providing detection of levels of bank theft, which is a huge problem for charities.

Research Impact: The paper adds to the knowledge base in charity logistics and demonstrates how current bring-site collection schedules could be better optimised based on a knowledge of likely collection yield and optimal routing. It also contributes to the debate on how remote bank-fill monitor technologies as part of the new ‘internet of things’ could aid bring-site collection management, and understanding of which postcode areas yield the best quality stock.

Practical Impact: The research results may prompt change in the way that charities service their bring-banks with the concept that remote monitoring might help identify unprofitable locations and collection practices that are unsustainable. Recommendations are made in terms of new routing and collection strategies for the specific case covered.

Keywords: charity, reverse logistics and optimisation
A REVERSE LOGISTICS NETWORK DESIGN MODEL FOR LEAD/ACID BATTERY RECYCLING

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Purpose: Demand for lead/acid batteries has been increasing due to the rising amount of vehicles, such as automobiles, trucks, motorcycles on roads, marine crafts and several industrial applications. Nowadays, along with these demand increments and some constraints encountered in Turkey, such as the lack of producing pure lead economically from the primary sources, prohibition on import of scrap batteries have made reverse logistics activities much more interested issue for battery recycling. The most of industrial lead requirements are met through imports with highly purchasing costs and both this issue and environmental considerations have forced the battery manufacturers to build-up an effective and efficient spent battery collection and recovery systems. The implementation of such a collection and recycling system is affected by collection and recovery centers’ location decisions which are strategic and much more important. In the case, collection centers are both regional wholesalers which market the new batteries for meeting the customers’ demand and initial collection points which collects the spent batteries from the retailers or service outlets, store for up to 90 days and then send to licensed recycling facilities. The aim of the study is to develop a mathematical model for reverse logistics network design for lead/acid battery collection and recycling.

Research Approach: A mixed integer mathematical model which considers both forward and reverse flows simultaneously is developed for the design of a reverse logistics network. The proposed mathematical model is applied to the case of a battery manufacturer, one of the leaders of the battery sector in Turkey. In the proposed model, minimization of the total closed-loop supply chain costs and maximization of the collection of returned batteries covered by the opened collection centres, are addressed as the objective function.

Findings and Originality: The main purpose of this study is to develop a multi-echelon, multi-product logistics network design model for the previously mentioned objectives as a multi objective model. In this respect, while minimizing the total costs related to the closed-loop supply chain of the firm, disassembly/reclaiming costs for the recycling facility are taken into account as an addition to the main model. The proposed model provides the decisions related to collection centres’ locations and their optimal values of production and transportation quantities of both manufactured and recycled batteries while taking into account the battery demands of customers and spent battery returns. Major factors and effects of the total cost of the closed-loop supply chain network design problem are examined with the help of Taguchi design of experiment technique. Goal programming approach was used to deal with multi objectivity of the model. At the end of the study, experimental results are given and interpreted.

Research Impact: This study proposes a multi objective mathematical model for reverse logistics network design for lead/acid battery industry and considers the amount of returned battery collection besides cost function. Findings of the study are expected to provide useful insights to academics for future researches.

Practical Impact: The proposed model is developed based on a real world case and provides a solution for an effective and efficient battery reverse logistics network.

Keywords: Reverse logistics, Battery recycling, Logistics network design
DEVELOPING A DECARBONISATION STRATEGY FOR LOGISTICS

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**Purpose:** Increasing numbers of companies are developing formal programmes to reduce CO₂ emissions from their logistics operations. They are coming under external pressure from customers, government and trade bodies to do this. For example, the UK Freight Transport Association is setting its member companies a voluntary target for cutting their freight-related CO₂ emissions by 2015. How should a company plan and manage the decarbonisation of its logistics? This paper will outline a seven-stage strategic framework that companies can adopt for this purpose. It is based on discussions with companies in a range of sectors that have developed or are developing formal plans to cut carbon emissions from their logistics operations.

**Research Approach:** The paper will be based on information obtained in the course of several research and consultancy projects. These projects included interviews with senior logistics managers in the chemical, FMCG and logistics services sectors. These discussions provided an insight into the internal procedures that companies are adopting to measure and manage CO₂ emissions from their logistics operations and the problems that they have been encountering. On the basis of this industry experience, an attempt has been made to develop a company-level strategic framework for the decarbonising of logistics, which might be regarded as current industry best practice. This framework has been presented to groups of logistics managers. In the light of their feedback, it has been elaborated and refined.

**Findings and Originality:** No attempt has yet been made to devise a strategy for the decarbonisation of logistics. Most companies are at an early stage in the process of cutting logistics-related CO₂ emissions and developing ad hoc methods and procedures to achieve this. The seven-stage framework that will be summarised in this paper is original. It outlines a systematic procedure for measuring CO₂ emissions, deriving targets, identifying and evaluating decarbonisation options and finally putting in place a system for implementing the decarbonisation programme and assessing its impact.

**Research Impact:** The paper will usefully contribute to the expanding literature on ‘low carbon logistics’ providing a broader, strategic overview of the decarbonisation process. It will also be possible to use the seven-stage model to assess the status of companies’ decarbonisation initiatives and examine how this evolves through time.

**Practical Impact:** The paper will provide companies with guidance on the various stages through which they need go in decarbonising their logistics. It will examine the various challenges and potential pitfalls at each stage and identify the tools and data sources that they can access to help to plan and manage the process.

**Keywords:** CO₂ emissions, decarbonisation, logistics, strategic framework
Purpose: Logistics service providers are facing a growing need to report the environmental impact, especially carbon dioxide emissions, of their customers' consignments. Also the national and EU targets for reducing CO$_2$ emissions induce pressure on LSPs to monitor and report their emissions and energy use, although in a less detailed manner than to the customers. Reporting for both stakeholders does, however, require identification of total haulage (ton-kilometres) in order to proportion the input (energy) and output (haulage) of transport operations. This is also a prerequisite for monitoring the energy and CO$_2$ efficiency and measuring the effectiveness of actions to improve the operations. Reporting for customers also requires rules for allocating the energy and emissions to customers sharing the loading space on a single trip. There are some general guidelines for reporting CO$_2$ emissions on consignment level but these lack practical instructions on how to actually measure and allocate the energy use and emissions on a single journey for each consignment. Meeting this level of detail is often perceived very difficult by LSPs. The purpose of this study is to find out whether or not it really is that difficult?

Research Approach: In order to answer this question, a conceptual model of the needed information for bottom-up calculations is developed and rules for allocation are determined based on the guidelines found in literature. This bottom-up method is tested in actual transport operations of a LSP. Also a top-down method is developed for the company and the results with the two methods are analyzed to identify the difficulties of both methods.

Findings and Originality: Consignment-level carbon footprinting is possible when the following data is available: fuel consumption (l) for the trip (consumption for each leg of a trip are even better), the weight (kg) of each consignment, distance (km) between customers and between each customer and terminal. In addition, it would be beneficial to have the information on the dimensions of each consignment or on the type of handling unit for volume-constrained cargo. None of these pieces of data requires any new on-board technology or other investments. What is required in many cases is a new process for managing the existing information. Practical guidelines for consignment-level carbon footprinting were established and tested in practice in this study. As a result the case company developed a top-down emission calculator and a process for bottom-up calculations.

Research Impact: The difficulty of consignment-level carbon footprinting was found out to be not so much because of the lack of weight and dimension data of consignments but because of inadequate processing of this data. Because of this there is a need for further research on the information systems and information management within the logistics sector.

Practical Impact: The guidelines developed for the case company have the potential of becoming the de facto standard for the logistics sector as a whole in Finland as the case company is one of the biggest LSP in Finland and has many contract carriers.

Keywords: carbon footprint, road freight, guidelines
Purpose: As part of a PhD research, this paper investigates the current level of knowledge of carbon dioxide emissions issues in logistics management, identify the main barriers and drivers of carbon reduction initiatives and analyse the different attitudes and roles of the logistics management in UK companies. The study focuses on the formation and implementation processes of logistics strategies behind these initiatives.

Research Approach: The research started by reviewing literature in strategy formation, logistics management, logistics strategy and carbon emissions in logistics. As a contemporary phenomenon, the state of carbon reduction initiatives in logistic management is not well understood, and a lot of ‘how’ and ‘why’ questions are being posed in this research. Therefore, case studies have been considered as the most appropriate approach to explore, examine and determine these unknowns. Five large UK companies with strong logistics activities have been selected for case study and in-depth interviews have been conducted with logistics managers in these companies. Relevant data from other published sources have also been analysed to enhance the data validity.

Findings and Originality: Key findings include:

- All the case study organisations have taken some actions to develop and implement initiatives to tackle carbon emissions issues.
- Companies with logistics as a core activity showed a top-down approach, with most of the initiatives originated within the top management. In the companies where logistics is a support activity there has been more involvement of the logistics managers in the formation and implementation of logistics initiatives.
- Despite a long-standing awareness of the issue by logistics managers, most initiatives to reduce carbon emissions specifically in logistics have only started in the last three years or so.
- Even for large companies with significant resources, the issue of carbon emissions in logistics activities has not been extensively embraced. To-date, these changes have been mainly operational, with little impact on corporate logistics strategies.
- In recent years the responsibilities of the logistics managers have multiplied due to the increasing competition and service level in the logistics function. The pressure to achieve customer satisfaction without affecting the cost structure has in part discouraged logistics managers from environmental issues such as carbon emissions.

As a new research area, few studies have been conducted on carbon emissions in logistic activities as they impact strategy setting by middle level management.

Research Impact: This study will contribute to better understanding of how strategies are formed within the logistics function in response to changes in the environment, in this case, the increased concern from stakeholders to reduce carbon emissions in business operations. Hopefully, it will shed light on the current state of UK logistics activities regarding carbon emissions. This research should also contribute to building theories related to the formation and implementation of logistics strategies.

Practical Impact: The study seeks to develop a framework to assist UK logistics’ managers in the adoption of logistics initiatives to reduce carbon emissions, and to embed them into the corporate logistics strategy.

Keywords: Logistics strategy, carbon emissions, case study
CASE STUDY: MANAGEMENT OF BIODIVERSITY RISKS IN THE SUPPLY CHAIN

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Purpose: This paper presents the results of an industrial case study (pilot) which investigated the risks and opportunities associated with biodiversity impact in the AkzoNobel ICI Paints supply chain. Previous research (Whatling et al, 2010) had developed a method for assessing risks and opportunities by undertaking a number of case studies within a cross-sector of industry. The outcome of this new case study has provided stakeholders with easily accessible information on a product supply chain and a quantifiable assessment whereby managers can evaluate the level of action needed to prevent/mitigate risk and turn risk into business opportunities.

Research Approach: The pilot study used the Toolkit for Assessing Biodiversity in the Supply Chain (TABS), a model developed in the previous study. A risks and opportunities approach to the biodiversity management process is used, which should be applied by the buying company when sourcing a product, material or service and selecting suppliers throughout its supply chain. A number of first tier and second tier suppliers participated in the pilot and provided data and information with respect to biodiversity at their facilities.

Findings and Originality: The risks and opportunities presented to business during the pilot study were assigned a value score which allows managers to prioritise resources to most significant impacts and provides an overall cumulative impact assessment with respect to both biodiversity and business impacts. The method provides a novel management tool for assessing business related biodiversity aspects in the supply chain.

Research Impact: The outcome of the study provided relevant and timely information, which can easily fit into existing management systems, for managers to evaluate the risks and opportunities concerning biodiversity in the supply chain and thus direct resources to highest risk areas. In order to meet this request the project has designed a computer based method for applying the TABS methodology using the Excel format.

Practical Impact: By knowing and understanding where the business risks and opportunities are the method has the potential to change industry thinking on biodiversity impact throughout a product supply chain. By partnership working and sharing of costs the potential that supply chains can have in reducing industry impacts on biodiversity can be realised.

Keywords: Biodiversity; Business, Supply Chain; Environmental Management Systems; Risk; Opportunity; Sustainable Procurement.
INFORMATION AND PHYSICAL RISK MANAGEMENT IN CONTAINER SHIPPING SUPPLY CHAIN

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Purpose: Container shipping has rapidly developed over the last few decades and is now playing an important role in international trade. However, the financial crisis in 2008 and 2009 has had tremendous impacts on the shipping industry; and shipping companies are facing various risks and challenges in surviving this financial crisis.

In light of the above, the purpose of this study is to identify the special characteristics of supply chain risk management in container shipping and to develop a model that can be used for identifying and assessing the relationships between risk sources and risk mitigating strategies in container shipping supply chains.

Research Approach: In this study, a systematic literature review is first conducted pertaining to the following aspects: risk in general and container shipping supply chains and risk mitigating strategies. A structured model is developed to link four dimensions; namely, information risk, physical risk, risk mitigating strategies, and risk consequence. Interviews and questionnaires with a number of senior managers in the container shipping industry are conducted to confirm the factors of information risk, physical risk, and risk mitigating strategies.

Findings and Originality: This study proposes a conceptual model for information and physical risk management in the context of container shipping. The model includes four dimensions as mentioned above and some factors of these dimensions. Information risk includes information delay, information inaccuracy, and IT problem; physical risk includes transportation delay and cargo/asset damage; risk mitigating strategies could divide into three levels, namely, intra-organisation, intra-channel, and inter-channel; risk consequence includes financial loss and reputation loss.

The originality of the work is reflected in the fact that supply chain risk management is a relatively new concept, and although there have been several studies addressing supply chain risk management, specific research focusing on container shipping sector is still lacking. It is expected that this work will provide some useful insight into this challenging issue.

Research Impact: This study identifies main risk dimensions and factors in container shipping supply chains. The proposed model forms a basis for evaluating and analysing relationships between the various elements in supply chain risk management in container shipping.

Practical Impact: The model will help practitioners better understand the existing risks in container shipping supply chain and assist them in formulating effective mitigating strategies.

Keywords: container shipping, supply chain risk, risk mitigating strategies
HOW TO MITIGATE RISK THROUGH SUPPLY CHAIN REDESIGN USING HUBS

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Purpose: The purpose of this study is to identify the conditions under which a business model structured through hubs can benefit a supply chain characterized by multiple manufacturers and multiple suppliers providing high volume, high unit priced deterministic demand and long lead time materials.

Research Approach: The study implements mathematical models, analytical methods including optimization and numeric studies to assess current operation of a real life multinational company and compare it with an alternative model which includes hubs. Materials considered are high volume, high unit priced, with deterministic demand and long lead times. Both business designs are quantified, compared and evaluated in terms of total costs and cash flow management. The conditions for benefiting all parties in the alternative model are explained and markup rate discussions are highlighted. The parametric analysis which is necessary for assessing the robustness of the alternative supply chain design along with the numeric study is also presented. Findings and Originality: The research problem is inspired from the strategy assessment need of a real company. The company under consideration is a leading multinational company which makes the assessment extremely critical. The concepts and problems related with the global business environment are among the contemporary subjects that draw the attention of both researchers and practitioners. The study proves that the total cost of the alternative business model structured through hubs can be less than that of the traditional business model with direct shipments between parties. Discussions on both business models are further extended by considering additional criteria such as operational efficiency, operational ease, risk pooling, flexibility and service level improvement in order to identify the overall improvement provided to the supply chain.

Research Impact: The study provides a detailed analysis of cost structures and cost components for all parties, induced by several operating policies of both the traditional business model in which materials flow between parties directly and the alternative model in which materials flow through the pipeline over hubs. In doing so, it also identifies the best modes of operation for both traditional and alternative business models. Further analysis outlines a numerical implementation and parametric analysis for a real industry case, including the conditions for benefiting all parties in the alternative model. The findings are further supported by a markup rate analysis, a detailed discussion on operational efficiency, operational ease, risk pooling, flexibility and service level differences provided by the two models.

Practical Impact: The study assesses the practicability of a business strategy on distribution channels with the use of hubs. It places specific emphasis on supply chain network design based on associated costs, financial ownership of materials, service levels and flexibility considerations. It also demonstrates the optimal values for decisions such as production and transportation lot sizes, hub location and hub capacities. The discussions on robustness provide additional insights in evaluating the strategic business decisions for companies. It also provides a foundation for convincing the managers who have counter arguments against changes in supply chain design.

Keywords: Supply Chain Network Design, Inventory Management, Supply Chain Coordination, Hub
AMBIGESTIOUS SUPPLY CHAIN STRATEGY AND BUSINESS PERFORMANCE: A PHARMACEUTICAL WHOLESALER PERSPECTIVE

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Purpose: Wholesale distributors in the United Kingdom and the United States are aware of the magnitude of the changes that have taken place in medicine distribution systems. They have responded with innovation logistics strategies to deal with this highly competitive environment. Their new services rely on an ambidextrous supply chain strategy (i.e. exploitative and explorative logistics innovation).

This research aims to explore those innovative processes and the results concluded that wholesale distributors are developing practices to achieve a high level of operational efficiency, which at the same time evolve new logistics solutions to provide a competitive advantage, thereby maintaining their anchorage in the drug supply chain.

Research Approach: The main analysis examines pharmaceutical supply chains using the concept of the ambidextrous supply chain strategy (Kristal et al., 2010). The approach to logistics is considered from an holistically and strategic point of view where management strategy is based on two practices: one within the supply chain operations and the other across boundaries. Other theories such as; “competitive growth theory” (Roth, 1996), the development of combinatorial capacity, the theories of dynamic capabilities of knowledge-based view and the Law of Requisite Variety are also considered.

Data were gathered from archival and secondary data as recommended by Cantalone and Vickery (2010).

Findings and Originality: Traditionally simply responsible for administering pharmaceutical distribution; wholesaler distributors now seek regular innovation in logistics to develop strategies that are operational-logistics and business-sales driven, to increase the volume of sales in the drug supply chain.

Whereas “original” wholesaler-distributors were not market oriented, the “new generation” are more attentive to customer satisfaction, using innovation at the heart of their logistics services to improve market share. This is the era of Market Strategy driven logistics solutions where conventional efforts, are insufficient to provide competitiveness. Instead it is effective management of the flows to pharmaceutical wholesalers that is needed. The “new generation” wholesale distributors use ambidextrous based Supply Chain Strategy to respond to minute changes in requirements to improve their performance still further and cement their position in the supply chain.

Research Impact: Integrated networks foretold the end of intermediates and projected the disappearance of pharmaceutical wholesalers, but failed to take account of their adaptability. The results of this research show that the wholesalers have survived and flourished.

Although wholesalers have evolved, some academic research remained focussed on “dated” models. At a time when governments are trying to reduce health care costs, better understanding of their role in the pharmaceutical supply chain could be invaluable. This paper provides information about the ability of wholesalers to renew their logistics services and helps understand their contribution to today’s “new generation” of pharmaceutical supply chains.

Practical Impact: Wholesalers’ strategies, whether motivated by their own desires for improvement or driven to react to the needs of manufacturers and customers, take time to develop and are rarely understood or documented. This research contributes to that understanding and may also enable governments to understand the role of “new generation” wholesale distributors and thus exert greater control over health expenditures.

Keywords: Pharmaceutical supply chains, pharmaceutical wholesalers, logistics innovation, ambidextrous supply chain strategy.
Purpose: The main purpose of this paper is to show, by means of a case study, how to reduce transportation cost of patients inside an Italian Public Hospital. The cost savings have been achieved using tools that derived from Lean Thinking (Womack and Jones, 1996), in particular ‘Value Stream Mapping’ (Rother and Shook, 1988) and ‘Spaghetti-chart’. Value stream Mapping allows the organisation to see the so-called 7 wastes (Ohno, 1998) that produce extra costs: overproduction, inventory, extra processing steps, motion, defects, waiting and transportation. This latter cost, in Health Care industries such as Public Hospitals, is often related to patient transportation inside departments, wards and outpatient’s clinics. The track of a patient transportation can be seen and calculated using the Spaghetti-chart tool. The results make sometimes doctors and nurses astonished, especially when they have to face up to the fact that a patient from the emergency department to the discharge can cover more than a kilometre. The more transportations, the more costs and the more possibility for the patient to contract infections as well. This paper, after a brief introduction to the particular tools, describes the methodology of the research, its finding and then discusses the logistical solutions for the case. In particular the paper presents a method for calculating the distance covered and the costs related to hospital staff. The distances are often due to layout mistakes because departments inside hospitals have been sometimes built without taking into account the transportations. But, in any case, using smarter solutions based on a different flows, relevant savings can be achieved. Furthermore the paper discusses on the possibilities to reduce infections using different patient flows.

Research Approach: The research has been carried out using a qualitative inquiry. An Italian public hospital has been analysed as a case study and doctors and nurses have been interviewed on the subject. The calculations about distances and costs have been figured out along with a team dedicated to logistical aspects inside the hospital.

Findings and Originality: The paper shows the main wastes in term of patient transportation providing new tools in order to better analyse and calculate them.

Research Impact: This paper opens a debate about how to improve logistical aspects inside hospitals. Academics and practitioners could investigate in a qualitative/quantitative way on aspects such as layout design and tools to reduce transportation costs and infections.

Practical Impact: Value Stream Mapping and Spaghetti-chart are useful tools derived form Lean Thinking that can be used by health care professionals to identify and analyse wastes and to improve logistical processes.

Keywords: Spaghetti-chart, Value Stream Mapping, patient transportation, Lean Thinking
HEALTHCARE SUPPLY CHAINS: A CASE STUDY OF HOSPITAL-VENDOR COLLABORATIVE PRACTICES

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Purpose: The purpose of this paper is to analyse the healthcare supply chain and to identify the sources of complexity and diversity. In addition, it aims to explore the implementation of collaborative practices, such as Co-Managed Inventory (CMI), and to show which benefits are realized in practice.

Research Approach: The authors followed the case study research approach and conducted in-depth interviews with a major hospital and two vendors.

Findings and Originality: The article demonstrates that within hospitals there are several different healthcare supply chains with quite distinct characteristics. Regarding CMI implementation, significant financial benefits are reported, as well as improvements in the control of inventories and administration work.

Research Impact: Considering the scarcity of relevant work on CMI in the healthcare sector, we provide useful insights and explanations that could be extremely helpful to researchers involved in the understanding the healthcare supply chain and the uptake of collaborative practices.

Practical Impact: Results obtained will be relevant to other hospitals and vendors and this case study shows specific and measurable cost reductions as well as other areas for further improvement.

Keywords: healthcare supply chains, hospital, CMI/VMI, Greece
### FRIDAY 9th SEPTEMBER

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<td>Karlsson <em>et al.</em>. Recent city logistics projects in EU – an overview from a systematic perspective</td>
<td>Fleschhut, Wong. Probing Supply Chain Management for a SME</td>
<td>Tacken <em>et al.</em>. Environmental measurement and standards applied by German logistics providers</td>
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<td>Leonardi <em>et al.</em>. A consolidation network model for urban freight transport</td>
<td>van der Vorst <em>et al.</em> Towards a diagnostic instrument to identify improvement opportunities for quality controlled logistics in agrifood supply chain networks</td>
<td>Greening <em>et al.</em>. Evaluating carbon reduction policy using agent based modelling to simulate UK freight movements</td>
<td>Piecyk, McKinnon. Analysis of long-term trends in CO₂ emissions from UK road freight transport</td>
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<td>11.00 - 12.00</td>
<td>A8 – SHIPPING 2</td>
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<td>C8 – MODELLING 3</td>
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<td>Madejski. Pirates on the high seas: Destabilised supply chain efficiency and performance, the case of SIDS (small island developing state) Seychelles</td>
<td>Havenga <em>et al.</em>. A business case for domestic intermodal freight solutions in South Africa</td>
<td>Morgan, Pridgeon. A case study in applied bin packing with order constraints</td>
<td>Chanintrakul <em>et al.</em>. Revenue management for multiple recovery options in the computer recycling industry: A simulation model</td>
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<td>PLENARY 3</td>
<td>Three themes for the next phase of field service logistics</td>
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<td>Stuart Miller and Dan Turner (ByBox)</td>
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RECENT CITY LOGISTICS PROJECTS IN EU – AN OVERVIEW FROM A SYSTEMATIC PERSPECTIVE

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Purpose: The City Logistics concept aims to mitigate the negative impact of urban freight transport and, at the same time, support a lively city center and improve quality of life for residents. The transport of goods is of great importance for the economic system. The global urbanization trend as well as the increased environmental consciousness has driven an increased focus on urban freight transport.

During the last twenty years the research activities in City Logistics has steadily increased and several studies, both academic and more practical oriented studies, have been accomplished. A large number of City Logistics Demonstration Projects (CLPs) has been implemented. The overall purpose of most of these projects is to develop concepts and evaluate methods for implementation. However, the specific objectives as well as the characteristics in terms of business models, functionality, scope and technology are different. Typically objectives include economics, environmental and congestion aims. Different business models are used for infrastructure and operations financing. Functionality and technology in CL measures include, for instance, consolidation, regulations, vehicles and intelligent transport systems.

There are several large projects launched by the European Commission, aiming at developing concepts for sustainable cities, which include demonstration projects on urban freight transport. This paper aims at presenting a brief overview of recent European research initiatives and also a number of CLPs from a systematic perspective. The objective is to provide a survey which is useful for finding recent achievements and experiences representing different CL characteristics.

Research Approach: In order to identify and summarize recent experiences we study the documentation of European research projects and more specific the reports on accomplished CLPs. We apply a taxonomy framework to identify and describe the characteristics of the cases and the projects. From the perspective of this categorization, the objectives, measures and results, and the connections between these characteristics, are studied.

Findings and Originality: This study provides an insight to recent CLPs. This survey is described from a systematic perspective providing a concise overview of different CL characteristics explored in demonstration projects. This study examines the documentation and provides a basis for discussion of how to facilitate the dissemination of experiences such as best practice in developing feasible CL measures.

Research Impact: This paper contributes to the literature by providing an overview of recent European research projects and experiences from CLPs. This overview indicates a number of lessons learned and constitute a basis for future work. This includes the design of CL concepts, as well as how to facilitate the knowledge transfer from demonstration projects.

Practical Impact: The contribution of this paper is an overview which is useful for city authorities, logistics service providers, logistics purchasing firms as well as researchers, planning to realize a CLP or working with development of CL concepts or introduction of CL measures. The systematic perspective provides a brief mapping of where specific characteristics have been examined. This paper is useful for finding applicable achievements and experiences from previous projects.

Keywords: City logistics, Urban freight, City characteristics, taxonomy framework, measure
EXPLOITING ICT INNOVATION TO POSITIVELY IMPACT THE “TRIPLE BOTTOM LINE” WITHIN THE EXPRESS PARCELS DELIVERY SECTOR

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Purpose: To demonstrate how information communications technology could be used to promote, improved efficiency, effectiveness and economy within the Express Parcels Delivery Sector. We argue that the successful strategic design and introduction of ICT to plan more effective, efficient and economic deployment of vehicles in the Express Parcels Delivery Sector will result in reductions in vehicle carbon emissions, lower running costs and improve management decisions within the business concerned. We will demonstrate that introducing software in the management of the overnight parcel delivery sector positively impacts the Triple Bottom Line performance of an organisation and will ultimately provide a tangible benefit to society at large.

Research Approach: The research approach defines the research problem, selects a case study supported with academic underpinning It includes assumptions regarding the average size, weight and number of items per consignment based on quantitative data collection methods (conducting effective interviews, observation, and data mining.); sourced from UK express parcel and mail carriers. The case study report uses techniques to ensure data validity, reliability, and respect for research ethics

A major contributing factor influencing the number of parcel deliveries within a defined area is the time to deliver and between each delivery. The elements influencing any delivery completion include:

- The building profile split (business or residential) in any postal district or sector.
- The average road speed in any postal district or sector.
- Data concerning planned traffic events influencing the flow and speed of traffic for a particular time and day.

Findings and Originality: Current methods of transport management with TMS optimisation software are examined and why this type of ICT has not been universally adopted within the parcel and mail sector is considered. Comparisons are made with other TM systems in use in the road haulage industry and what perceived business value they have achieved. Consideration is given to developing a software program that specifically addresses the needs of parcel and mail deliveries in order to minimise resource used.

Research Impact: The research attempts to demonstrate that it would be possible to identify the maximum number of potential deliveries in a given area on a particular day with the introduction of software into the operation. This enables the operation to maximise total efficient practices by reducing the number of vehicles deployed each day.

Practical Impact: The ultimate objective is to create an operational strategy that results in social, economic and environmental benefits positively impacting the triple bottom line. The direct practical impact is a reduction in the parcels collection and delivery fleet thus reducing cost and carbon emissions. Management time engaged in fleet operations will be compressed thus affording an opportunity to concentrate on business growth and development.

Keywords: Efficiency, Effectiveness, Economy of parcel deliveries.
A CONSOLIDATION NETWORK MODEL FOR URBAN FREIGHT TRANSPORT

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Julian Allen, University of Westminster, Transport Studies Department

**Purpose:** The paper discusses the scope and the impacts expected from a different approach to urban freight distribution based on the consolidation network concept. This concept involves using a network of relatively small scale city centre transhipment points where clean vehicles can be used for deliveries in the dense central area. In this approach, urban freight deliveries using diesel vans are replaced by electrically assisted "tricycles" called Cargocycles and by electric vans of small size.

**Research Approach:** To assess the urban logistics changes, a number of factors were considered: different distribution and impact areas, ‘before’ and ‘after’ situations, changes in fleet, performance (load factor, distance etc) and external impacts of transport (fuel use, emissions, road space occupancy), and different scenarios of changes. The starting scenario is referred to as the ‘Real Case’. This is assumed to be what happens when a change is made from a typical operation using diesel powered vans making deliveries from a suburban depot into the city centre delivery area to a system using cleaner vehicles and a consolidation centre. The ‘Real case’ data were recorded in Central London in 2010 for retail delivery. So called ‘extension’ scenarios’ were then designed to test out the sensitivity of the changes shown in the ‘Real case’ to changes in the input values (e.g. what happens when the volumes to be moved increase or the weight changes?) Each scenario impact has been calculated.

**Findings and Originality:** The 20 scenarios calculated with the model show reductions in: overall distance travelled; emissions; and kerbspace (loading) requirements. However, the use of smaller (clean) vehicles leads to an increase in distance travelled on the roads within the delivery area itself. Consolidating the flows in the way achieved in the trial project has most benefits when the ‘before’ case involves less than full utilisation of the vehicles. Although most of the input data has been collected from the one trial, we have explored a wide range of scenarios and thus have been able to test the sensitivity of the results to changes in assumptions about the input data. In addition, it is clear that the ‘before’ situation that formed the basis for the trial can be considered typical of many urban delivery operations using vans.

**Research Impact:** The consolidation network model can be used as a tool to calculate and visualise the impacts of different scenarios on the future evolution of a consolidation network and to explore the implications of an increased use of clean vehicles for delivery in urban areas.

**Practical Impact:** Even in the presence of efficient logistics for urban distribution, there is a potential for efficiency improvement and reducing external costs of freight transport using a consolidation network. To apply such a consolidation network would be strongly beneficial for the public sector in terms of traffic reduction, emissions reduction and kerbspace requirements. The existing trial, according to company statements, demonstrates a commercial viability for the observed ‘Real case’ of consolidation and use of clean vehicles for final delivery.

**Keywords:** urban freight transport, consolidation centre, impact assessment model
Purpose: The research analyses the supply chain and supply chain practices currently applied in UK SMEs (small and medium enterprises), in this paper, a polymer distributor. The research investigates current best practices in logistics and supply chain management in literature and from case studies. Research in logistics and supply chain management mainly focuses on large companies and organizations. Less attention has been given to logistics and supply chain management in SMEs. However supply chain management becomes important for SMEs as more and more SMEs operate globally. This research presents a selection of best practices in supply chain management, which have been proven successfully for large organizations and probes their feasibility for a UK polymer distributor.

Research Approach: As a KTP (Knowledge Transfer Partnership) associate, the researcher is able to secure in-depth data and information of the organization. The research is embedded in a case study of a polymer distributor. The case study is accomplished by a action research, which involved participants’ observations and semi-structured interviews internally with employees and management and externally with customers and suppliers. In addition a customer survey has been conducted. Moreover secondary data in form of company data and market data has been collected. To test the feasibility of implementing supply chain management in the polymer distribution company, the following best practices have been evaluated: implementation of a supply chain strategy, supplier relationship management, inventory management and purchasing policies, supply chain management as a new function within the company, business process re-engineering, internal integration and offerings of integrated logistics services to customers, such as vendor managed inventory, just-in-time deliveries, consignment stock or repackaging of supply. It is also assessed if the transition from a distributor to a logistics service provider might be feasible and advisable.

Findings and Originality: The distributor faces a challenging sourcing situation with powerful suppliers, volatile prices, uncertain supply and imperfect information in an oligopoly market. A sole purchasing function only has been introduced recently. Additionally the distributor takes a traditional view on supply chain management, which focuses solely on transport. From the customer survey it is known, that most customers are happy with the services they receive from the distributor. Among the distributor’s customers Supply Chain Management does not play a big role in their operations. Supply Chain Management implementation is impeded by the lack of an ERP system, funding and human resources within the distributor. As the supply situation is most difficult for the distributor it is advised to concentrate on this area first in form of supplier relationship management and inventory management. The other approaches discussed in the paper appeared more as ‘nice to have’ than really necessary for a SME. However a more holistic approach in form of Supply Chain Management also should enhance the distributor’s operations. Convincing management that the merely sales-focused distributor would gain from a more supply chain focused perspective appeared as one of the most important aspects in the research.

Research Impact: This research focuses on Supply Chain Management within SMEs which has been given little attention so far. Even less attention has been given to the position of distributors in large corporations’ marketing channels in recent supply chain literature. This research aims to draw more attention on feasibility of Supply Chain Management in SMEs.

Practical Impact: Having conducted the research in cooperation with a distributor it was inherent to produce a research outcome which can be used as a guideline for practitioners in SMEs for implementation in a business environment.

Keywords: Supply Chain Management, SME, Logistics Service Provider
WHAT WE CAN LEARN FROM TOYOTA ON HOW TO TACKLE THE BULLWHIP EFFECT

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Purpose: Operating supply chains cause complex dynamics involving swings in both production rates and stock levels, commonly known as the bullwhip effect (Towill et al., 1992). Bullwhip refers to the phenomenon whereby the variance of demand may be amplified dramatically as the orders proceed through each echelon of a supply chain (Lee et al., 1997). Empirical research has confirmed how reducing demand variation can lead to simultaneous improvements in flexibility, capacity, inventory and throughput time.

The Toyota Motor Corporation is well known as one of the innovators in the field of lean management and sets the standard in efficiency and productivity in the auto manufacturing industry (Womack et al., 1990). After World War II Japanese car industry led by Toyota developed a new approach to compete against the mass production concept successfully applied by Henry Ford since the beginning of the 20th century. To contrast the new approach to manufacturing management used by Japanese vehicle manufacturers (e.g. Toyota, Honda, Nissan) with the mass production methods used by most Western manufacturer the term lean management was coined (Krafcik and MacDuffie, 1989). Lean thinking under a manufacturing perspective has been well described in literature over many years. The specific contribution of this paper is to examine the application of lean principles to tackle bullwhip. We therefore concentrate on logistics, as the task of coordinating material flow and information flow across the supply chain (Harrison and van Hoek, 2008).

Research Approach: To gain insight into the contributions of Toyota to dampen bullwhip, we performed a literature review of research and practitioner articles. The existing related research is based on the fundamental work started in this field by Taiichi Ohno and Shigeo Shingo, which was further developed by a number of colleagues working directly or indirectly for Toyota.

Findings and Originality: Toyota provides a vast number of concrete methods to eliminate or at least to dampen the bullwhip effect. Starting with the pioneering works about just-in-time management, group orientation, work structure, plant layout and supplier integration at Toyota City, many approaches have been developed so far to respond rapidly, effectively and efficiently to perturbations. The main thrust of this paper examines the connection between logistics systems and bullwhip. Fundamental properties and characteristics were summarised in seven generic lean logistics principles (Synchronisation, Takt, Flow, Pull, Stability, Standardisation and Integration) proposed by the “Toyota Way” to mitigate demand amplification.

Research Impact: This research will deepen the understanding of the underlying relationships between supply chain performance and logistics principles according to the “Toyota Way”.

Practical Impact: The enablers and relations identified to smooth supply chain dynamics will provide a framework, or understanding, from which a firm can evaluate its inherent options to tame undesirable and costly oscillations to enhance business performance.

Keywords: Toyota Production System, Bullwhip, Lean Logistics
TOWARDS A DIAGNOSTIC INSTRUMENT TO IDENTIFY IMPROVEMENT OPPORTUNITIES FOR QUALITY CONTROLLED LOGISTICS IN AGRIFOOD SUPPLY CHAIN NETWORKS

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Purpose: Western-European consumers have become not only more demanding on product availability in retail outlets but also on other food attributes such as quality, integrity, and safety. When (re)designing food supply-chain networks, from a logistics point of view, one has to consider these demands next to traditional efficiency and responsiveness requirements. The concept ‘Quality Controlled Logistics’ (QCL) hypothesizes that if product quality in each step of the supply chain can be predicted in advance, goods flows can be controlled in a pro-active manner and better chain designs can be established resulting in higher product availability, constant quality, and less product losses. The paper discusses opportunities of using real-time product quality information for improvement of the design and management of AgriFood Supply Chain Networks, and presents a preliminary diagnostic instrument for assessment of ‘critical quality’ and ‘logistics control’ points in the supply chain network.

Research Approach: The paper discusses relevant literature from food technological as well as food supply chain management journals. The QCL concept is developed from an extended literature review and findings from multiple case studies. An exploratory case study is presented to illustrate the value of the diagnostic instrument.

Findings and Originality: We introduce a new concept called Quality Controlled Logistics that provides a framework for concurrently optimizing product quality and availability in market outlets, which will minimize shrinkage and maximize revenues. Six basic QCL-elements are presented:

1. Define consumer preferences on product quality attributes and definition of the consumer product acceptance period
2. Define the critical quality points (CQP) in the supply chain that have major impact on the product quality attributes
3. Measure product quality attributes and use quality change models to predict product quality in all supply chain stages
4. Log data and exchange of (demand and supply) information with supply chain partners real-time
5. Use local dynamic/adaptive logistics and quality control in each stage to optimize product quality
6. Use AgriFood Supply Chain Management practices to direct specific products batches – under specific environmental conditions – to specific market segments.

Results of a tomato-chain case illustrate the added value of the QCL concept for identifying improvement opportunities in the supply chain.

Research and Practical Impact: Operations management literature usually takes product quality as given. If one approaches product quality as a dynamic issue and uses time dependent quality information, then more degrees of freedom come to the forefront that will improve supply chain performance. Future research aims for the further development of a complete diagnostic instrument and the quantification of costs and performance improvements of QCL scenarios in multiple cases.

Keywords: Food supply chains, food logistics management, food quality management
ENVIRONMENTAL MEASUREMENT AND STANDARDS APPLIED BY GERMAN LOGISTICS PROVIDERS

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Purpose: It is estimated that freight transport accounts for roughly eight percent of the global energy-related CO₂ emissions (Kahn et al., 2007). McKinnon (2007) has developed a framework for guiding CO₂ emissions reduction in road freight transport. Global Reporting Initiative (2006) has developed standards for monitoring environmental performance of companies. The Carbon Trust (2006) developed guidelines for the measurement of CO₂ emissions. However, in logistics, the application of practices to measure ecological performance has not been verified at company level. The aim of the paper is to explore the application of environmental measurement and standards recommended in the literature.

Research Approach: The research follows a deductive-to-inductive approach using deduction as foundation and induction to identify new insights. As recommended by Maylor and Blackmon, 2005, a non-probabilistic purposive sampling strategy was applied to select the case studies. Two main company characteristics were considered: number of employees and sectors served. In total 50 German logistics providers were invited to contribute to the research and ten of them agreed to participate. During the case studies, managers from the logistics providers investigated were interviewed. All the interviewees, with the exception of the one, influence on the decision making of national as well as international transport flows. The interviews were tape-recorded and transcribed in German and translated to English. Subsequently, the interview scripts were synthesized by applying content-analysis, as recommended by Saunders et al. (2007), into an Excel table. Keywords were returned for final adjustment and approval to the interviewee. The data was analysed using cross-case analysis as suggested by Maylor and Blackmon (2005).

Findings and Originality: The measurement of the environmental performance of road freight operations in Germany seems to have a strong focus on CO₂ emissions. Moreover, occasionally energy consumption and vehicle utilisation were named. Other forms of impacts seem not to be taken into account in the monitoring systems used by the participating companies. The carbon footprint technique appears to be the participant’s chosen measurement technique, since either companies have implemented it or are in the process to implement it. However, different standards are used or planned to be used indicating somehow a lacking general agreement on the measurement. This represents an area of opportunity for standardisation at sectoral level in terms of the effectiveness of the application of different certification schemes. This paper has generated empirical evidences of the application of environmental measurement practices and standards recommended in the green logistics literature. The approach applied in this paper could be used as a guide for future research in the topic.

Research Impact: This paper is the starting point for mainly three directions of further research. The first one aims to investigate the present restrictions and selection criteria on a wider research perspective taking into account more companies to allow generalisation. The second one should use the same settings; however, transfer it to a different logistics service or a different modality. The third one should investigate the issue using a closer scope, e.g. customer of the LSP, ownership of company.

Practical Impact: Implications for German logistics providers are to compare present findings with their own views and actions. Furthermore, German logistics providers need to find an inter-organisational agreement on the definition of green logistics, its range and standards to allow benchmarking. Finally, they should introduce environmental performance measurement which has the capability to connect economic and ecological factors and to set clear goals to achieve an evolutionary stage in environmental management.


Keywords: Environmental measurement, carbon footprint, CO₂ emissions, German logistics providers
Purpose: To secure sustainable development and minimise the effect of global warming, an EU directive declares a need for reduction in greenhouse gas emissions of approximately 30 % by 2020. This means that current CO$_2$ emissions from freight transport need to be dramatically reduced. Current research has concluded that this is feasible, but that it requires that all potential mitigation opportunities from logistics are to be secured. Much of these opportunities seem to remain as the current trend for CO$_2$ emissions from freight transport in Europe, particularly for road transport, still points in the opposite direction; these emissions are increasing. To turn this trend and reach the target of 2020, authorities can use both traditional and innovative control instruments for reducing CO$_2$ emissions from freight transport. To be effective, the design of these control instruments could be affected by the drivers of companies to have sustainable freight transport. The purpose of this paper is to use a company perspective to examine drivers for sustainable freight transport and the potential effect of voluntary, regulatory and investment-based control instruments for CO$_2$-efficient freight transport. The research questions are: Which are the main drivers for companies to reduce CO$_2$ emissions from freight transport? Which control methods are most efficient in terms of reducing CO$_2$ emissions from freight transport from a company perspective?

Research Approach: The research is based on a survey conducted among freight transport intensive industries, including both freight owners and logistics and transport providers, in Sweden. A questionnaire with a five-point Likert scale measuring drivers for companies to implement sustainable freight transport solutions as well as traditional and innovative control instruments for reducing CO$_2$ emissions from freight transport were developed. The survey was sent to logistics managers in 427 companies with a response rate of 40.3 %.

Findings and Originality: The findings show that the main drivers for companies in Sweden to implement sustainable freight transport solutions are to be seen as an environmental employer and show social responsibility. A belief in that it will result in long-term competitiveness and that it has marketing potential are also essential drivers. Different types of requirements, from customers, authorities and company owners, as well as short-term profitability are less important drivers. The control instruments that are perceived to be most efficient from a company perspective to reduce CO$_2$ emissions are different types of governmental investments, such as technology subvention, technology grants and investment in rail. Restrictions and increased taxes on CO$_2$ emissions are also perceived as quite efficient, while carbon offset, requests for voluntary engagement and kilometre taxes are perceived as less efficient control instruments.

Research and Practical Impact: Based on the findings, the paper relates the drivers for sustainable freight transport solutions to the level of perceived efficiency of different control instruments. It also identifies gaps between drivers and control instruments. For instance, based on drivers, behaviour and attitudes of citizens seem to have great impact on reduction of CO$_2$ emissions, but there is still a lack of belief in voluntary action for fulfilling such wishes. Finally, the paper presents implications for logistics research and practical implications for development of control instruments.

Keywords: freight transport, survey, sustainability
EVALUATING CARBON REDUCTION POLICY USING AGENT BASED MODELLING TO SIMULATE UK FREIGHT MOVEMENTS

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Purpose: Current UK transport policy regarding carbon reduction is generally developed within modal constraints, thereby largely neglecting the inter-modal dependencies. This can often result in sub-optimal infrastructure designs and operational outcomes. The challenge of integrating carbon reduction policy across all modes requires an approach that incorporates interdependencies, and allows for the influence of one mode on another mode. Such an approach inevitably assumes the characteristics of a complex adaptive system comprising freight owners, freight movers, infrastructure owners and policy makers. Within the such a system each constituent adapts to its contextual environment thereby redefining the environment for others. This co-evolution results in a self-organizing system which is emergent and therefore difficult to govern using traditional linear/deterministic approaches. This paper sets out a modelling framework suitable for the simulation of complex adaptive systems such as the UK freight system, illustrating its application through a parameterised simulation of the UK freight infrastructure /operation using an evolutionary approach to identify improved robust carbon reduction policy mixes.

Research Approach: Agent based modelling is used to simulate the UK freight infrastructure and its evolution in a series of carbon reduction policy parameterised computer experiments. The approach incorporates 3 different agent types: freight owners (who generate movement orders), freight movers (who move the material from origins to destinations in a manner that best meets the demands of the freight owners), and infrastructure agents (who build infrastructure to satisfy the capacity demands of the freight movers). The agent’s behavioural responses to policy stimuli is modelled using practitioner validated algorithms. The results of the computer simulations are analysed using logistics regression to identify any generalisable patterns.

Findings and Originality: The findings identify the characteristics of robust and effective carbon reduction inter-modal freight policy mixes. In so doing the paper provides a framework for the evaluation of future UK freight policies and governance. Research Impact: The paper sets out a methodology for understanding freight transport policy carbon reduction outcomes incorporating a more complete consideration of modal interdependencies. By combining the complex systems theoretical perspective with computer simulation it is possible to develop a methodological framework for the robust evaluation of freight transport carbon reduction policy.

Practical Impact: The difficulty in gathering meaningful empirical data representative of a large scale complex system drives the need for alternative approaches to understanding how systems such as the UK freight system behave under different carbon reduction policy mixes. The combination of agent based computer simulation and a complex systems theoretical perspective allows policy makers to formulate the most effective robust carbon reduction frameworks, allowing the other freight stakeholders to develop robust business models in an uncertain and often impenetrable complex environment.

Keywords: agent based modelling, infrastructure, freight, complex systems theory
EXPLORING OPERATIONAL WASTE IN HAULIER OPERATIONS

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**Purpose:** Performance of the haulier industry has attracted research attention for many decades, not the least due to interest in gaining increased operational efficiency and in reducing costs. In recent years, focus has shifted towards other areas including organisational issues, sustainability including environmental impacts and the role of the hauliers in supply chains. The literature does not however encompass many waste frameworks that can be used for generic performance and efficiency analysis. The purpose of this paper is to identify and define operational waste in haulier operations and to expand previous research on hauliers’ operational efficiency. Furthermore, the purpose is to build a framework to classify the operational waste and identify the activities typically involved.

**Research Approach:** The approach for this research was qualitative, starting with a literature review focusing on various aspects of transportation operations and the involved inefficiency in typical activities such as loading, driving, modal change, unloading, administration, etc. Furthermore, ways to improve the efficiency by, for example, implementing new technologies, developing key performance indicators and finding ways to categorise waste in hauliers’ operations have been explored. The literature study was then followed by interviews conducted with five different categories of experts, related either directly to the hauliers’ operations or being experts on improvement work and inefficiency related to business operations.

**Findings and Originality:** Previous research in the field of haulier efficiency has mainly focused on fill rate, technical concepts, mathematical optimisation and lorry usage, neglecting many aspects or constraints characterizing the hauliers’ organisational environment. In this work, the framework used for identifying operational waste is based on three waste groups: resource utilisation, fuel usage and damages, and administration and information flows; and the framework has taken a holistic approach to waste leading to a generic framework of operational inefficiencies in hauliers’ operations.

**Research Impact:** The research impact of this work can be identified in two separate areas. Firstly, the inefficiencies typically found in hauliers’ operations are put into a common waste vocabulary that is in part in line with today’s common Lean thinking. Secondly, it offers an exemplified framework of operational waste groups in hauliers’ operations and thereby provides academics with a generic framework for inefficiency analysing.

**Practical Impact:** The practical impact of this research is an empirically based framework of waste in hauliers’ operations and the suggested classification of waste categories can be applied to identify waste in haulier operations and used as a base for increasing operational performance in a constructive way.

**Keywords:** Haulier operations, transportation, efficiency, performance, waste.
SUSTAINABLE TECHNOLOGIES FOR AUXILIARY TRUCK POWER AND TRAILER REFRIGERATION – A REVIEW OF THE EVIDENCE

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Tom Cherrett, University of Southampton

Ben Waterson, University of Southampton

Purpose: The European Union is committed to achieving a series of climate and energy targets by 2020 that include a reduction in greenhouse gas emissions of at least 20% below 1990 levels, a requirement that 20% of EU energy consumption should come from renewable resources and a 20% reduction in primary energy use. By 2050, the European commission has set a goal of reducing emissions by between 80-95% which implies that key areas of the transportation sector need to be decarbonised, particularly freight and goods.

Through a critical literature review and company survey, this paper conducts an economic and technological appraisal of low and zero carbon, renewable technologies that are, and could be applied to the road haulage sector with regard to auxiliary truck power and trailers refrigeration units.

Innovative technologies such as photovoltaic thin film and solid oxide fuel cells (SOFCs) could find niche applications within Trailer Refrigeration Units (TRUs) as the drive to become more energy efficient forces logistics providers to investigate ‘bundles’ of alternative power options. New synthetic fuels, bio fuels and liquid nitrogen present promising potential in terms of cost savings and carbon footprint mitigation but the supply network for these fuels is key to their long-term viability and take-up by the industry. This paper will discuss the possibility of using all these technologies to power auxiliary truck systems such as air conditioning and other appliances, and TRUs in multi temperature trailers.

Bio fuels and synthetic hydrogen fuels are becoming very important due to the recent rise in oil prices. Geo-political instability in some production areas and oil scarcity require innovative solutions that can provide energy security and economic stability for logistics suppliers. The advantages of these fuels are that they can run on conventional Internal Combustion Engines (ICEs) while minimising the tank-to-wheel carbon footprint. SOFC can run with conventional fuels and bio fuels eliminating many of the supply chain challenges that Proton Exchange Membrane fuel cells (PEMFC) present, such as the lack of refuelling stations, energy storage and distribution issues. There is much research in development regarding SOFC and once near to market devices achieve the commercial stage it seems plausible that this technology will find a niche application in TRUs and auxiliary truck power systems.

Photovoltaic panels and thin film’s continuous improvements in efficiency and lower costs, together with the possibility of exporting the energy surplus to the grid could considerably reduce the payback period of the investment in a solar trailer, making of this alternative a financially sound option.

There is an increasing interest in liquid nitrogen TRUs. These units do not require an engine, minimising the need for mobile parts and reducing maintenance costs.

Research Approach: This paper uses the findings from a critical literature review and company survey to determine the extent to which photovoltaic thin film, solid oxide fuel cells (SOFCs), liquid nitrogen and synthetic hydrogen fuels and bio fuels are being used in the context of road haulage. The paper will demonstrate the time scale of near to market technologies and the relative success case study applications. The research is being undertaken as part of a first year EngD literature review, working with a large logistics provider in the food retail sector.

Findings and Originality: This paper will suggest a new approach to achieve a faster return on investment on photovoltaic trailers and their energy management. The findings will reveal the feasibility and timeframe to market for Fuel Cells (SOFC) devices for auxiliary power and TRU, photovoltaic trailers and new more efficient fuels.

Research Impact: The paper will contribute to knowledge in this field by bringing together current case study evidence to help demonstrate the main differences between the alternative technologies, the main economic drivers and the time scales for introduction, and their feasibility given the reliability and location of fuel supply chains in the UK and globally. The implementation of the findings could make a positive contribution towards the decarbonisation of the distribution sector. The paper will build up on findings from other researchers from different disciplines adding time scales forecasted by commercial entities. Current prices will update the feasibility of the alternatives discussed.

Practical Impact: By reducing or virtually eliminating pollution and noise levels, delivery time slots could be extended into previously restricted entry periods and areas, and improve the efficiency of logistics operations. Alternative technologies not only could reduce the fuel bill of TRUs and their carbon footprint but also they could provide gains in marketing terms due to a more environmentally friendly brand image.

Keywords: Sustainability, logistics, fuel cells, photovoltaic panels, bio fuels, hydrogen, green logistics, sustainable distribution, liquid nitrogen, transport refrigeration units.
Purpose: This paper examines the long-term trends in CO$_2$ emissions associated with movements of freight by road in the UK. A spreadsheet model has been constructed, which estimates future CO$_2$ emissions based on changes in a range of key logistics parameters such as modal split, distance travelled, empty running, vehicle loading and fuel efficiency. Statistics and reports on the UK road freight transport system are reviewed in order to examine the availability of data on the key freight parameters. Based on available forecasts of trends in each of these key parameters, a number of scenarios are derived and modelled. As a result, the likely range of CO$_2$ emissions from road freight transport in 2020 is estimated.

Research Approach: Review of literature on the long-term trends in key logistics and freight transport parameters. Modelling based on secondary data from national and international sources (e.g. UK Department for Transport, Eurostat, WBCSD).

Findings and Originality: Freight transport accounts for 5-6% of the UK’s carbon footprint. Government and companies are intensifying their efforts to reduce CO$_2$ emissions from road freight transport. In order to identify the most effective decarbonisation measures, one needs to understand the main factors influencing the environmental impact of road freight transport. The relationship between transport volumes and the CO$_2$ emissions generated by movements of raw materials, components and finished products can be decomposed into a series of key road freight transport parameters. This paper presents future trajectories of CO$_2$ emissions from road freight transport based on the projections of changes in these key parameters derived from a range of national and international studies.

Research Impact: There are only a limited number of published studies presenting long-term projections of future volumes of freight transport and related CO$_2$ emissions. Further, previous freight forecasting studies have typically projected future trends on the assumption that freight transport, as a second-order activity, will be correlated to or lag behind some economic indices, most often GDP. This study proposes an alternative approach to the long-term forecasting of freight transport activity and related externalities. The paper focuses on the importance of changes in key road freight transport parameters to the road freight-related CO$_2$ emissions and reviews the availability of relevant data to calibrate the forecasting model.

Practical Impact: This paper will be of particular interest to public sector organizations and transport trade bodies in the UK. By providing an overview of long term trends in CO$_2$ emissions from the sector, this paper will help to inform future freight transport policies and derive feasible reduction targets for the logistics industry.

Keywords: Road freight transport, CO$_2$ emissions, modelling
PIRATES ON THE HIGH SEAS: DESTABILISED SUPPLY CHAIN EFFICIENCY AND PERFORMANCE, THE CASE OF SIDS SMALL ISLAND DEVELOPING STATE SEYCHELLES

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Purpose: To investigate the extent to which escalating pirate activity in the N.W. Indian Ocean (defined as: Suez to the north, 10 degrees south and 78 degrees east), has manifested itself in providing a negative effect upon supply chain efficiencies and performance. There has been a heightened level of pirate activity, which has been adversely affecting supply chains, especially trade routes from S.E. and N.E. Asia to Europe. There has been much enhanced naval activity, including patrols by EUNAVFOR Somalia – Operation ATALANTA, the European Union’s first naval operation. The past two years have seen pirate activity shift from the Horn of Africa, to southern / eastern reaches of the N.W. Indian Ocean, including Seychelles waters. It is this shift of pirate activity and how it manifests itself upon a small island economy, which is the research focus.

Research Approach: Incorporating descriptive research, the extent of this paradigm shift in the nature of sea-going supply chain management in Seychelles’ waters is investigated, with the further application of deductive research methods. The twenty leading supply chain operators serving Port Victoria, Seychelles are surveyed, in order to gauge the extent to which pirate activity is having a marked effect upon their supply chains serving the Seychelles economy. Evaluation of the findings will be proven in order to provide a rational judgment.

Findings and Originality: Whilst much has been written concerning the recent phenomenon of piracy off the Horn of Africa, there is a dearth of data and/or information relating to the actual costs to logistics and supply chain operators in the region, and especially to SIDS small island developing states such as Seychelles which depend wholly upon the sea for their surface-borne logistics supply chain linkages.

This research, which is on-going, aims to measure the impact of such pirate activity upon logistics costs. Interviews and focus groups will be used to augment the research findings, and provide qualitative data.

Research Impact: The paper presents for the first time, factual research-based information relating to the extent of damage and indeed additional landed costs that the advent of pirate activity is causing to logistics efficiency and performance in the region.

Practical Impact: The research will provide base-line measurements of the extent of cost associated with this new pirate phenomenon to Seychelles supply chains. Whilst seeking to provide recommendations for future investigation in this burgeoning area of research.

Keywords: supply chain efficiency, supply chain performance, piracy.
PORT CENTRIC LOGISTICS – A KEY OPTIMISER OF EFFICIENCY IN COST-EFFECTIVE AND SUSTAINABLE INTERNATIONAL SUPPLY CHAINS

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Purpose: Predicated on the proven success of its Jebel Ali terminal in Dubai as a major driver of substantial economic growth, Dubai World has committed to construct the UK’s newest deep-sea container port combined with Europe’s largest logistics park, 25 miles east of central London. Designed to handle the world’s largest container ships, London Gateway provides unrivalled deep-sea shipping access to the largest consumer markets in the UK.

DP World has conducted extensive research to support its significant investment budget and substantiate the intuitive principle that the planned port centric logistics platform will encourage global brands to move away from conventional distribution methods in order to improve supply chain efficiencies, reduce distribution costs, cut road miles and lower carbon outputs.

Research Approach: In-house desk based internet research has been augmented by support from a number of specialist independent consultants. Preliminary analysis concentrated on demographic data to link geographic centres of population with corresponding levels of disposable income. Focussed primarily on retail, electronics and FMCG sectors, importers’ distribution centres were mapped, and basic network modelling conducted to assess the aggregate cost of primary and secondary distribution of imported merchandise arriving into the UK by container.

More detailed studies followed on a case by case basis as importers ventured to explore, through meticulous analysis of end to end supply chain costs, the cost and service benefits of port centric logistics operations.

Findings and Originality: Research has proven that significant cost savings and environmental benefits can be achieved by locating distribution and logistics operations adjacent to port of arrival, principally generated by the removal of primary leg distribution, i.e. transportation of full containers from port to (hinterland) distribution centres, and return transportation of empty containers back to port.

Further benefits can be achieved in the secondary distribution phase, i.e. delivery of goods from distribution centres to sales outlets and/or consumers. The level of benefits in secondary distribution depends on the geographic profile of delivery points, and practical implications of integrating international merchandise with UK-sourced products. As a general rule, benefits and savings increase with proximity of consumer markets to the port of entry.

Research Impact: Sequential research has been necessary to understand the relationships between shipping lines and cargo owners, and the influence of the latter in inducing carriers’ choice of port calls. This has also been swayed by constraints of UK berth capacity capable of handling the increasing size of vessels on order and due to enter service within the next two years.

Practical Impact: Against a background of low growth forecasts, retailers and FMCG companies are wrestling with serious supply chain challenges, with continued pressure on net margin calling for smarter logistics planning and innovation to reduce costs, whilst maintaining availability of a growing product offer. Combined with changing patterns of consumer demand, and demographic shifts of disposable income, the proliferation of multiple channels to market, retailers are under increasing and urgent pressure to re-engineer their legacy supply chain structures. Port centric logistics is attracting the interest of leading importers as a key optimiser of efficiency in cost-effective and sustainable international supply chains.
A BUSINESS CASE FOR DOMESTIC INTERMODAL FREIGHT SOLUTIONS IN SOUTH AFRICA

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Purpose: A business case for an integrated alternative to road and rail competition was not developed in South Africa due to the rapid deregulation of freight transport in the country two decades ago. This was compounded by the deterioration of rail service as a result of low historical investment levels, resulting in intermodal progress over the past decade being limited to discussions between industry players. High national logistics costs, considerable road infrastructure challenges and environmental impact concerns fuelled renewed interest in rail with industry pressure for large investment in rail capital projects. This provided the impetus for pioneering the first quantification of the intermodal gap in South Africa and how to bridge it.

Research Approach: The research employed a quantitative assessment of intermodal market potential (based on gravity-modelling of supply and demand resulting in a route density view of all domestic freight flows). Major drivers of low rail cost are long distances, high densities of freight that require similar equipment, and few origin and destination points. In the model, uniform high value cargo was identified by classifying and measuring all cargo according to commodity characteristics that can use common logistics hubs. Externality costs e.g. emissions, accidents, congestion and policing were added. The research culminated in a business case for investment in a domestic intermodal freight solution.

Findings and Originality: The research provides the first identification of real opportunities for cooperation between road and rail to develop intermodal freight logistics solutions harnessing the strength of each service provider. The results demonstrate that such solutions can save the national economy, freight owners and service providers substantial costs. Cost savings are quantified on a c/tonkm basis as well as overall savings for the identified corridors. Building three intermodal terminals to connect the three major industrial hubs (i.e. Gauteng, Durban and Cape Town) through an intermodal solution, could reduce the transport costs for the identified 12 million tons of intermodal-friendly freight flows on the Cape and Natal corridors by 68% (including externalities). The business case evoked keen interest from government, freight owners and logistics service providers with discussions underway to enable the establishment of an intermodal freight solution for South Africa.

Keywords: Intermodal solutions, freight transport demand forecasting, South Africa
IMPLEMENTATION OF INTERMODAL FREIGHT TRANSPORT AS A TRANSPORT STRATEGY: LOGISTICAL PREREQUISITES AND CONSEQUENCES FOR THE SWEDISH GROCERY RETAILERS

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Purpose: Changes in the logistics system, whether strategic, physical or service-related can be considered just one aspect of prerequisites or outcomes of implementing an intermodal freight solutions. However, these changes are likely to have financial impact, affect other supply chain partners outside the shipper organization, may create opportunities for intermodal transport solutions in ways that previously has not been possible. Thus, these aspects are an important issue in understanding the complexities of intermodal transport from the shipper organization’s perspective and give insight to the barriers preventing and factors hindering the adaptation of intermodal solutions by a larger market.

The aim of the paper is to identify and analyse the changes in the logistics systems that act as enablers and changes that are consequences of implementation of intermodal freight transport solution in the system.

Research Approach: Research is conducted using a multiple case study approach. Empirical data is mainly obtained through in-depth semi-structured interviews with respondents involved in the project development.

Findings and Originality: Certain intermodal solutions get implemented without any major changes in the logistics systems, on the contrary solutions are implemented on strict service requirements that characterized the previous solution and the new solution simply must meet the same conditions. On the other hand, for certain cases changes in the logistical system act as triggers to the change of transport solution that enable transportation of highly concentrated flows. Finally, intermodal solutions itself can result in major changes in the logistics system. In the latter case, the effect of decision to initiate such a change is greatest and thus strong incentives must exist to support such a decision.

Research Impact: Paper aims to contribute to the intermodal research in several ways. Firstly, by focusing on the demand side of the intermodal transport instead of the common view to look at the supply side. Secondly, intermodal research is mainly concerned with operational and technical issues, thus often limiting itself to studying intermodal transport chains outside of its context. In our paper we look at the intermodal transport solutions within the supply chain context, thus broadening the perspective to include organizational and managerial issues, but also to understand how implementation is context dependent (how certain factors outside the transport chain may have impact on the solution) and how the intermodal solution itself may have impact on the context (supply chain), within which it is being implemented.

Practical Impact: Case studies and the conceptual framework a gives a detailed overview and reveals important changes in supply chain and transport link that act as prerequisites or are resulting changes from implementation of intermodal solutions. Moreover, the framework gives structure how to study a potential development process and gives answers to why intermodal R&D is rather problematic.

Keywords: intermodal transport, case study, supply chain perspective, logistics system, change
Purpose: This paper covers ongoing research into procedures to increase the efficiency of loading operations at Corby Works in Kettering, UK. The company has experienced considerable problems in dispatching orders effectively due to an inability to establish whether or not it is possible to place an order on the appropriate vehicle. This problem is modelled as a highly constrained variant of the bin-packing problem and solved using a combination of mixed integer programming and heuristics.

Research Approach: A combination of mathematical modelling and heuristics is employed in order to recognise infeasible loads or to configure feasible ones early in the dispatch process. This results in a considerable saving in time and frustration for the company and increases productivity. However, the need to produce solutions quickly in a demanding environment places heavy time constraints on the process whereby solutions are required on the order of seconds. As a consequence, a number of methods are to be used in collaboration, with mathematical models used to prove instances infeasible and heuristics to find feasible solutions. A dynamic branch and bound approach is also being investigated.

Findings and Originality: The problem has some unusual constraints, including a constraint on the order in which items can be packed due to the need to visit each of four warehouses at most once while loading. In addition, when taken as a whole, the problem’s constraints appear to render standard bin-packing models ineffective, even with very small problem instances. Hence, it is necessary to use a relaxed model to generate solutions quickly, with some constraint combinations evaluated during a dynamic post-processing phase.

Research Impact: It is suspected that some of the problem’s constraints, including the order constraint mentioned previously, are commonplace in real-world bin packing problems. However, we are not aware of any published research tackling it to date. Hence it is conjectured that the techniques used in this study will have significant, general applicability.

Practical impact: The practical impact of this research is potentially huge. Financial savings to the company are expected to be significant for this case study. In addition, it is hoped that similar techniques will be employed throughout the company’s loading operations once this project is complete. The prospect of increasing efficiency on such a large scale may be vital to corporate survival in harsh and difficult economic conditions and so the need to optimise processes has become paramount.
Purpose: This paper presents a study undertaken across six European retailers to investigate the management of replenishment systems in retail stores. The study was conducted from the starting point that retail stock-outs are caused to a large extent at store level. Within stores, replenishment employees and central systems encounter interaction between each other whereby they can influence each other in various aspects and to varying extent. The objective of the study is to identify types of replenishment interaction within store logistics operations.

Research Approach: The study explored and compared six cases of retail companies from different retail sectors from two cultural areas using a qualitative methodological stance. Since most previous research around this topic was conducted in the grocery industry, this study combines cases from the grocery and the non-grocery sector to widen the scope. In each case, semi-structured interviews were conducted at three hierarchical levels: central organisation, store management and shop floor employee. The data deriving from those interviews was then analysed within and across cases by using a social constructionist method resulting in the extraction of a typology.

Findings and Originality: The findings identify four replenishment interaction types. Depending on the amount of interaction and the impact that employees have on the system, retailers can be classified into Operations Focus, Store-based, Customer Care Focus and Outlet types. This study adds to the research streams of out-of-stock root causes and in-store logistics by conducting such a classification of store replenishment management systems for the first time.

Research Impact: This paper amalagates various in-store replenishment solutions into an academic framework. So far retailers operate their own store replenishment management approaches without much academic reflection or insight. The paper therefore reveals and structures this knowledge and makes it accessible to a wider audience. Additionally, it provides a base for further research into the management and design of in-store logistics processes and replenishment operations.

Practical Impact: Management approaches from different companies across sectors and countries are analysed and made accessible. The findings and the resulting framework can be applied for the analysis and design of in-store replenishment management systems. The need for interaction between systems and employees differs between product categories and can be looked at individually. The consideration of categories’ requirements for interaction in the replenishment management allows companies to avoid wasteful behaviour and achieve a suitable level of responsiveness. It also guides retailers in the identification of the skills that their replenishment employees require to satisfy customers.

Keywords: In-store Logistics, Replenishment, Service Process Design
Purpose: In today’s competitive world, many firms in various sectors might not be able to sustain their competitive advantage or even stay in business if they do not have appropriate value-added recovery systems and make profitability from returns due to the large volumes of reverse logistics activities. In addition, several electronic and electrical manufacturers have to deal with take-back operations of end-of-use and end-of-life items due to the WEEE Directive in the European Union (EU). On the other hand, several recovery players consider returns as a potential profit source. Hence, the purpose of this research is to formulate a simulation model to investigate the revenue management impact of multiple recovery options systems affected by the model’s parameters and the results from a questionnaire survey.

Research Approach: The triangulation approach, more specifically the multilevel model is adopted to achieve the research objective. Namely, this study uses mixed research methods combining a case study in the recycled computer sector, a questionnaire survey, and a simulation model as research strategy.

Findings and Originality: The findings of the research are the revenue management impact of a multiple recovery options system affected by the model’s parameters and the results from the questionnaire survey by carrying out “what-if” assessments. The originality of this work is based on the use of the proposed simulation model which addresses some of the previous research gaps as follows: multiple recovery options operations, multiple periods, and the element of uncertainty in terms of return quantity and reprocessing time.

Research Impact: Pricing and revenue management are considered as one of the most critical themes of quantitative models for reverse logistics, since such issues are considered as a niche research area and the fifth phase (prices and markets) of the evolution of closed loop supply chain research. Furthermore, this research area has not been extensively addressed in academic literature to date. Hence, the results of this paper contribute to current pricing and revenue management research.

Practical Impact: Pricing and revenue management of recovered products has become a crucial issue concerning profitability for the computer recycling industry. Moreover, the results from the simulation model have a potential to support decision making in the recovery operations and reverse logistics sector.

Keywords: Reverse logistics, Revenue management, Multiple recovery options
Purpose: Legislative, environmental and economic drivers are moving producers, retailers and service providers towards the establishment of reverse logistics systems to reduce the impact of the supply chain in terms of cost reduction and customer service improvement. Many of the reverse logistics systems developed are led by the original product manufacturers responding to the requirements of legislation. Producer led systems are termed closed-loop since the originator of the product designs and controls the reverse flow of parts for reuse. The insurance car crash repair sector however is an example of a reverse flow of product where the producer is not involved (Aitken and Murray, 2010). The challenges, opportunities and risks faced by this service sector industry in developing an innovative reverse flow of parts is the focus of this research paper. The objectives of the research were to develop an understanding of the following:

1. How does a service company led reverse logistics system standardise product reuse when the original producer is not involved?
2. What information flow is required to support the establishment of an open reverse logistics system for reusing parts?
3. How can service industry firms reduce the barriers to developing an open reverse logistics system?

Research Approach: Reverse logistics (RL) is a concept that has been widely researched since the early 1990s with authors using a variety of terminologies to describe the characteristics of reverse logistics including 3R (Recycle, Reduce and Recover), 4R (Repair, Refine, Redesign and Rethink) and 6R (Recognition, Recovery, Review, Renewal, Removal and RE-engineering). The continued development of the concept reflects the journey which reverse logistics is travelling along to move from a fad to a management paradigm (Towill, 2000). The evolving nature of reverse logistics supported the selection of an exploratory case study approach to answer the how and what research questions. The case studies focused on insurance led supply chains that were planning to develop reverse logistics systems for the repair of vehicles.

Findings and Originality: Changes in governance along the supply chain were found to be pivotal in establishing the RL system. The complexity of knowledge development and management, flexible trading structures and relationship management were found to be significant variables in the establishment of the service company led RL system.

Research Impact: Research into service company led supply chains that establish reverse product flows without the support of the manufacturer is an area that has been poorly researched.

Practical Impact: For practitioners these findings provide an insight into some of the governance and knowledge management developments that are required to operate a service company led reverse logistics system to reduce costs and improve service performance.

Keywords: Service, reverse logistics, governance