

THE STATE OF LOGISTICS: RESEARCH PRIORITIES FOR SUSTAINED IMPROVEMENT

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1. Introduction

The importance of logistics and supply chain management for the South African economy was re-emphasised by findings of the second annual State of Logistics Survey conducted by the Council for Scientific and Industrial Research (CSIR). Total logistics costs remained at 15.2% of the GDP, which is high compared to that of South Africa's trading partners such as the USA, where the logistics costs were 8.6% of the GDP for 2004. Transport costs are rising globally and as a transport-intensive economy, the effect thereof is magnified in South Africa.

South Africa is responding to inefficiencies in its logistics system with, amongst others, the 2005 publication of the National Freight Logistics Strategy (NFLS), which is now in the process of being implemented and requires extensive research support to enable its execution. In order to ensure sustained improvement of the national system, it is crucial that a body of knowledge be developed to inform decision-making, and to inform the national debate on causes of system inefficiencies and proposed improvements. Interventions need to be rooted in a rigorous research programme that takes a holistic view on all aspects of the national system, ranging from a macro-economic perspective on cost drivers to the reduction of the logistics divide between the first and second economy.

A review of international research in logistics indicates that a number of traditional areas in logistics and supply chain management are still widely explored. However, relatively recent events such as 9/11, the tsunami disaster and hurricane Katrina has lead to the introduction of novel research areas such as supply chain security, as well as disaster and humanitarian logistics.

The demands of a developing economy require that the research agenda is wider than the traditional focus on logistics and supply chain management. In addition to a macro view on system inefficiencies, specific areas such as the integration of rural and small businesses, government service delivery, sector cooperation and emergency logistics need to be explored. In addition, research organisations need to expand their roles as providers of research products to being the nodal points from where networks with appropriate research partners can be developed, and through whom appropriate research can be adopted for local application.

This article provides a brief overview of the current State of Logistics and government's response in terms of the National Freight Logistics Strategy. It reviews focus areas in international and local logistics research that were used to inform the development of a framework within which research themes are identified. Such a locally relevant agenda requires collaboration between various role players who conduct research on diverse aspects of logistics, all of which ultimately contribute to the collective understanding of the logistics system.

2. The status of the national logistics system

The current status of the national logistics system is characterised by a number of well-publicised key factors, including the deteriorating road and rail infrastructure, ports inefficiencies, and a cost-ineffective road-rail split of freight.

The State of Logistics Survey takes a holistic, multi-perspective view on the logistics system, and identifies the following as key characteristics of the system:¹

- » The total cost of logistics is at 15.2% of GDP. Transportation cost is the biggest cost driver, and has risen by R13 bn in the past year;
- » Growth in freight volume is predominantly captured by road;
- » Lead industries with respect to supply chain innovation collaborate across industry boundaries to improve the utilisation of the constrained national infrastructure;
- » In cost-sensitive industries, firm-level innovation dominates at the expense of channel-level innovation;
- » Key logistics challenges inhibit government service provision; and
- » Targeted investment is required to allow small businesses access to the national logistics infrastructure

These issues emanate from a number of driving factors. The NFLS highlights two primary aspects, namely prolonged underinvestment in rail infrastructure and a fragmented regulatory environment that is not conducive to optimal performance of the system.

From an economic perspective, the status of both logistics services and infrastructure impacts on the cost of doing business (15.2% of GDP), the ability to be globally competitive, and the potential for economic development. The National Freight Logistics Strategy recognises “the freight system’s inability to fulfil the demand for cargo movement at prices, levels of service, quality of service and at acceptable levels of reliability in a manner that supports national developmental strategies”²

The inability of the National Logistics System to provide equal and cost-effective access to both small and large enterprises is hampering the impact of development initiatives targeted at these businesses. The logistics divide is perpetuated, and the economic divide between small and large enterprises exacerbated.

¹ CSIR, Second Annual State of Logistics Survey, 2005, ISBN 0-7988-5559-2

² National Freight Logistics Strategy, National Department of Transport, 2005

3. Towards an improved freight logistics system

3.1 Background

The National Freight Logistics Strategy³ was developed by the Inter-Departmental Task Team on Logistics (IDTTL), under direction of the Department of Transport (DoT). The team included other key economic departments. The NFLS was accepted by Parliament during 2005. The NFLS is a response to the inability of the freight system to fulfil the demands placed upon it by economic development and the portfolio of national developmental strategies. The NFLS considers the system to be “structurally incapable of appropriately allocating costs and raising efficiency”.⁴ Elements of the system perform well, but the overall system performance, and especially the state of infrastructure, constitutes the bulk of the problem. The view of the NFLS is that an *integrated system-level approach* is required, that shifts the system’s emphasis from a focus on supply towards the demand-driven delivery of freight logistics services. The concise summary of the problem statement that the NFLS responds to is:

“The freight system in South Africa is fraught with inefficiencies at system and firm levels. There are infrastructure shortfalls and mismatches; the institutional structure of the freight system is inappropriate, and there is a lack of integrated planning. Information gaps and asymmetries abound; the skills base is deficient, and the regulatory frameworks are incapable of resolving problems in the industry.”⁵

3.2 The response to the problem

The NFLS developed a vision for freight transport that responds to aspects of the problem statement by re-aligning the institutional and regulatory framework. The purpose is to respond to existing problems, and to provide a means for the transformation of the system in order to support the future needs of both the state’s developmental strategy and role players such as cargo owners and logistics service providers. In order to achieve this vision, government has decided that a fundamental change in its approach is required: it has to play an active role in integrating planning, delivery and assessment in the freight system. DoT will play this integrative freight system planning role across both the public and private sectors. This requires the development of a “freight transport master plan”, which will be discussed in the section on implementation. Government will also take a more interventionist approach to regulating the freight system, moving from modal regulators (that create regulatory gaps in an intermodal system) towards functional regulators (economic, security, safety and environment) that regulate across the entire consignment life cycle (across transport modes).

The vision also has a major impact on infrastructure ownership and proposes three categories, namely⁶:

- » State infrastructure utilities that have a strategic and economic developmental mandate;
- » State-owned enterprises that are commercialised public infrastructure owners with socio-economic obligations rather than a pure profit agenda; and
- » Private sector infrastructure owners.

Separation between infrastructure owners and operators is targeted at achieving vertical separation of infrastructure and operations, combined with open access to infrastructure. An

³ National Freight Logistics Strategy, Department of Transport, 2005

⁴ Ibid, page ii.

⁵ Ibid, page ii, page 4.

⁶ Ibid, page ii

economic regulator will manage the relationships between infrastructure owners and operators.

3.3 The implementation of the NFLS

Two elements are emphasised in the implementation: first and second economy integration with the development of rural freight transport systems from an integrated freight system perspective, as well as an approach to corridor development that prioritises critical corridors.

The IDTTL, led by the DoT, is the guardian of the implementation of the NFLS. The required regulatory and institutional reform will use existing legal, governance and regulatory instruments in the interim, while new regulations and institutions are being created.

The all-important integrated planning component of the strategy will be executed by a Technical Task team, led by the DoT, which will design and implement a “freight system master plan” for the entire country. This will integrate regional plans at provincial, municipal and metro levels. The purpose of this plan is to address the lack of integrated planning within the public sphere of the freight logistics system and between the private and public sectors. The plan is to filter the local level planning up into the Provincial Growth and Development Strategies which will, in turn, inform the master plan. The master plan will be a collation of freight transport plans across the country and will define strategic networks and placement of appropriate facilities and services. The plan will attempt to map out the requirements of the freight system over the medium to long term, and then to use the existing planning context to coordinate delivery of the system components over the period of the strategy.

3.4 Research requirements of the NFLS

The research support required for the freight logistics system master plan includes:

- » Development of **methodologies for accurate freight logistics demand forecasts** over 5, 10 and 15-year periods in order to enable effective planning and infrastructure network strategy development. DoT aims to develop a range of freight demand scenarios that will combine public and private sector initiatives;
- » A wide range of **modelling support for the freight demand forecasts**, namely: modelling the circular impact of increased supply of logistics infrastructure and its impact on traffic demand, as well as econometric models of initiatives such as the Department of Trade and Industry’s (DTI) IDZs and the Department of Agriculture’s agricultural development zones;
- » The development of a **comparison between the forecasts and the planned freight logistics system master plan** in order to do an infrastructure gap analysis between market demand and capacity delivery plans;
- » Methodologies to use the master plan to **assess the current and the planned future freight logistics infrastructure** supply in the public and private sphere;
- » Detailed, credible, freight **traffic information** is required (volumes, types, flows), and must be gathered on an ongoing basis to support the information requirements of the plan. This requires the development of an advanced freight database which can be used to provide input into sophisticated infrastructure and other planning systems. Advanced logistics modelling, tracking and planning systems are also required to provide information for the freight database. The development of a diagnostic national standard in logistics information is also planned;
- » The design of a **planned platform for freight logistics** (supported by the freight database) that will have a multitude of functions, including: provision of information for government policy development and decision-making, provision of access to information to all role players, and provision of a non-proprietary transactional platform to enable supply chain collaboration and performance measurement of key corridors;

- » Integration of the existing DTI corridor **performance measurement platform** into this platform, and research on how to make full use of the freight database and the freight logistics platform.
- » **Regional planning integration.** Freight system planning on at least the SADC level is required, which calls for an audit of the demand and supply picture regarding freight transport in SADC and other African countries that affect South Africa's transport networks and trade flows.

The overall implementation of the vision of the NFLS also requires that a spectrum of supporting research be undertaken, aimed at:

- » Developing a better understanding of rural logistics requirements, in order to achieve the objectives of the NFLS. The NFLS says that "a strong case can be made for research into the logistical requirements of rural SMMEs outside the economic mainstream".
- » Forming a national logistics centre that can coordinate skills development and research by the TETA, unions, academia, and other role players. A skills demand and supply study is required, as well as the modelling of the impact of systemic changes and other variables such as HIV/AIDS.
- » Investigating the corridor aspects of the NFLS, which requires demand analysis, forecasting and the development of a corridor infrastructure and operations investment model. Development of a corridor optimisation strategy is also envisaged.

4. Status of international logistics research

4.1 Overview

When considering the status of international logistics research, it immediately becomes apparent that this is a daunting and almost impossible task. However, it is possible to highlight the main focus areas as well as give some indication of who the main players are in the area of logistics and supply chain management (SCM). There is a growing realisation of the importance of logistics and SCM, and more research is being undertaken internationally. Scientific journals covering these topics are obvious sources of information: a recent article in the *Journal of Business Logistics*⁷ (the fourth in a continuing series of articles) provides an overview and summary of SCM and logistics-related doctoral dissertations. This compendium covers the period 1999-2004 and although it is supposed to include all dissertations, the focus is predominantly on research undertaken in the United States. For this analysis, information from this period only is considered (and not any of the previous compendiums). An interesting trend is the noticeable increase in the number of doctoral dissertations, despite the fact that the requirements for these dissertations have become increasingly stringent. This results in more complex and multifaceted dissertations that cover multiple aspects of logistics and SCM.

Role players in international logistics research include academic institutions and research organisations, as well as private companies and even the military. Company-confidential and military research is not all published for public consumption, which complicates the task of providing a complete overview of international logistics and SCM research. This article sets out to highlight the most important areas and, where possible, give a review of research undertaken in a few specific countries.

⁷ Stock, JR and Broadus, CJ, 2006. Doctoral Research in Supply Chain Management and/or Logistics-related areas: 1999-2004. *Journal of Business Logistics*, Vol 27, No 1, p 139-358.

The major areas of focus for the mainstream logistics and supply chain management journals include:

- » Supply chain management: general issues and topics, with an emphasis lately on supply chain synchronisation, robust supply chains and reducing supply chain complexity;
- » SCM metrics within the supply chain, and measures of performance;
- » SCM collaboration and cooperation among supply chain partners, and how to share benefits;
- » SCM information systems that integrate supply chain operations;
- » Logistics technology, especially RFID⁸;
- » Logistics and its role in SCM;
- » Logistics modelling and simulation of logistics practices;
- » Logistics benchmarking;
- » Logistics customer service and customer satisfaction issues; and
- » Reverse logistics/product returns processing.

There is also an increased emphasis on logistics and SCM topics that are of collective national importance. Security in the supply chain has become a priority since 9/11, and an increasing number of papers on this topic are being published. The Council for Supply Chain Management Professionals (CSCMP) regularly commissions research projects. Four of the more recent projects were on the topics of security⁹, RFID¹⁰, legal and regulatory issues¹¹ and the value of supply chain management¹². A totally new area in logistics and SCM is that of disaster logistics¹³ and humanitarian logistics¹⁴. Recent disasters such as the December 2004 tsunami and hurricane Katrina have illustrated the need for introducing more sophisticated logistics and SCM principles. While research is still being conducted in the traditional areas of logistics such as transportation, warehousing, inventory management, etc, the focus is increasingly on the areas of security, disaster and humanitarian logistics.

An analysis of the doctoral dissertations shows that the dominant traditional research topics are decision-support systems, inventory, miscellaneous transportation, supply chain management and international logistics. More than twenty percent of all the dissertations involve some aspect of decision-support systems. This topic includes artificial intelligence, computers in logistics and SCM, electronic data interchange (EDI), expert systems, forecasting, modelling of logistics systems or supply chains, simulation and technology in logistics and SCM. Miscellaneous transportation research includes topics such as general transportation modelling, routing and scheduling, transportation networks, and transportation policy. There is an overlap between what is published in the mainstream logistics and SCM journals and what is produced as doctoral dissertations.

The origins of logistics and SCM can be traced back to the military. Modern warfare requires constant renewal, and in this regard there is a drive in the military towards introducing the latest developments in logistics and SCM. The converse is also noticeable, in the sense that research is taking place that is specific to military logistics. An example is velocity management¹⁵, where a totally new philosophy to mass stock holding was introduced. This approach addresses the speed and reliability of support processes in order for the logistics

⁸ Radio Frequency Identification

⁹ Helferich, Omar K and Cook, RL, 2002, Securing the Supply Chain, Council for Supply Chain Management Professionals, Oak Brook, Illinois, USA, pp 355.

¹⁰ Abell, P and Kay, M, 2005. Breakthrough Connective Technology: How RFID and Other Applications Are Revolutionizing the Supply Chain, Council for Supply Chain Management Professionals, p 23.

¹¹ Cutler, JM, JR, 2006. Rules of the Game: Legal and Regulatory Issues for the Supply Chain Manager, Council for Supply Chain Management Professionals, p 52.

¹² Manrodt, KB, Gibson, B and Rutner, S, 2005, Communicating the value of Supply Chain Management to your CEO, Council for Supply Chain Management Professionals, p 23.

¹³ Fortune, 3 October, 2005. Mediation on Risk: Hurricane Katrina brought out the worst in Washington and the best in business.

¹⁴ Van Wassenhove, LN, 2006. Humanitarian aid logistics: supply chain management in high gear, J of Op Res Soc, Vol 57, No 5, May 2006, p475-489.

¹⁵ Walden, JL, 2006. Velocity Management in Logistics and Distribution, CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA, pp 325

system to receive what is needed, when it is needed, and without massive stocks in the area of operations.

Most of the international research published is undertaken by researchers at academic institutions. From the journals that were audited, the majority of researchers are from the USA. It seems as if researchers from Europe and Asia mainly publish in their own journals, which are not as widely available as the journals from the USA. The universities in the USA that granted the greatest number of doctoral degrees in logistics and SCM include Georgia Institute of Technology, Massachusetts Institute of Technology, Pennsylvania State University, University of Tennessee and Purdue University.

Data are not available to determine the nature and size of research funding by different countries. In the USA, universities do get funds from industry to support their research programmes and funding is in some cases allocated for directed research to address specific problems within selected industries or companies. In Europe, the European Union has a massive research programme and the funding covers many scientific disciplines. Some logistics and SCM-related research is sponsored in this way.

4.2 Country-specific research

This section summarises logistics and supply chain related research that is being undertaken in countries other than the USA (which has been covered in the previous section). The summary is based on information that was available on the Internet (mostly in English), and is by no means exhaustive.

Canada

In Canada, a new Inter-university Research Centre of Enterprise Networks, Logistics and Transportation (CIRRELT) has just been formed by combining the expertise from five universities¹⁶ in the French-speaking region. The Centre, which will be funded by the Quebec government for the first six years, will focus its research on the supply chain and its supporting networks. The research has therefore been grouped into the following five themes:

- **Logistics networks** – The emphasis of this theme is on the development of concepts, methods and tools necessary to improve the performance of enterprise networks in relation to the new economy. The research is mainly based on optimisation, simulation, systems analysis and artificial intelligence methodologies and covers the following areas: the design of logistics networks and production-distribution centres, re-engineering of manufacturing and logistics processes, integrated life-cycle management, software for collaboration, manufacturing and logistics, system reliability and maintenance, and experimental platforms.
- **Transport networks** – This theme includes research projects aimed at improving the quality, efficiency, ease of use and validity of the different models, methods and tools used for the analysis, planning and management of transport networks. The research focuses on single mode and intermodal systems for urban as well as long-distance transport of both passengers and freight. It includes, amongst others, city logistics and the development of intelligent transport systems for the management and control of traffic flows in real time, and the ability to forecast traffic volumes and times of movement. This theme also covers the development of planning software and software libraries, as well as traffic simulators and simulators of transport systems (e.g. terminals).

¹⁶ Université de Montréal, École Polytechnique (Montréal), HÉC-Montréal, Université du Québec à Montréal, Université Laval. <http://www.centor.ulaval.ca/?ID=0&LANGUE=1033>

- **Information and decision technologies** – This theme includes research aimed at the adoption or development of information, decision and Internet technologies, the modelling of processes and information systems related to logistics networks, or the improvement of the underlying methodologies (optimisation, simulation, etc) used in the other themes. The most recent information technologies such as RFID, geographical information systems (GIS), global positioning systems (GPS) and smart cards allow for the time-space traceability of the activities and resources in the supply chain. This opens a vast field of research on the planning and management of systems by utilising the available information. This theme also covers the development of models and algorithms for the design and operation of the telecommunication systems needed for the exchange of the abovementioned information.
- **Safety and the environment** – The use of transport and logistics networks could present a threat to the safety of humans and the environment. This theme focuses on the impact of production and transport on the environment, regulations for transport safety, accident analysis, the safety of the elderly, the impact of intelligent transport systems on safety and the transport of hazardous materials.
- **Economy and the organisation** – This theme addresses the economic, political and managerial questions raised by the activities of transport and enterprise networks. In particular, it covers research on the demand for transport, the institutional framework that determines the supply of transport, cost-benefit analysis of infrastructure, transport regulations and the functioning of the transport market in general, e.g. the response of transporters to tariff structures. It also includes research on the relationships between enterprises, the management of knowledge and competency networks, global business strategies and the operation and management of international business networks, thus contributing to the development of a theory of enterprise networks. Also of interest is the development of new business models based on the possibilities offered by new information, decision and Internet technologies, especially for the deployment of electronic business strategies to implement integrated logistics processes.

Other logistics research undertaken in Canada includes that of the Research Group for Logistics and Manufacturing at the University of Waterloo¹⁷ and the Centre for Transportation Studies (CTS)¹⁸ at the Sauder School of Business, Vancouver. Logistics and Supply Chain Management research at the former focuses on the integration of manufacturing and logistics decisions, supplier selection and development, the analysis of multi-echelon inventory and logistics systems, transportation decisions in the supply chain, and competition and collaboration between parties in the supply chain. At CTS, research fields include transport economics, policy and planning, land-use modelling, freight security and intelligent transportation systems, maritime and international logistics, maritime transportation and bulk systems analysis, rail cost and productivity measurement, air cargo logistics, policy and strategies for building transport, logistics and distribution hubs, outsourcing and third-party logistics.

Australia

The Logistics Association of Australia (LAA)¹⁹ annually organises and co-sponsors a research project as part of its education and training initiatives. Government and industry are invited to co-sponsor and collaborate in the research. The LAA short-listed the following five research topics, which are considered to be of importance to the Australian logistics and supply chain sector, for the 2006 project:

- » Impact of importing and offshore manufacturing on Australian supply chains
- » Influence of merger and acquisition activity on price and service levels

¹⁷ <http://watmims.uwaterloo.ca/>

¹⁸ <http://www.sauder.ubc.ca/cts/>

¹⁹ http://www.laa.asn.au/research_project

- » 3PL/4PL in Australia
- » Comparative Australian state infrastructure study
- » Strategic “fit” and performance measurement issues in supply chain alliance decisions

The Centre for Freight and Logistics of the Melbourne University Private²⁰ has a particular interest in freight systems integration, the integrity of supply chain systems, and the role and business success of third party service providers as key players in chain systems. Their research programme focuses on “integrating complex export and import freight systems and supply chains (bulk and containerized) that involve ports and shipping linkages; corporate strategies for delivering and capturing value (profit and margins) and business success; the assessment of chain and supply chain integrity; advanced modelling techniques for operational efficiency and for management decision making, and on policy and legislative frameworks for effective integrated freight systems”.

The Centre for Extended Enterprise and Business Intelligence of the Curtin University of Technology²¹ has Logistics Informatics as one of its research areas. Logistics Informatics focuses on information systems to support logistics and supply chain processes. These include: warehousing information systems, web-based e-warehousing systems, warehouse automation, transport scheduling, third party contractors, container and goods track and trace, fleet routing, truck location determination using Global Positioning Systems, order capture and placement, order fulfilment, invoicing, payment systems and virtual logistics systems.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has an Adaptive Supply Networks research programme²² in its Division of Mathematical and Information Sciences. Their research themes include, amongst others, negotiated scheduling, adaptive logistics, complex dynamic networks, and human and electronic collaboration (trust in supply networks). The team develops decision-support technologies that “improve the coordination of joint activities and balance both shared and individual objectives amongst the parties in supply networks”.

Netherlands

In the Netherlands there is a need to find intelligent logistics solutions that will reduce the amount of (especially road) transport, congestion, pollution as well as the space required. As a result, a number of initiatives have been launched over the past couple of years to encourage innovation and stimulate the development and application of knowledge in the field of logistics and supply chain management. Some of these initiatives, like Connekt, are funded through the Bsik (previously ICES) fund with profits from natural gas.

Connekt was established in 1999 by a number of ministries, large companies and trade organisations to “contribute to knowledge that would lead to the implementation of innovative solutions for traffic and transport problems”²³. Connekt is responsible for identifying issues of concern, finding parties to conduct the necessary research and disseminating the knowledge. Their current focus is on “reliable accessibility” for both people and goods, where reliability is used in the sense of being “on time” as well as “secure”. This is being addressed through three themes, namely:

- » accessibility of the main ports (Schiphol airport and ports of Rotterdam and Amsterdam);
- » ICT for mobility, and
- » sustainable accessibility of urban areas.

²⁰ www.muprivate.edu.au/index.php?id=641

²¹ www.ceebi.research.cbs.curtin.edu.au

²² <http://www.cmis.csiro.au/asn/index.htm>

²³ <http://www.connekt.nl/>

Connekt also houses ITS-NL, established by the Ministry of Transport to disseminate knowledge on Intelligent Transport Systems (ITS) and implement ITS in the Netherlands.

The accessibility of main ports includes the logistics processes and the integration of various modes inside the ports, as well as connectivity to the hinterland. Connekt funded research for the FAMAS (First All Modes All Sizes) project, initiated by the Port of Rotterdam to design a new generation of container terminals, including service centres for hinterland transport and inter-terminal transport systems, for the 2nd Maasvlakte. Other completed research projects include:

- » Underground logistics systems – a transport system without delays to link the Aalsmeer flower auction, Schiphol airport and the rail network;
- » Distrivaart – an intermodal network combining the use of inland waterways and road transport for transporting fast-moving consumer goods (e.g. beer) between producers and supermarket distribution centres, and
- » Urban distribution for retail, including the Citybox and Multi-trailer concepts.

Connekt also facilitated the establishment of the TRANSUMO (TRANSition to SUstainable MObility) programme²⁴ in 2004, in which universities, research and development institutes, private companies and government collaborate. The participants contributed € 30 million that was matched by € 30 million from the Bsik fund, to finance the programme's activities for five years. The research themes include:

- » Integrated Logistics Networks, with two projects:
 - National networks – Optimal design of multimodal networks for the transport of bulk material for road construction;
 - European networks – Optimal design and management of sustainable European logistics networks, and
- » Logistics Chain Integration, with five projects:
 - PROTECT – security in freight supply chains;
 - PILOT – the use of knowledge-based expert systems and new tracking and tracing technology (e.g. RFID) to manage large-scale transport systems;
 - DIPLOMA – the use of intelligent agents for web-based collaborative planning;
 - Chain synchronisation in logistics networks (no further information available);
 - ECO (no further information available).

The results of the projects will be tested at the main ports, important transport corridors and transport nodes.

TRAIL is the Netherlands Research School for Transport, Infrastructure and Logistics, a joint initiative of five Dutch universities²⁵. TRAIL research programmes include:

- » Freight transport automation and multimodality;
- » Seamless multimodal mobility ;
- » Chain management and control, and
- » Logistics process control.

TRAIL participates in the Connekt and TRANSUMO initiatives.

In 2000 the Dutch government and agricultural industry established "Platform Agro-logistics", an initiative to encourage innovation in order to improve logistics efficiency in the agricultural sector²⁶. The Platform does not subsidise projects, but instead provides mentors to guide

²⁴ <http://www.transumo.nl/NL/Home.aspx>

²⁵ Delft University of Technology, Erasmus University of Rotterdam, Radboud University of Nijmegen, University of Groningen and University of Twente. www.rstrail.nl

²⁶ <http://www.agrologistiek.nl/>

project participants. Some of its funding is obtained from Connekt. In addition to the Distrivaat and Underground logistics systems projects mentioned above, innovation projects include²⁷:

- » Agribusiness parks;
- » EFFORRT (European Food and Flower Overland Road and Rail Transport) – long-distance express train for the combined transport of passengers, perishable products and other time-sensitive goods;
- » Use of bus lane during off-peak for delivery vehicles;
- » Virtual cattle auctions;
- » Virtual import and export inspections; and
- » Tracking and tracing in flower and meat supply chains.

An agro-logistics Community of Practice (CoP) has been formed to share knowledge and experiences amongst participants of the different projects and to help search for solutions²⁸. Creative workshops are organised for the CoP.

Holland International Distribution Council (HIDC)²⁹ is a private non-profit organisation that aims to strengthen the competitiveness of the Dutch logistics sector in the European market and provides matchmaking services for logistics partnerships in Europe. It also promotes knowledge development and application in order for the Netherlands to maintain its leading edge in logistics. Its knowledge development programme consists of the following themes:

- » European logistics networks;
- » Multimodal networks;
- » Intelligent logistics;
- » Regional logistics projects; and
- » Agro-logistics, as a crosscutting theme that links with Platform Agrologistics.

HIDC collaborates with its members, knowledge institutions and other organisations to develop knowledge and also plays an active role in the dissemination of the outcomes of the knowledge projects. HIDC participated, for example, in the Distrivaat project (see above) and in developing a guideline document for consolidating agricultural loads³⁰.

European Union

The European Union Research and Development funding is coordinated within a general Framework Programme. In the 6th Framework Programme (FP6), which will be concluded at the end of 2006, intermodal transport and logistics were covered under sustainable surface transport in the sustainable development, global change and ecosystems thematic area. The indicative budget for sustainable surface transport in FP6 was € 670 million³¹, which was spread over eight calls, starting in December 2002.

The research domains for intermodal transport and logistics were³²:

- » Freight transport corridors
- » Intermodal freight transport systems, technologies and strategies
- » Intermodal freight transport management systems
- » Motorways of the sea
- » EU coordination and promotion forum on intermodal passenger travel
- » Knowledge base for intermodal passenger travel
- » City logistics

²⁷ Platform Agro-logistics. 2001. Vision Agro-logistics.

http://www.agrologistiek.nl/upl_docs/visie%20agrologistiek.pdf

²⁸ Kranendonk & Kersten. 2005. Mid-life CoPs: Experiences and Alignment. Proceedings of I-KNOW '05

²⁹ www.ndl.nl

³⁰ Michon, M, Duineveld, M & Groothedde, B. 2003. Stappenplan , 'Bundelen en samenwerken doe je zo!' Buck Consultants Int, A&F, TNO Inro report.

http://www.ndl.nl/files_content/pdf/ToolBook_Bundelen_Doe_Je_Zo-dec2003.pdf

³¹ <http://cordis.europa.eu/fp6/sustdev.htm>

³² ftp://ftp.cordis.europa.eu/pub/fp6/docs/wp/sp1/f2_wp_200216_en.pdf

» Logistics best practise

In the 7th Framework Programme there will be a separate thematic area for transport with a budget of approximately € 5 billion. The research domains that will be supported are not yet known.

India

The Confederation of Indian Industry (CII) established the CII Institute of Logistics³³, which is the first of its kind in India. The Institute is located in Chennai and focuses on education and training, information and knowledge, consulting and supply chain improvement projects, and research. It is envisaged that the Institute will become a centre of international excellence in logistics and supply chain management. A current major research project investigates the integrated logistics service provider industry in India. The Institute is also developing a knowledge bank for logistics and supply chain management. In order to populate their knowledge bank, they track developments, research best practises, perform benchmarks and develop new knowledge in logistics and supply chain management.

China

Logistics seems to be a new field of research in China, but there are a couple of logistics research centres at universities such as the Logistics Research Centre at the Nankai University³⁴, the Modern Business Logistics Research Centre at the Fudan University³⁵ (established in 2000) and the Research Centre for Modern Logistics at the Tsinghua University³⁶ (established in 2002). Logistics research at the Nankai University includes the following work for the State Economic and Trade Commission: logistics development in China and a logistics development strategy for China (2001 – 2020), auditing systems and performance evaluation systems for logistics, container transshipment terminals for the New Asia-Europe land bridge and a multi-modal Chinese container system. Other research includes the development of an index to measure the international competitiveness of the logistics industry (ICLI), the contribution of logistics to economic growth in the central city, an analysis of the effects of globalisation on Chinese logistics, 3PL strategic alliances, urban industry logistics strategy, and a container logistics centre for Tianjin port. The Fudan University focuses on business logistics in the manufacturing industry as well as advanced quantitative analysis and decision-making techniques for business logistics. The logistics research programme at the Tsinghua University includes software development for freight scheduling, warehouse management and distribution management, logistics parks and freight terminal planning, logistics strategy development, reverse logistics, etc.

5. Status of local research

The status of Logistics and SCM research in South Africa is not easy to determine, in view of the limited number of publications on the topic, and the fact that there is no local journal that focuses on this topic. There are efforts under way to start a local South African Journal of Transportation and Supply Chain Management, but the first edition has not been published yet.

³³ <http://cii logistics.com>

³⁴ http://logistics.nankai.edu.cn/index_en.asp

³⁵ <http://www.fdms.fudan.edu.cn/en/aboutus/ResearchFramework.asp>

³⁶ http://www.sz.tsinghua.edu.cn/en/laboratories/010_1.htm

Research is typically conducted at universities and research organisations. In this respect, departments that focus on logistics and SCM are located at the Universities of Stellenbosch and Pretoria (a few departments in each case), the Tshwane University of Technology, the Universities of Johannesburg and the Witwatersrand, and Nelson Mandela Metropolitan University. Whether there are activities in logistics and SCM at the rest of the universities in the country is not clear. A list of recent and current research topics at one or two of the local universities follows below:

- » The influence of supply chain collaboration on customer value;
- » Risk management in supply chains;
- » Optimisation of international maritime supply chains;
- » The use made of logistics outsourcing in the wholesale and manufacturing industries in South Africa;
- » The use of RFID in Supply Chain management;
- » The role of transport in achieving NEPAD objectives;
- » The status of logistics and supply chain best practice in the manufacturing sector of South African;
- » Modal split trends in South Africa;
- » An analysis of the impact of the proposed Three Tier Distribution Model on the supply chain of South African Breweries (Ltd);
- » Supply Chain Security: With focus on the South African automotive industry;
- » Strategic supply chain importance of logistics parks in the South African automotive industry;
- » The structuring of African maritime supply chains for higher efficiency;
- » Optimisation of international supply chains through logistics streaming; and
- » Building blocks for supply chain management - a study of inventory modelling.

One would expect similar lists from other universities. The CSIR, as a national research organisation, only recognised the importance of logistics and SCM a few years ago. It recently initiated the State of Logistics surveys and two such surveys³⁷ have been published. In addition, the CSIR has published a number of papers on work in the fruit industry in the journal of the Operations Research Society of South Africa³⁸. This journal is not particularly well known to the logistics and SCM fraternity, with the result that the papers have gone largely unnoticed amongst the audience at whom they are aimed.

While the list of research topics outlined above is impressive, there is no indication of what happens with respect to dissemination of results. The topics reflect some of the issues that are addressed in international logistics research, as well as country and industry-specific research, some of which are presented at local conferences. In this regard the annual SAPICS conference is possibly the most important one. Topics covered at the 2005 and 2006 conferences (SAPICS 2005, 2006) included:

- General topics in SCM;
- SCM Outsourcing;
- Forecasting and Collaborative Planning Forecasting and Replenishment (CPFR);
- SCM integration;
- SCM benchmarking, metrics and performance evaluation using SCOR;
- Traditional topics such as inventory management, warehousing, etc. as well as a few papers on modelling and simulation; and
- New areas such as service level agreements (SLA's), RFID and security.

³⁷ CSIR, First Annual State of Logistics Survey, 2004 and CSIR, Second Annual State of Logistics Survey, 2005, ISBN 0-7988-5559-2

³⁸ (i) Van Dyk, FE and Maspero, E, 2004. An Analysis of the South African fruit logistics infrastructure, ORION, Vol 20, No 1, 2004, p. 55-72. (ii) Bekker J, Mostert M and Van Dyk FE, 2005. Simulation of fruit pallet movement in the port of Durban: A case study, ORION, Vol 21, No 1, 2005, p. 63-76. (iii) Ortmann, FG, van Vuuren, JH and van Dyk, FE, 2006. Modelling the South African fruit export infrastructure: A case study, to appear in ORION June 2006.

While these topics correspond to what happens elsewhere in the world, the publishing of local peer-reviewed papers in recognised journals and the dissemination of research remain problematic.

The private sector also commissions research work, but this is typically aimed at optimising the entire supply chain or elements thereof. Some of this work is entered for the annual Logistics Achievers Award. The work recognised in this way is almost always very impressive, but not published as formal research. Short descriptions of the work are published in Logistics News, and the magazine has endeavored to run an annual conference where the award winners present their work. Again, the wider dissemination of these research results remains problematic.

Lastly, a few South African-authored textbooks covering logistics and SCM have been published. These are comparable to international textbooks^{39,40}.

Funding for local research is very limited, and neither government nor industry is a large contributor to logistics research. The challenge to establishing a viable and sustainable continued research capacity is to secure funding, amongst others from local sources. Indications are that government departments are more favourably inclined towards research funding, especially since there has been a realisation that major problems abound in the national freight logistics infrastructure. In addition, the accelerated and shared-growth initiative (ASGISA) of government recognises the importance of the removal of six constraints to economic growth. One of these constraints is **“the cost, efficiency and capacity of the national logistics system, which was pushing up the price of moving goods and conveying services over distance”**. This illustrates how seriously government views the whole area of logistics and supply chain management for South Africa in the years ahead. To address this specific constraint will require an in-depth and concerted research effort, the funding of which will be critical.

6. Research focus

A review of the international topics in logistics research emphasises that logistics research is driven by, amongst others, demands of and inefficiencies in the economy, the drive to improve national competitiveness and the need to deal innovatively with specific constraints. The research spend needs to reflect the needs of a developing economy and the economic strategy of government.

Logistics pressures in the South African economy centre around addressing systemic inefficiencies that influence export competitiveness, providing infrastructure and services that enable both the first and second economy, and finding innovative means of developing supply chains that can deal with South Africa's distance from most of the major markets.

The development of an efficient logistics system is mostly focused at interventions that have an impact at a national level, such as the development of corridor infrastructure, and the correction of structural cost inefficiencies. However, an enabling logistics system can only create benefits if the operation of supply chains on this system takes place efficiently. This implies that cooperation takes place at sector level, with a focus on taking advantage of opportunities that arise from improved collaboration and resource sharing. In addition, a firm-level focus is needed for individual logistics supply chains to be as effective as possible.

Players in the economy range from large organisations with advanced logistics capability and access to sophisticated infrastructure, to small players that are limited in their capacity to

³⁹ Vogt, JJ, Pienaar, WJ and de Wit, PWC, 2002. Business Logistics Management: Theory and Practice, Oxford University Press Southern Africa, Goodwood, Cape Town, pp 316.

⁴⁰ Hugo, WMJ, Badenhorst-Weiss, JA, van Biljon, EHB (eds.), 2004. Supply Chain Management – Logistics in Perspective, Van Schaik Publishers, Pretoria, RSA , pp. 369.

integrate into sophisticated supply chains. The developmental challenges in the economy are further characterised by a discrepancy between the geographic spread of economic activity and access to logistics infrastructure and services. The need for economic development demands that strategies be developed to provide equitable access to the logistics system, and develop supply chains that are accessible to small and large players. In the context of the SADC region, South Africa's relatively strong position places demands on its logistics capacity, especially when disaster relief or emergency support is required.

The research base is small and relatively fragmented. Logistics research is undertaken by a limited number of universities, and the focus of private research is often to improve firm-level competitiveness. The research focus is further diluted by the fact that logistics is a relatively new research area, which is associated with a large diversity of disciplines ranging from business management to transport economics.

A comprehensive approach to logistics research is required to address the above complexities. The national ability to improve logistics performance needs to be supported by research that considers multiple perspectives on the problem, and enables integrative thinking about solutions.

The following research themes need to form core elements of such a programme:

Theme 1: Addressing structural inefficiencies

An important aspect of ASGISA was the removal of six constraints to economic growth. One of these constraints is "the cost, efficiency and capacity of the national logistics system, which was pushing up the price of moving goods and conveying services over distance"⁴¹. The ability to compete as a nation is critically dependent on an efficient and effective logistics system.

Research to support the development of such a system has a predominantly macro view, and develops a body of knowledge pertaining to:

- » structural inefficiencies and how to address them;
- » economic infrastructure and its impact on logistics;
- » logistics as an enabler of national competitiveness; and
- » implementation challenges of the National Freight Logistics Strategy.

The overall focus of this theme is to improve and maintain national competitiveness, with the aim of developing knowledge to support the elimination of inefficiencies, as well as knowledge that takes a forward-looking view on maintaining a competitive edge through logistics excellence.

Theme 2: Sector cooperation for competitiveness

The firm-level focus on logistics efficiency implies that firms are creating their own optimal operations, without necessarily improving their efficiency as channel partners. Research in this area needs to explore models of integration that enable competition, and that provides sectors with a means of influencing the development of the national system to address their particular collective logistics requirements. The aim of this theme is to develop knowledge that will enable sectors to collaborate for improved international competitiveness.

Theme 3: Small business and rural logistics

The national logistics system is in the first instance focused on developing corridor solutions that will enable the competitiveness of established enterprises and supply chains. While the

⁴¹ Parliamentary media briefing by Minister Mandisi Mpahlwa, Cape Town, February 2006

focus of economic development is on the growth of small enterprises, logistics services and infrastructure are inaccessible and cost-inefficient for such enterprises. In addition, the focus on corridor solutions does not enable logistics access for rural enterprises that are dependent on the secondary logistics network. The aim of this theme is to develop strategies for reducing the logistics divide, both from a rural-corridor perspective, and from the perspective of having small and large players participating in the same channel.

Theme 4: *Logistics modelling*

The national logistics system can only be improved if decisions are based on accurate information. A need exists to develop a suite of models, ranging from a macro-economic to a supply chain perspective, aimed at assisting decision-making. Models are required of the current and projected flow of goods across the network, the impact of alternative strategies for improving the national system and early indicators of under-investment in critical aspects. The aim of this theme is to develop locally relevant tools to aid strategic and operational decision-making at a national level.

Theme 5: *Emergency logistics*

South Africa's relatively strong role in the region places a demand on its logistics system for the delivery of goods in the event of humanitarian crises. These include the delivery of food relief in the case of drought and famine, and the provision of emergency supplies in the case of natural disasters. The aim of this theme is to develop knowledge pertaining to the capacity to deliver emergency logistics support, the impact of the national logistics system on normal operations and strategies for developing the flexibility in the system to respond in emergency situations.

Theme 6: *Supply chain security*

Security concerns in developed economies are placing increasing demands on supply chain security, and traceability of goods along a chain. The ability to compete in these economies is dependent on the ability to comply with security and traceability demands. This places significant demands on especially emerging enterprises. The focus of this research theme is to develop tools and processes that enable cost-effective compliance with security and traceability requirements.

Theme 7: *Firm-level efficiency*

Effective utilisation of the national logistics system requires that individual firms optimise their operations, and engage optimally with the national system. This requires competence and capabilities in a wide range of logistics and supply chain elements. International and local research in this area is relatively abundant. The purpose of this theme is to develop a body of knowledge that will enable firms to optimise their performance, specifically in the context of the particular national logistics system within which they operate.

Theme 8: *Government service delivery*

The ability of government to deliver services is largely dependent on its ability to manage its logistics operations, often in remote areas. Delivery of education, products and services of home affairs and health care are good examples. The logistics focus in government is often still on procurement, and the focus on optimisation of the entire supply chain is lacking. The purpose of this theme is to develop a body of knowledge that will enable improved government service delivery.

7. Role of research organisations

The research focus as outlined above requires that a number of players integrate their efforts for the development of, and participation in, a holistic research programme. Players in logistics research are fragmented, with some focused research being undertaken at firm-level, and the remaining research being undertaken by logistics departments at a few universities. This composition leaves large gaps in terms of a holistic, integrated approach to the research that is required to support national logistics challenges.

In this context, research organisations should redefine their role and re-focus their efforts in order to deliver research with a focus on supporting national priorities, and that forms part of a well-integrated multidisciplinary research programme. To this end, research organisations need to adopt a number of roles that are aimed at establishing the long-term capacity for providing in the national needs for logistics knowledge needs. It is proposed that the following roles be adopted:

Establish a research agenda

The need for improvement of the national logistics system implies a need for research to support efforts aimed at improving the system. Logistics is a relatively young and broadly defined field, and research organisations need to consolidate their efforts in order to deliver research products that are in support of national priorities. To this end, a research agenda needs to be defined that comprises topics that are locally relevant, and appropriate in the context of developing economies.

Explore and enable research networks

The wide variety of topics defined under the banner of logistics implies that the capacity for undertaking research in all related areas is limited. In addition, the sophistication of role players in logistics in a developing economy varies widely. While sophisticated sectors need to be developing flexible export channels, some players are grappling with the basics of access to cost-effective services. As such, local research in logistics needs to be prioritised, and networks need to be developed with international research institutions in order to foster research collaboration and early identification of locally relevant research. In addition, networks with research institutions in other developing economies need to be developed, in order to jointly explore questions that are not addressed in mainstream logistics research.

Establish a multi-disciplinary approach

The nature of business in a developing economy implies that traditional methods of dealing with sophisticated logistics demands are not the only relevant solutions. Complexities such as the integration of low-volume supply chains, and the delivery of goods and (government) services to remote areas with limited resources imply that alternative approaches need to be developed, and that benefit can be derived from a multi-disciplinary approach to logistics research. Interfaces need to be created between disciplines such as macro and developmental economics, sustainability sciences, entrepreneurship, mathematical modelling and industrial engineering.

Logistics research capacity

A limited number of programmes are available for the development of logistics graduates, and the focus is mostly on traditional definitions of logistics. As discussed above, a multidisciplinary approach to logistics research is required in a developing economy. This implies that researchers need to be challenged to increase the scope of their approach to logistics problems, and explore the potential that exists for logistics as an enabler of economic

development. A number of European Union research initiatives can be used to fund collaborative research projects that provide opportunities for developing post-graduate researchers. Cooperation with development agencies can also unlock funds for specialised research areas such as humanitarian logistics.

8. Conclusion

Logistics has a very important role to play in accelerating South Africa's economic development. Logistics infrastructure capacity problems have dominated the logistics debate in recent times, but the NFLS recommends that the logistics system require a range of interventions. The development and implementation of these interventions require a substantive base of both quantitative and qualitative research. A number of research themes that require prioritisation and further debate have been identified in this paper. National research capacity in logistics needs to be strengthened by international research collaboration, with the aim of building local capacity and optimally leveraging international investment in logistics research.

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