An exploration of the New Zealand use of technology to facilitate logistics

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Abstract

This paper summarises a survey to understand the current state of adoption and use of Logistics Technology, encompassing both information technology and materials handling technologies, in New Zealand. An exploratory survey was distributed to appropriate firms. We present descriptive statistics relating to the reasons for adopting the technologies, the drivers for adoption, metrics used to establish whether the technology has increased value, and the education and training provided relating to these technologies. We find that inter-firm technology and measurement is uncommon, Followers are still likely to be implementing transactional and internally integrative technologies, Leaders are more likely to be planning to implement materials handling technologies and are more sophisticated in their educational and training programmes.

Keywords

Logistics Technology, New Zealand, strategic investment, exploratory research.

INTRODUCTION

The movement and flow of goods throughout facilities and the wider supply chain helps firms within the supply chain to achieve one of their key objectives – the placement of the right product in the right place at the right time. This work has been greatly aided in recent decades by advancements in technology and infrastructure in many countries that have allowed firms to progressively satisfy more customers, seeking a more diverse range of goods, while not incurring significantly higher costs. In particular, the changes in the range of technology available, both those relating to the physical manipulation of products and information technology which helps to organise and facilitate the use of information relating to the products, has rapidly advanced in ways that help logistics significantly.

This research was undertaken as part of the Logistics Technology report series, run for the first time in New Zealand in 2014 and which will also run in Australia in 2015. The New Zealand economy remains reliant on the movement of physical goods as part of our import and export activities (Spanjaard & Warburton, 2012). This flow is facilitated by logistics activities relating to the physical movement of products. Those technologies that improve this flow and physical movement of goods are Logistics Technologies. They may be as simple as a delivery truck that is running on electric batteries instead of a petrol engine, or the use of more sophisticated information systems (IS) that make an alert when a supplier has dispatched specific products.

There is surprisingly little discussion about logistics given the crucial role that logistics plays in New Zealand. There is a strong reliance on exports, including many perishable products like dairy and meat products. Local logistics infrastructure must also manage country-specific challenges; e.g., remote regions with challenging road and train conditions, seasonality of products with uni-directional transport requirements, and limited

transparency of supply chains due to missing tracking at change of transport points (Spanjaard & Warburton, 2012). With logistics technologies rapidly evolving around the relevant needs, the focus may shift towards awareness of upcoming technologies and consideration for changes. This is especially true for both the technologies that support the physical material flows as well as the IS-based approaches that support effective materials flows and allow sharing information between trading partners. At present, some New Zealand firms still use basic computers and print out documents (e.g., they work with 'pen and paper') while other firms use almost entirely automated logistics technologies (e.g., advanced computer systems, data warehouses, and robots moving items throughout the workspace without needing input or supervision from staff). This significant difference in adoption and use of logistics technologies has not been yet examined in New Zealand.

This research starts a series which will identify over the next years the changes about what logistics technologies are being used in New Zealand, what types of organisations are using which technologies, which adoptions are successful and why they are successful. It will indicate future areas for research and the outcomes will inform teaching practices. This paper introduces the research series with an overview of existing literature and describes the exploratory survey method that we used. We present the results from the survey in New Zealand, highlight some of the key implications and outline areas for future research. The survey will be replicated annually, mapping the change over time regarding the technology, allowing stakeholders to learn about recent developments and understanding the potential market of the upcoming year. The data is enriched in future years by not limiting the focus on the local market and its infrastructure, but by reapplying an adopted version of the survey in further countries; i.e. the countries most goods are exported to.

LITERATURE REVIEW

While there are many technologies that support the logistics in a supply chain, we limit discussion to identification systems (e.g., radio frequency identification [RFID]), the use of management systems (e.g., ERP systems), and provide an overview of related literature on the adoption of IT innovations.

Identification systems

The successor of barcodes, RFID, enables automatic identification of goods and real-time data collection. While identified as a promising revolution in supply chain management, the uptake has been slower than it was initially anticipated (Thiesse, Staake, Schmitt, & Fleisch, 2011). Major retailers and manufacturers are testing and implementing RFID in their businesses. Wal-Mart, one of the early adopters of this technology on a large scale, reported that RFID reduces stock-outs by 21% and eliminates the need for manually placing orders; Metro Group identified significant savings in labour cost and time (J. Leung, Cheung, & Chu, 2014).

The principles of RFID are transferring and receiving data amongst objects and the reading device; even without requiring clear eyesight. The major components for RFID are tags and readers. A tag is a small device, which has substrate material with a microchip (to store data) and an antenna (to transmit data). Tags may be 'active' (using their own power source for transmission and therefore are more expensive), 'semi-passive' (transmits when requested, less power consumption, more affordable), or 'passive' (requiring an electro-magnetic field to fuel the transmission, generally induced by the reader); they can be read-only or can write and change the data encoded on them. A reader powers and transmits data to and from tags. An overview of the components and principles of RFID is provided by Kumar et al. (2009).

A three-step process of evaluation for RFID projects (viz., benefit identification, benefit forecast, and benefit assessment) has been proposed by Baars, Gille, and Strüker (2009). Advantages include the ability to capture and use real-time sales data, helping retailers to know actual sales and product availability. Second, RFID improves replenishment and category management so suppliers can place a replenishment order as soon as the inventory level reaches a predetermined level. Third, RFID can track the flow of products from suppliers to retailers and vice versa, helping to detect stock losses, increase customer service level and decrease safety stock level. Fourth, RFID saves the labour cost, especially in warehouses and distribution centres. An overview of benefits of RFID use is provided by Kima and Glock (2014).

There are significant challenges implementing RFID. First, the cost of using tags far exceeds the cost of printing barcodes, particularly the use of active tags. Second, there is no accepted single global standard. Third, reliability issues relating to products or items in the working environment that disrupt radio signals. Fourth, security issues raise the possibility of remote- and undetectable-theft of data from tags. Despite the many challenges, RFID is still a promising revolution in supply chain management. It improves the efficiency of logistics and supply chain management by providing applications to reduce stock out situation, inventory shrinkage, improve shipping accuracy, reduce labour cost, and increase customer service level.

With increased computerisation, visual identification is becoming a trend in logistics. Rather than using expensive tags for products, camera system and algorithms to recognise products, scan labels, or monitor the fill rate of shelves. This development is further promoted by wearable technologies for workers; e.g., Google Glass. The main advantage is that in many cases existing technology can be reused (e.g., the surveillance system to protocol the shelf status), the reading rate is higher than other identification systems, and the setup of cameras is simple and causes less interference with the surrounding structure. However, the system is not able to scan packaged product bundles (SCDigest Editorial Staff, 2013).

Management systems

There are various forms of Logistics Technology to aid the movement and management of goods (Wood, Reiners, & Pahl, 2015), including five key categories. First, logistics information systems as transactional systems to capture changes in information on materials movements. Second, transport management systems enable improved vehicle routing (Suzuki, 2012), loading (Zhang et al., 2012), and planning (Li, Taudes, Chao, & Hanping, 2011). Third, geographic information systems (GIS) incorporate real-time data and changes with actual transport networks ant traffic conditions to enable adaptive logistics responses (S. C. H. Leung, Lim, Tan, & Yu, 2012). Fourth, predictive and optimisation support systems such as the use of advanced planning systems (APS) to manage inventory over multiple echelons, considering transport and production (Stadtler, Kilger, & Meyr, 2010). Fifth, supply chain event management (SCEM) allowing identification of execution from a plan, allowing managers to take corrective actions (Pahl, Voß, & Mies, 2005). Enterprise resource planning (ERP) systems have moved from a transactional focus towards encompassing a wider range of functionality and often subsume or incorporate these other forms of Logistics Technologies.

Technology for transport vehicles, materials handling systems, and packaging

Logistics is not solely improved by implementing the latest management systems as this has little benefit if the hardware support the flow of materials is out-dated. Technology upgrades are done all areas; yet there is a noticeable focus on established and less emerging technology. One reason is the availability as a read-to-use product, but also lowers the risk by minimising the impact of failures as part of the new context and long-term studies for reliability. Examples of Logistics Technologies that are not yet widely established are smart vehicles, smart agents, gesture control, or smart boxes. One reason for this (other than risks) for this low level of investment in Logistics Technology is the limited knowledge and restricted access to experts to implement the technology. Given the need to attract international investors and maintain global access to markets, it may become necessary for local investment in these technologies and particularly investment in supporting education.

Applications of Logistics Technologies in warehouses include (management information systems, pick-to-light systems (Ramaa, Subramanya, & Rangaswamy, 2012), ‘smart’ conveyor belts with integrated scanning devices to manage flow of items (Boysen, Briskorn, & Tschöke, in press), or new shelf-systems (e.g., AutoStore)), smart packaging (e.g., sizeable container or light container), or smart- and self-guided vehicles (e.g., automated trains at Rio Tinto, self-driving trucks).

Insights from international trends

Many New Zealand firms are small- and medium-sized enterprises (SMEs) which often face limitations relating to their ability to make investments – particularly true when we consider new technologies. SMEs also struggle to make decisions and manage the change process as they lack sufficient internal resources and the correct skills set in their personnel to make effective changes.

The ability to access government funding and support can often be crucial to enable SMEs to adopt appropriate technologies. However, the ability to use funding effectively within the organisation is also important. This element of organisational planning is a key barrier to the adoption of IT by SMEs (Kollberg & Dreyer, 2006); there is an emphasis on short-term planning, while long-term planning is more commonly conducted by larger organisations. Without effective planning, large-scale implementation of new Logistics Technologies are subject to the same risks as any other large project and can lead to cost overruns, delays in introduction, or a scaling back of features which may limit the overall value offered by the technology (Brueggen & Luft, 2014).

Other organisational barriers include the owner-manager context (which we didn’t explore in the present research); indicated as leading to delays in adoption in many cases (e.g., Al-Qirim, 2007; Gono, Harindranath, & Özcan, 2013; Iddris, 2012; Ifinedo, 2011a, 2011b; Zilber & de Araújo, 2012)). These studies spanned developed and developing countries, indicating a strong and widespread barrier.

Technological barriers are relevant and relate to an awareness of what is possible and tracking changes in technology trends (e.g., Patterson, Grimm, & Corsi, 2003); it is relevant to firms in developed and developing nations. Furthermore, IT competence within the firm was considered important (Evangelista, McKinnon, &

Sweeney, 2013). Yet, others considered access to external experts as important. This was true both in developed (e.g., Al-Qirim, 2007) as well as in developing nations (e.g., Gono et al., 2013; Kapurubandara, 2009)

Overall, Wood and Wood (2014) discuss how many external factors are not barriers *per se*, but represent merely influences on technology adoption; three key factors emerge. First, *regulatory or legislative changes* can instantly impact on the requirements on how logistics firms operate. Second, the *lag of technological capabilities by legislation*. Adoption of technology often raises issues that legislation may take a while to address. Meanwhile, firms in many developing nations may 'leapfrog' by jumping several generations of technology and immediately adopting a more advanced technology. Third, *the presence and exertion of influence of strong firms in the supply chain*. Such firms may mandate changes that directly impact suppliers or customers. Alternatively, they may provide access to systems or technologies (at their own cost) for the suppliers with the intention to support their own (and eventually the suppliers') outcomes.

Summarising the findings, developing countries face operational and technological barriers while developed countries face other (generally) external influences. New Zealand and South Africa seem to overlap both these categories, facing many of the same barriers to implementation of new technologies.

METHODOLOGY

The exploration and examination of the use of different types of technologies in the New Zealand market has not been well established. To some degree, the use of information technology (IT), information and communications technologies (ICT), or information systems (IS) has been conducted, as outlined in the literature review section. However, the present research takes a different approach as it specifically examines the use of technologies to aid and facilitate the movement and flow of goods. Therefore, it goes beyond merely examining the use of IT but also examines physical materials handling technologies; e.g., forklifts, AGVs, and conveyor systems.

The purpose of this research is to understand and evaluate the current state of Logistics Technology adoption and use in New Zealand and to identify and analyse changes in trends over time. This requires a longitudinal approach with collection of data at multiple points.

An online survey was created and invitations to participate were distributed to key contacts in the industry. At first, participants included industry members known to the researchers through their involvement in industry groups and advertised by various groups with an interest in logistics and supply chain management. Publicly available contact details of parties that may be interested were used to email out invitations. Finally, the dissemination was extended by allowing everyone to forward invitations to other parties they believed may be interested in participating. The survey was further advertised in other mailing lists to other industry groups. While a larger number started the survey, 31 surveys were used for the analysis. Even though the participants answered the survey only as fully as they felt comfortable with; it was sufficient to be considered further on. The survey was running from November 2013 to February 2014.

Early in the survey, we asked participants to self-report on their level of maturity of use and management of Logistics Technology. Using this classification, analysis involved division of responses into "Leader" (those that had responded that they are mature in their use of Logistics Technology; 10 respondents [32%]) and "Follower" (those that reported being less mature in their use of Logistics Technology; 21 respondents [68%]).

Many respondents reported coming from the wholesaling / distribution or transport sector (Figure 1). Few were from manufacturing, where logistics is not generally a key competitive priority and is often outsourced to third party logistics (3PL) firms. Demarcation by sector is not necessarily possible, however; one respondent noted the scope of their firm is expansive enough to cover many of the sectors listed. Similarly, this may have been true for some of the other respondents from large firms. Within the survey, we had good participation from larger firms (45% of respondents reporting 100+ employees) and this may have exacerbated this problem of isolating a specific sector that the firm operates in. There was a diverse participation from a range of firm sizes (Figure 2). The proportion of employees that work in logistics-focused roles differs markedly over the firms, with 42% of respondents reporting only a small fraction of 0-10% of employees working in these roles (Figure 3).

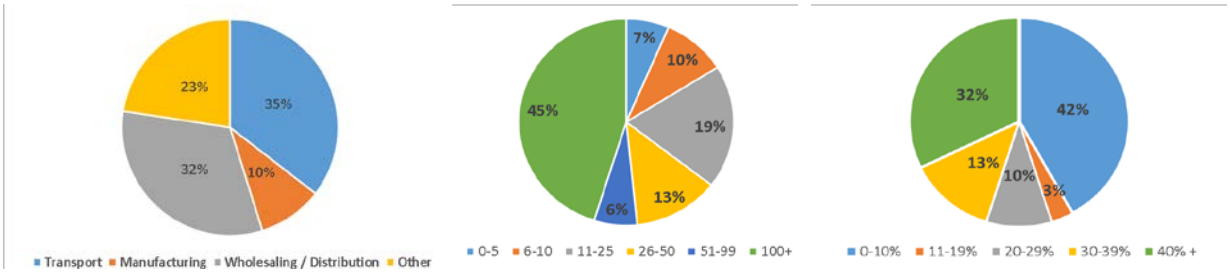

Figure 1 Industry sector membership (Based on Figure 1, Wood and Wood (2014, p. 1)

Figure 2 Approximate number of employees (FTEs). (Based on Figure 2, Wood and Wood (2014, p. 2)

Figure 3 Approximate proportion of employees in logistics-focused roles. (Based on Figure 3, Wood and Wood (2014, p. 2)

OVERVIEW AND EXISTING USE – VALUE FROM LOGISTICS TECHNOLOGY

There is a range of different technologies that can be used in ways that support logistics. Some of these are transactional (e.g., enterprise resource planning (ERP) systems) and used to capture and record movements and locations of items. Others help logistics firms to manage assets and locations (e.g., global positioning systems (GPS) or to coordinate the flow of goods between trading partners (e.g., vendor managed inventory (VMI) or contracts management systems).

We found that most respondents use ERP systems (69%). This is unsurprising as ERP systems are foundational in delivering internal integration of functions and are a pre-requisite before firms move towards external integration and serious commitments to inter-firm collaborative approaches. Similarly, around 31% of firms reported that they used contract management systems, indicating a strong commitment to internal integration.

Interestingly, inter-firm system approaches were moderately well-represented. The use of VMI and collaborative planning, forecasting, and replenishment (CPFR) systems was moderately high 46%. A small proportion of firms were using company-government portals (15%); this may be due to the fact that not all firms needed to engage directly with government agencies if they were not involved in cross-border movements or regulated goods. Only three firms reported the use of customer-supplier portals. These portals represent a technology that can be rapidly scaled up and employed by many firms to improve inter-firm integration of processes and it was surprising that only such a small number of firms report that they use this approach.

Identification of goods and asset management was clearly important, with 46% of firms using GPS. Despite significant discussion on the use of RFID systems in the popular press and research indicating it is due to explode in the near future, only one respondent indicated that this was a system that they used in their logistics.

Measuring value

Commonly used supply chain metrics include those used in the SCOR model on Level 1 (Bolstorff & Rosenbaum, 2012, p. 58); i.e. reliability, responsiveness, flexibility, costs, and asset management (see Table 1). The Logistics Technology survey included several metrics, which were then categorised against the SCOR metrics. However, the survey did not include measures relating to supply chain responsiveness, while other included metrics do not match any category and are not further considered. The questions about the metrics were not answered by all survey participants, yet the summed responses provide clear insight in what kind of metrics (category) Leaders or Followers, respectively, use. The Leaders use a wider range than Followers, particularly around reliability and flexibility. Leaders and Followers are equally interested in cost-focused measures. The numbers are higher in the reliability category as most of the items in the survey are subsumed by this category.

Many of these metrics are intra-firm measures. Leaders reported greater use of inter-firm metrics than did Followers. Followers still require significant internal integration work and improvement before making a serious commitment to integrating with supply chain partners and improving inter-company logistics.

Table 1 Metrics used to measure performance of Logistics Technologies

Metrics	Leaders	Followers
Reliability – delivery to the right place, right time, right quantity to right specification	16	8
Responsiveness – speed that products can be supplied to customer	*Unmeasured in survey*	
Agility/flexibility – ability to implement changes to maintain or gain competitive advantage	4	1
Costs – costs of operating supply chain processes	3	3
Asset management – effectiveness of asset management; both fixed and working capital.	1	0

Changes that have been made over the last year

Despite the 'rock star status' of the New Zealand economy (O'Sullivan, 2014), many firms still appear reluctant to make significant investments. Therefore, we examined the changes that have been made over the past year. We would anticipate that many firms are still making moderate investments and upgrades to their technology, given the increasing availability of technology and the global connections. Of interest is what type of organisation is investing in which types of technology.

The data we gathered are too sparse to draw definitive conclusions, but descriptive analysis shows that the Followers are tending to invest in transactional systems. Particularly, there are still many organisations that is still investing in order management systems as well as systems to support the automation of processes and

planning, quality management, and integration with sales and marketing. In contrast, Leaders (who we assume to generally have robust transactional systems) focus on using technology more broadly. Similarly, technologies like GPS are only of value to a firm if they have already achieved internal integration. This is reflected where we see Leaders are more likely to be investing in a wider range of non-transactional technologies.

Value from Logistics Technologies

The business drivers that are pushing managers to adopt particular types of technology are important. The dominant driver for Leaders to use technology is cost reduction (mean of 4.7 with a low standard deviation of 0.49), followed by Health and Safety and Supply Chain Efficiency; an expected result as these have traditionally a significant impact on cost, profit, reputation, and, thus, customer satisfaction. These are also top-drivers for the Follower, in addition to Higher Profit Margins. End-customer experience, risk reduction, internal process and quality improvements as well as Supply Chain Transparency are all areas that Leaders considered to be significantly more important drivers for change than the Followers (Table 2). Note that only two Followers answered this question, leading to a low standard deviation in responses.

While many firms seem to agree that these are important drivers (low standard deviation), the drivers that are most controversial are those relating to environmental factors: sustainability and carbon emission reductions are both drivers with the highest standard deviation amongst both Followers and Leaders, indicating significant disagreements in the fundamental importance of these drivers.

Table 2 Drivers of technology use

	Leaders		Followers	
	Mean	**StdDev**	**Mean**	**StdDev**
Cost reduction	4.7	0.49	4.0	0
Health and safety	4.6	0.79	4.0	0
Supply chain efficiency	4.6	0.53	4.0	0
Higher profit margins	4.4	0.53	4.5	0.71
Sales/revenue growth	4.4	0.53	4.0	0
Service level improvements	4.4	0.53	4.0	0
Risk reduction	4.4	0.53	3.5	0.71
End customer experience	4.4	0.53	3.5	0.71
Internal process improvements	4.3	0.49	3.5	0.71
Quality improvements	4.3	0.12	3.9	0.50
Supply chain transparency	4.0	0.82	3.5	0.71
Sustainability	3.9	1.46	4.0	1.41
Cost avoidance (e.g., avoiding contractual penalties)	3.7	0.76	3.0	0
Working capital improvements	3.6	0.98	3.5	0.71
Carbon emission reduction	3.3	1.38	4.0	1.41
Inter-firm process improvements	3.0	0.82	3.0	0

Value derived from the use of technology: Efficiency, Service Level Improvement, and Health and Safety have been reflected as one of the key values that Leaders have derived from their use of Logistics Technology (Table 3). Firms agree, both Leader and Followers, on the value of inter-firm process improvements with relatively low ratings, indicating a currently strong focus on intra-firm values. Followers see the highest value in the end customer experience and an efficient manufacturing process; yet these results are of low significance due to the low number of firms in this category. Areas around compliance (border or regulator and to contract) have high levels of standard deviations; as do lead time reductions, fasters speed to market, quality, manufacturing efficiency, working capital improvements, and carbon emissions.

Table 4 shows the planned investment over the next 12 months in Logistics Technology. Leaders are generally investing in materials handling technology (conveyor belts, sorting technology, storage) and software systems (internal IS, ERP, VMI). The overall low investment in inter-firm technology (e.g., E-Systems, collaborative tools) as well as tracking technology (e.g., RFID) is surprising; all with a relatively high agreement among the Leaders. In contrast, Followers are showing interest in software systems (IS, ERP, VMI), yet with an inter-firm trend. Table 4, as well as the study in general, shows that the Followers realised that Logistics Technology and especially software systems are important to gain a competitive advantage, thus the larger planned investments. Furthermore, the Followers demonstrate a less conservative strategy; i.e., investing in alternative energy (bio fuels) and linking the goods (bar coding systems) and customer (e-payment) to the system.

Table 3 Value identified from the technology in the last year

	Leaders		Followers	
	Mean	**Std Dev**	**Mean**	**Std Dev**
Supply chain efficiency	4.7	0.52	4.0	0
Service level improvements	4.5	0.55	4.0	0
Health and safety	4.3	0.52	4.0	0
End customer experience	4.3	0.52	4.5	0.71
Sustainability	4.3	0.82	4.0	1.41
Sales/revenue growth	4.2	0.75	4.0	0.71
Higher profit margins	4.2	0.41	3.5	0
Cost reduction	4.2	0.41	3.5	0.71
Risk reduction	4.2	0.41	3.5	0
Innovation	4.2	0.41	3.9	0.71
Internal process improvements	3.8	0.75	3.5	0
Lead time reduction	3.8	1.47	4.0	0
Documentation Accuracy	3.8	0.41	3.0	0
Faster speed to market	3.7	1.51	3.5	0
Compliance to contract	3.7	1.37	4.0	0
Quality improvements	3.7	1.37	3.0	0.71
Inter-firm process improvements	3.3	0.52	4.0	0
Carbon emission reduction	3.3	1.37	4.0	1.41
Working capital improvements	3.2	1.30	4.0	0.71
Manufacturing efficiency	3.2	1.83	4.5	0.71
Cost avoidance (e.g., avoiding contractual penalties)	3.2	1.72	4.0	0.71
Border or Regulatory compliance	3.2	1.72	4.0	0.71

Table 4 Planned level of investments over the next 12 months

	Leaders		Followers	
	Mean	**Std Dev**	**Mean**	**Std Dev**
Conveyor belts	3.4	2.19	1	0
Sorting technologies	3.4	1.82	1	0
Storage	3.4	1.82	1	0
Information systems (internal)	3	1.41	2.33	1.15
Enterprise resource planning (ERP) System	3	1.87	2	1
Vendor managed inventory (VMI) System	3	2	2	1
New forklifts	3	1.87	1	0
Computer system in all areas of the business	2.8	1.64	2.67	1.53
In-bound logistics	2.8	2.05	1	0
Information systems (external, bridging with partners)	2.6	1.34	1.67	0.58
Wrapping Systems	2.6	2.19	1	0
Automated Container loading or Unloading	2.2	1.64	1	0
Bar coding system	2	1.22	2	1
Voice order picking	2	1.73	1	0
Bio fuels	2	1.73	2	1.73
Radio frequency identification (RFID) implementation	1.8	1.79	1.67	1.15
Automatic storage and retrieval system (ASRS)	1.8	1.79	1	0
E-Auctions or Tenders systems	1.8	1.79	1	0
E-Payment systems	1.8	1.3	2	1.73
E-Catalogues systems	1.8	1.3	1	0
Collaborative e-design or groupware	1.8	1.3	1	0
Collaborative e- workflow	1.8	1.79	1	0
Automated Pallet stacking	1.6	1.34	1	0
New Automated guided vehicles (AGV)	1.6	1.34	1	0
E-Government systems	1.6	1.34	1.33	0.58
E-Training tools	1.6	1.34	2	1.73

Skills and education

Many senior employees in manufacturing and logistics today would have been required to completely understand their business and likely 'worked their way up' from junior roles. Employment decreased in 2008 and remained relatively static until 2012 (Ministry of Business, Innovation and Employment (MBIE), 2014, p. 2), possibly resulting from the impact of the Global Financial Crisis. However, in 2013 and 2014, employment began to increase. This is reflected in supply chain focused recruitment as well, where "[t]here were a number of attractive procurement and supply chain opportunities at all levels with senior demand planners and supply chain analysts in particularly high demand" (Robert Walters Survey 2013). This is also reflected by the inclusion of Procurement Managers on the New Zealand long-term skills shortage list (Immigration New Zealand, 2014).

Upskilling staff is important and the survey showed stark differences in the approaches taken amongst our respondents (Table 5). We would expect large firms to be able to invest more time and resources in externally

provided training opportunities. We found that Leaders invest in both practical, in-house training but also in external training and formal training opportunities. Followers tend to focus on job-based training. This may be a reflection on the learning styles workers demonstrate in many logistics and supply chain roles, which may not particularly attracted to 'book-based' learning; while there is little evidence of this, students in a construction management programme indicated a preference for active learning styles (Hamzeh & Jacobs, 2010).

We consider these differences to be important as the Leaders have staff that are engaging with external parties to gain formal qualifications or attend conferences and workshops. During these events, staff will be exposed to other ideas and concepts, which they can use to improve their own workplaces, expand their business networks, and access the latest research and technologies. Now, even formal training programmes seem to become more 'active' rather than having students passively learning from books or lectures (Wood & Reefke, 2010), creating a more inclusive environment suitable and to those already working in this area.Over the last year, Leaders have made much more significant investments in training and development relating to Logistics Technology than Followers have (Table 5). Furthermore, Leaders are more likely to relate Logistics Technology to personal development plans or objectives for staff, linking technologies to staff development.

Future trends are likely to encompass a greater use of online learning technologies, offered in a 'buffet style' allowing smaller organisations to 'scale' their training programmes by selecting relevant modules and not paying for modules they consider to be less relevant. Yet, the nature of these training packages are also rapidly changing as they move towards 'gamified' environments which use elements more commonly found in games to encourage participation and encourage behavioural changes (Kapp, 2014). In particularly, rapid advances are being made in the incorporation of artificial intelligence (for a full review, see Wood and Reiners (2013)).

Table 5 Methods of training and education used

	Leaders		Followers	
	Mean	**Std Dev**	**Mean**	**Std Dev**
Practical on the job learning (e.g., buddying or mentoring)	4	0.71	3	0.00
Studying towards formal qualifications	3.2	0.84	1.5	0.71
Attendance of external courses (e.g., University or Polytechnic)	3.2	0.84	1	0.00
Attendance of external events (e.g., conferences and workshops)	3	1.22	1.5	0.71
E-learning (internally developed)	2.4	1.95	2	0.00
Classroom training (internally developed)	2.4	1.14	1	0.00
Classroom training (externally developed)	2.4	1.34	1	0.00
E-learning (externally developed)	2	1.22	1.5	0.71
No training in the last year	1.6	0.89	1.5	0.71

Table 6 Importance of Logistics Technologies in development plans

	Leaders		Followers	
	Mean	**Std Dev**	**Mean**	**Std Dev**
To what extent do Logistics technologies related goals/activities inform individuals' personal development plans / objectives?	4.2	0.84	1.3	0.58
Over the last 12 months, to what extent have you invested in training and development specifically to prepare your staff for Logistics Technologies	3.4	0.89	1.7	0.58

CONCLUSIONS

This exploratory research investigated the adoption and use of Logistics Technologies amongst New Zealand enterprises. It focused on the types of technologies, reasons driving adoption, metrics used in measuring value, and educational opportunities. While we had a small number of participants, it became clear that the Leaders have been investing in more sophisticated Logistics Technologies while Followers have still been working on implementing transactional systems. Leaders use a wider range of metrics to evaluate the successful use of their Logistics Technologies, while Followers rely more heavily on reliability metrics. Leaders offer a more Logistics Technologies educational opportunities with much stronger use of external training opportunities.

This paper provides a glimpse into the New Zealand companies and their use of Logistics Technology. It provides a first understanding in how firms, Leaders as well as Followers, plan their investment on Logistics Technology and what is their driver to do this. However, as an exploratory study, we acknowledge that the small sample size of Leaders and Followers challenges statistical generalisability of our findings and these insights should be treated as exploratory only and used with caution. The New Zealand marketplace differs in nature from other markets; caution should be taken when generalising from these results to other markets.

Future research should explore these elements with a larger sample size and seek to understand how these changes occur over time. In particular, the lack of investment plans and interest in materials-handling technologies and educational practices appear to be emerging as a significant differentiator between firms. A longitudinal approach, focusing on some of the key relationships discussed here, would be beneficial.

Furthermore, it would be interesting to run the survey in multiple countries to gain an understanding of how different market conditions influence the use of Logistics Technologies. This is planned with a refined survey that will be distributed in early 2015 over both New Zealand and Australia.

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