



# Logistics Technology in 2014 New Zealand

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## Abstract

This report examines the current state of Logistics Technology use in New Zealand in 2014. Responses from 31 participants are divided into Leaders and Followers and then analysed. This provides insight into how those at the cutting edge of the use and management of Logistics Technology users perceive the challenges and opportunities differently to those that follow or adopt more slowly. Differences are seen in the types of technology employed and being invested in and how the effectiveness is measured. Followers tend to focus on cost measures and restrict analysis to intra-firm metrics; Leaders tend to use a wide range of measures and evaluate inter-firm metrics. In the near future, Leaders are more willing to invest in materials handling technologies. Leaders make significantly greater efforts relating to training and education to support Logistics Technologies, use a wider range of training methods, and use more formal training methods than Followers do.

## Contents

Logistics Technology in 2014: New Zealand .....	iii
Acknowledgements .....	iv
About the research .....	1
Barriers .....	3
Improvements and recent changes .....	7
Drivers .....	8
Value and benefit from Logistics Technologies .....	9
Preparing for the future .....	13
Metrics and measures .....	15
Internal integration before supply chain integration .....	17
The Followers – Adopting a risk mitigation approach? .....	18
Skills for the future .....	19
Owners as managers .....	21
Comparison to international research and trends .....	22
The way forward .....	24
International comparisons .....	27
References .....	30

## Logistics Technology in 2014: New Zealand

Welcome to the 2014 Logistics Technology survey for New Zealand.

Please note that this is **exploratory research** and is **not** based on rigorous academic research. While most figures in this report are based on data from our Logistics Technology survey, many comments and observations in the accompanying text are based on our discussions with industry representatives, managers, and employees. Thus, the report is partly **commentary provided by the authors** (and is thus biased by our own opinions and beliefs), balanced by the survey and other international trends in technology adoption.

As we did not get a large number of responses to the survey we want to ensure all readers are aware that this is exploratory research and ***you should NOT report on or assume any comments or notes within this report as factual or supported by extensive / rigorous research.***

The Logistics Technology report has been established to run on an annual basis and provide a snapshot of the current use of different types of technologies used to support logistics activities. Over time, the change in technology use will be tracked and evaluated, with the results used to inform stakeholders in the business community.

The bulk of this report provides insight gained from our Logistics Technology survey. However, despite significant interest by several key members of the community, the response rate has not been as good as we had hoped for. Thirty one people started the survey but not all finished the survey. Some of the fault lies with us; the survey was intended to be in-depth and provide significant insight; yet, the length appears to have turned off many respondents. In future years, we will endeavour to shorten the survey and hope this brings a better response.

Despite the low participation rate with thirty one participants (not all of whom finished the survey); we see from the data some trends are still apparent. While these are not statistically significant results, we think they are important as they provide an indication that some international trends are relevant in the New Zealand context. These are trends and patterns that the New Zealand business community should be mindful of.

Those firms in a weak position now (and which therefore do not have access to capital for investments) will increasingly be in a tough position. These firms will find it increasingly difficult to compete as they will lack the technology and capabilities of some of their key competitors. We believe this will lead to many smaller or weaker players in the next few years being acquired or going out of business as the investments in technologies made by the larger companies come to fruition and begin to pay off.

Our conversations with some in the industry, both those domestic and international, lead us to believe that change is on the horizon and particularly in the domestic trucking industry, where we see the opportunity still for significant consolidation. Many small firms will be unable to cope with the increasing requirements to use more advanced logistics technologies and will likely be swallowed by other firms during mergers and acquisitions. We believe there has been action already, with large players in New Zealand acquiring some smaller firms. It will be these larger firms, with the financial strength and technical capability to implement new technologies, which will adapt, innovate, and be able to surpass their weaker competitors.

Much of this report must remain speculative; with a small number of responses we cannot safely make generalisations about logistics across New Zealand. However, even with this limited sample size, we can still make some observations and also draw upon our own knowledge and understanding of the industry. We conducted a number of statistical tests over the samples and some of the differences were statistically significant; however, there are relatively few differences that could be statistically determined. As a result we decided to use the data and purely exploratory and descriptive way to supplement this with our own commentary drawing more widely common knowledge and an understanding of these trends.

Throughout the report, we opted to present much of the data using a division between Leaders and Followers based on the self-reporting by the respondents based on the maturity and the use of Logistics Technology. Therefore, separated the data and show some of the differences between Leaders and Followers. We hope that some of these differences are insightful and we also draw your attention to the amount of investment that the Leaders make in their employee training and up skilling. This was one of the strongest distinctions between Leaders and Followers in all of the data.

Even with the small amount of data we collected, the general pattern still matches what we would expect in many cases. This is particularly true as the participants in our survey are also those that are interested in this topic already. Therefore, we can see that many participants are well aware of some challenges and issues, and many are either struggling with some of these technologies or are already well-advanced. As we can see, many gaps between the more successful companies and the less successful companies strengthen our belief that there are challenges remaining in the industry which will still need to be addressed.

We are particularly grateful to the industry associations and groups that have supported this survey either explicitly by encouraging members to participate or implicitly with their words of support and encouragement. While the outcome may not match what we hoped, we believe many people will still find value in the results and will be encouraged to join us future iterations survey. The use of specific technologies can be supportive of many manufacturing and logistics requirements in firm, with a wide range of possible applications; for an overview of possible applications see Wood, Reiners, and Pahl (2014). The adoption use of logistics technologies will enable many firms, both large and small, to become more competitive and effective in their management, although this is not as automatic as ‘installing’ software and may require overcoming substantial barriers.

## Acknowledgements

We would like to thank all participants who contributed their time and expertise to complete the survey and to the industry organisations that have supported the survey.

This research and report would not have been possible without the additional support and input provided by:

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## About the research

This was the first annual survey of Logistics Technologies. Invitations to complete an online survey were distributed and advertised by various groups with an interest in logistics and supply chain management.

A total of 31 participants started the survey over the period of November 2013 to February 2014.

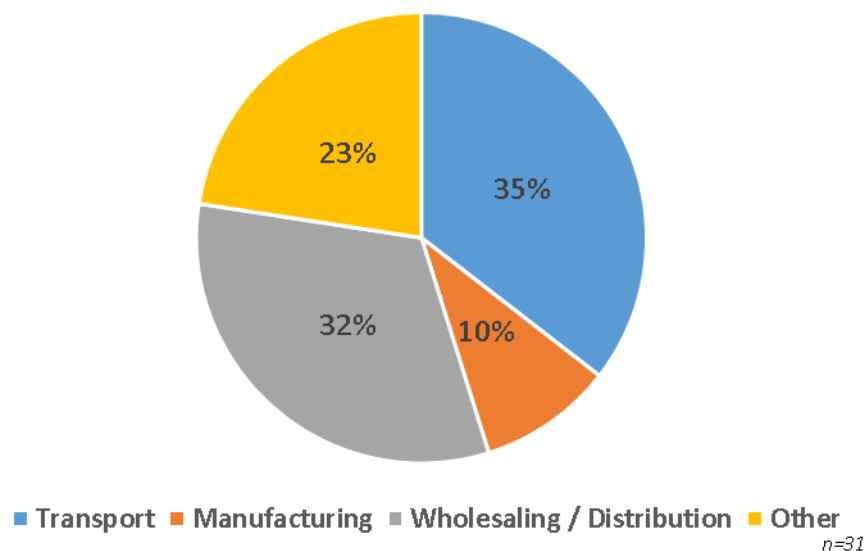
An early question in the survey asked respondents to self-report the level of maturity and use of logistics technology management within their firm. This enabled us to divide the responses into the categories of “Leader” for those with a high level of maturity in the management and integration of logistics technologies; and “Follower”, for those less integrated and developed in their use of logistics technologies. This allows a division of result that shows a different focus for these two, quite distinctive, groups over many of their responses to the survey. Of the 31 respondents, ten respondents (32%) self-reported themselves in the two higher levels of maturity and thus we classified them as Leaders; 21 respondents (68%) self-reported themselves in the two lower levels of maturity and thus we classified them as Followers.

Many of the respondents come from the transport sector or the wholesaling and distribution sector. Few came from the manufacturing sector. In examining the content of the other sectors represented, it becomes clear that such a simple demarcation by sector is difficult. One respondent noted the scope of their firm’s business covers the entire breadth of the supply chain; they manage manufacturing as well as a transport, distribution, and wholesaling functions. This is true of many large organisations in New Zealand which span many activities and jobs relating to logistics and supply chain management.

With a larger number of respondents, we would have been able to further present some analyses in an industry-based comparison. Even from the data we have, it is clear the members of the transport and the wholesaling and distribution sectors were more enthusiastic about participation in this type of research, perhaps driven by how important they perceive logistics activities as being to their core business (Figure 1).

**Figure 1**

**Which industry sector does your company participate in?**

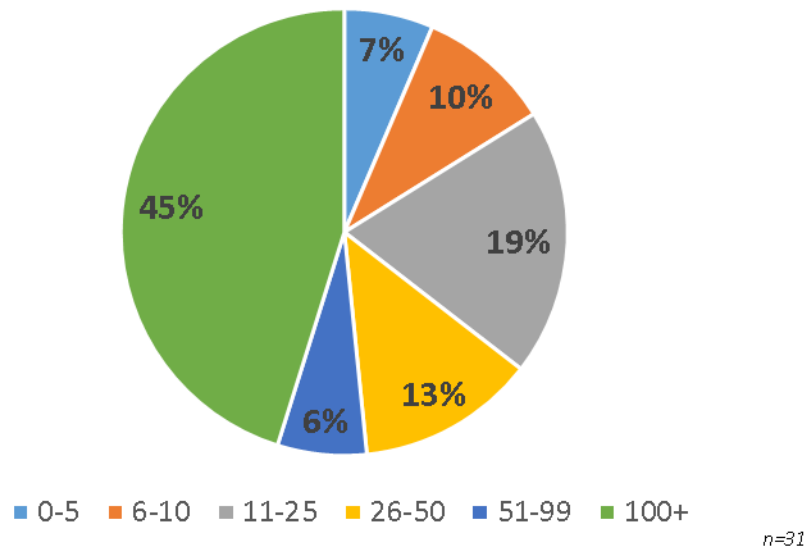


We expected many smaller companies might show interest in the use of logistics technologies. However, as can be seen in Figure 2, while there are a moderate numbers smaller companies, more interest was shown in this survey by some of the larger companies. This may be true if many of the respondents came from large companies in the transport sector. Further evidence is found in some of the other data, where some of the larger firms said employees spread over many parts of New Zealand.

One would assume larger firms are more able and capable of opting in updating the technology and more regular basis, allowing them to stay ahead of the competition.

**Figure 2**

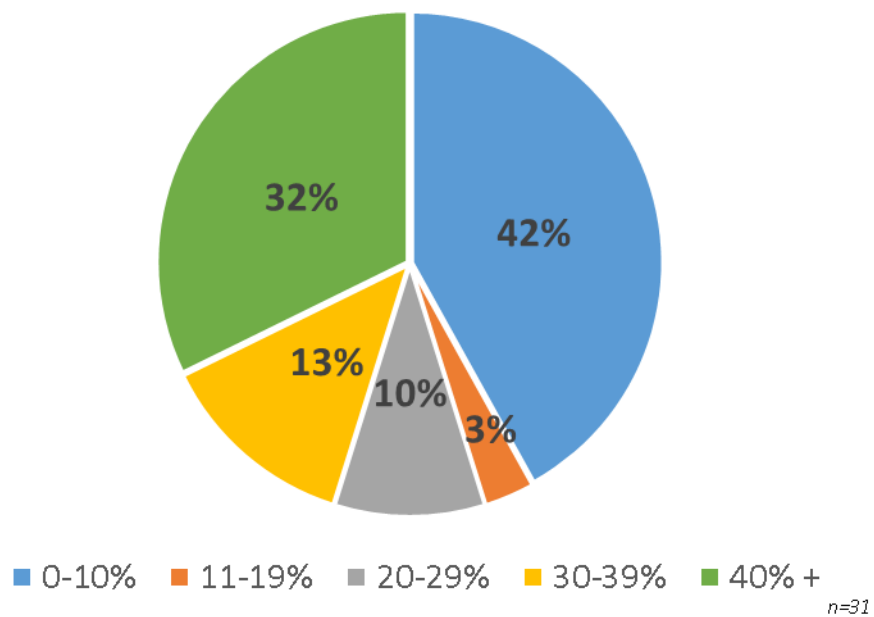
What is the approximate number of employees (full-time equivalents)?



Firms which are focused on transport and logistics will have a large number of their staff focused on logistics on a day-to-day basis. There are still many respondents who have a small proportion of staff dedicated in their logistics roles (Figure 3). This may be particularly relevant in a manufacturing company.

**Figure 3**

What approximate proportion of employees are in logistics-focused roles?



## Barriers

One of the key questions we wanted insight into was simply: why are so few firms using advanced IT to support their logistics activities? We are aware of firms, sometimes with surprisingly high profiles, that seem reluctant to adopt or use contemporary approaches; meanwhile, other firms embraced new technological advances and leveraged these effectively.

Why have so few firms adopted appropriate technologies? Are they unaware of the options? Or do they struggle in the implementation? What are the implications for businesses of the lack of investment in logistics technologies? How can educational or training institutes help firms overcome these barriers?

Technology adoption models frequently examine adoption and use of technologies over several phases, where the firms must progress from the initial or foundation levels before they can adopt the more advanced technologies. Supply chain models, in particular, indicate that first we must have internal integration which must be undertaken first then followed by extra integration. Conceptually, this makes sense; it is difficult to integrate with external trading partners unless you can fully access and share data and information internally. Thus, it is only by first integrating across the organisation gathering, collecting, and analysing the appropriate data internally, a firm will be in a position to share information with other trading partners in the supply chain.

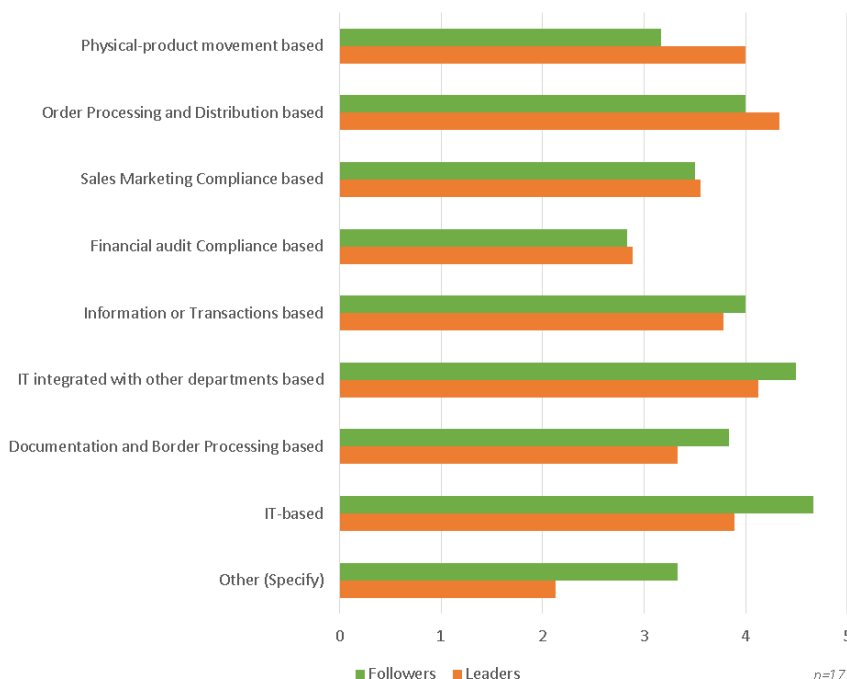
In the last year many organisations actively engaged in IT developments. Yet, Figure 4 shows Leaders focused on physical product and distribution technologies. This would be essential for many firms as Distribution provides essential links between manufacturers and end users. This would also indicate firms are building external data pathways critical for trusted data transaction business relationships; most or many of the internal IT data flows would need to be integrated at an organisational level rather than at only the department level.

Followers concentrated on transaction, internal process/data integration or general IT based commerce which indicates IT development is focused on documenting, standardising, and creating whole company databases so all departments can accessed real time company processes and required before external business links can be developed. It is interesting to see both Leaders and Followers have similar activity in Sales/Marketing and financial audit IT compliance areas, which would reflect I-government mandated developments and anti-spam legislative changes.

**Figure 4**

**Overall, how has Logistics Technologies investment in your organisation changed over the past 12 months in each of these categories?**

Moderate decline (1); No change (2); Little progress (3); Some progress (4); Moderate progress (5); Significant progress (6).



Followers may experience a greater number of barriers and see these as being more significant than the Leaders (Figure 5).

As we analyse the data it became clear the size of a firm also influences their ability to adopt Logistics Technology. Those with the financial resources find it easier to make these investments. We are mindful that those firms which describe themselves as Leaders in terms of their maturity in the management of logistics technologies are also those that are likely to be the more successful firms. Their success will be related to their financial ability to make investments and stay abreast of the cutting edge of developments in technology.

It was clear that the right people with the right skill sets are also going to be important to both Leaders and Followers. Both groups report having the right people is a key barrier to success. This may be a reflection of the present state of New Zealand's economy which has been described in early 2014 as having 'rock star' status (O'Sullivan, 2014); this would indicate there will be intense competition for the best staff. There is no reason to assume the effects will be different if the skills relate to logistics or technology, and this has been seen as a key barrier by both the Leaders and Followers.

We might assume some of the Followers lacked the sophistication to make a compelling business case for the adoption of the planned Logistics Technology improvements. Coupled with the likely low-level of cross-functional integration within a firm, this could make it difficult for a Follower to access the investment required for significant new initiatives.

By nature, a Follower has less capability in planning activities and would be less certain about what should be measured following implementation. If they have trouble conceptualising how they should make advances of the use of technologies it is also possible they are not sure what other firms, other competitors, or exemplars, may be achieving. Such a lack of awareness will make it more difficult for them to take decisive action in terms of implementation and on-going monitoring and improvement cycles, all of which will negatively impact on their ability to effectively implement technologies.

Many large firms are likely to be more aware of some of the international trends and changes, forcing them to take a more proactive approach to the adoption of new technologies. If they are aware there are shifts in the international business environment towards particular technologies, or some of their key competitors are starting to use the technology, it is likely it will be easier to make a compelling business case to adopt technology. We see this as either as a defensive measure or a protective measure.

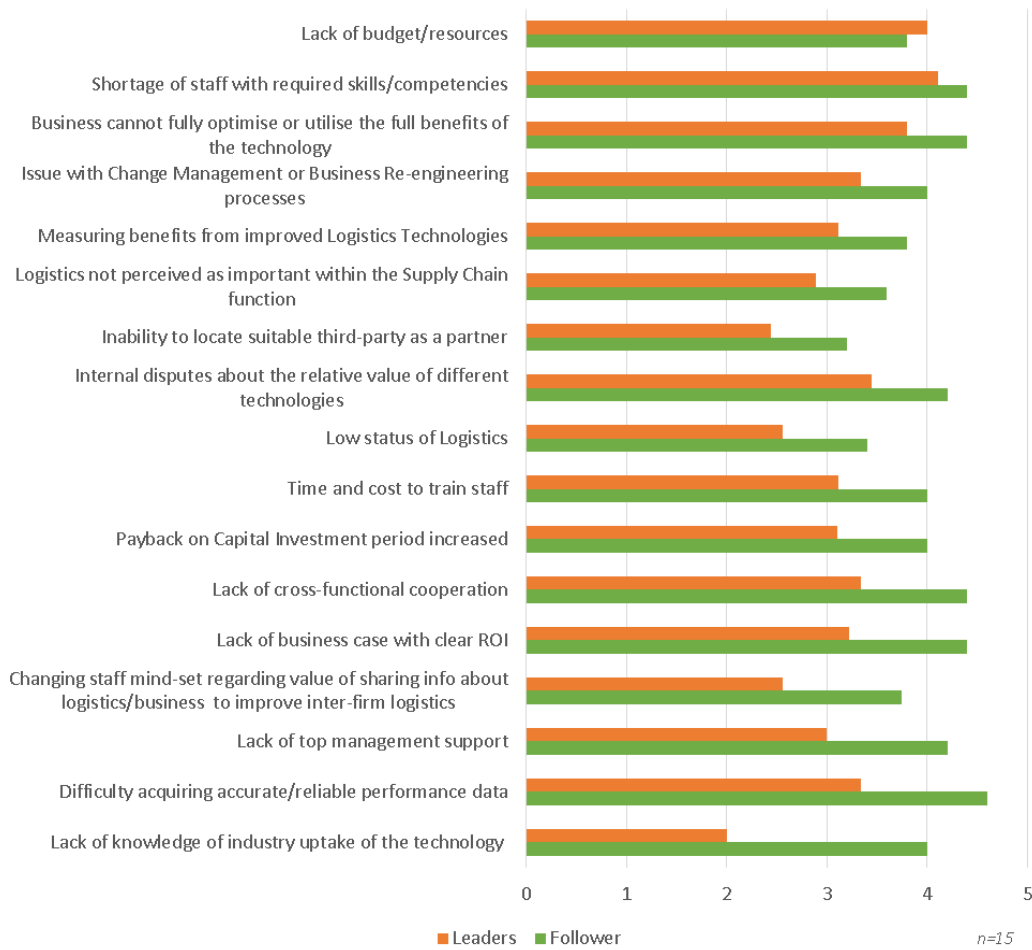
Perhaps not unsurprisingly, in almost every category the Followers believed the barrier to be more significant than did the Leaders (Figure 5). Despite earlier reflections to the contrary, the only barrier which Leaders perceived as being greater than Followers was the lack of budget/resources.



**Figure 5**

**To what extent have you encountered the following barriers in using logistics technologies?**

Don't know (1); Not at all (2); To a little extent (3); To some extent (4); To a moderate extent (5); To a large extent (6). Respondents could answer regarding each barrier they had encountered.



Many firms already have systems and technologies in place they may not be fully using. What prevents them from making better use of these technologies? There is a general sense that they lack of integration, experience difficulties with software, and do not have appropriate access to both internal and external parties; in these areas, Leaders report the barriers are more significant than Followers (Figure 6).

Some further factors respondents identified as being related to why they were not making better use of existing systems included:

- their existing technology was not appropriate;
- financial costs involved with set-up were too great; and,
- there was a lack of skilled staff

Leaders will still experience problems with compatibility and inter-firm challenges; in fact, as they are the ones engaged in this type of activity, we would expect to experience these challenges more frequently than a Follower.

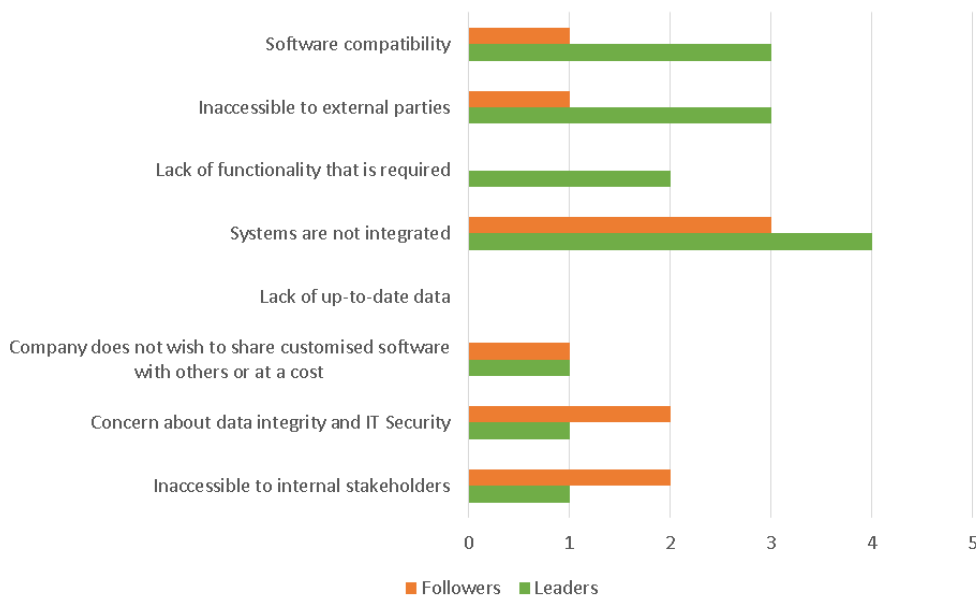
What will be seen their future? Many of these challenges and barriers will continue to grow in significance. When this happens, the gap between what a Leader and Follower could achieve will likely increase in size.

Another shift we might anticipate is the existence of strong and dominant firms in the supply chains who are willing and able to gift, or license, their proprietary technologies to other firms in the supply chain. Such an offer from a strong partner may enable a weaker partner to leapfrog jump ahead and acquire advanced technology with a small investment. Such a gift may come with a cost; accepting a gift of technology in this manner would effectively force a supply chain member to become locked into a relationship and increasingly reliant on this technology and by extension, the supply chain firm that provided it.

**Figure 6**

**What are the barriers to using your existing IT systems/software to support Logistics Technologies?**

The total number of firms that responded to each element. Respondents included 8 Leaders and 5 Followers.



## Improvements and recent changes

Given the relative accessibility of new technologies, increasingly open and globally connected trade, and the number of technology vendors available, it is interesting to understand how and where respondents have been making improvements throughout their organisations.

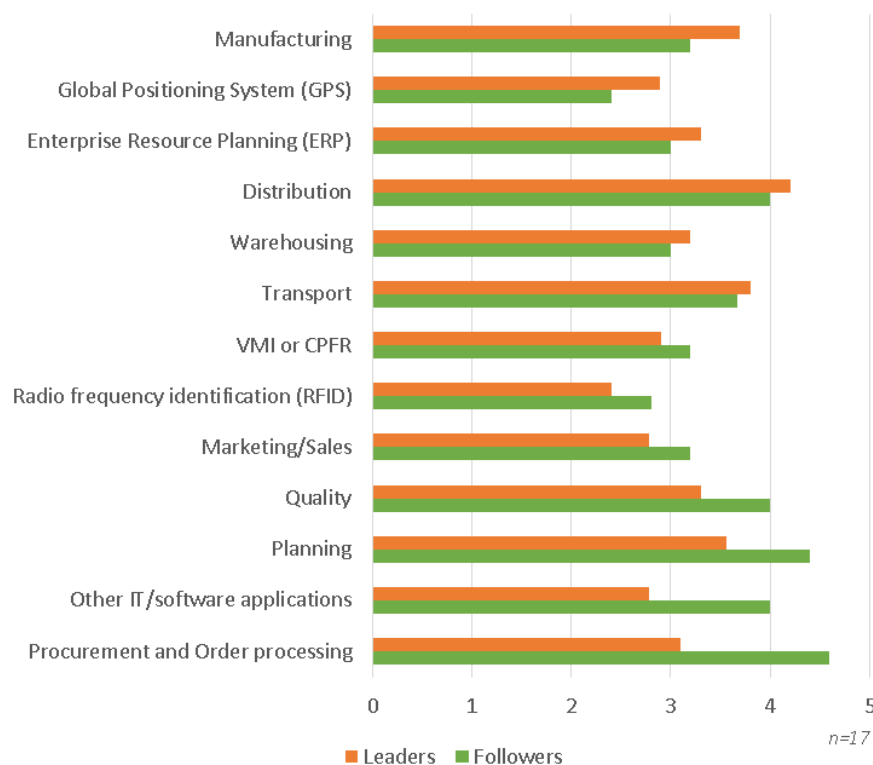
While it is hard to draw conclusions, the Followers appear to have invested more in transactional systems, such as order management systems, than Leaders (Figure 7; showing the average of the responses); the emphasis seems to be on the automation of process and planning. In contrast, Leaders focused on the use of technology to aid more broadly in different areas (e.g., manufacturing), with the use of elements, such as Global Positioning System (GPS), only being of value to a firm if they already achieved some success in management of their technologies.

Over a longer period, we might anticipate importance of the investments in physical handling technologies in distribution and transport to provide leadership to those that implement them earlier. The gap which needs to be bridged for Followers in the adoption of these technologies could make it important to use the technology, but increasingly expensive to adopt it.

**Figure 7**

**How would you rate your progress in advancing your Logistics Technologies during the last 12 months in the following areas?**

Moderate decline (1); No change (2); Little progress (3); Some progress (4); Moderate progress (5); or Significant progress (6).



## Drivers

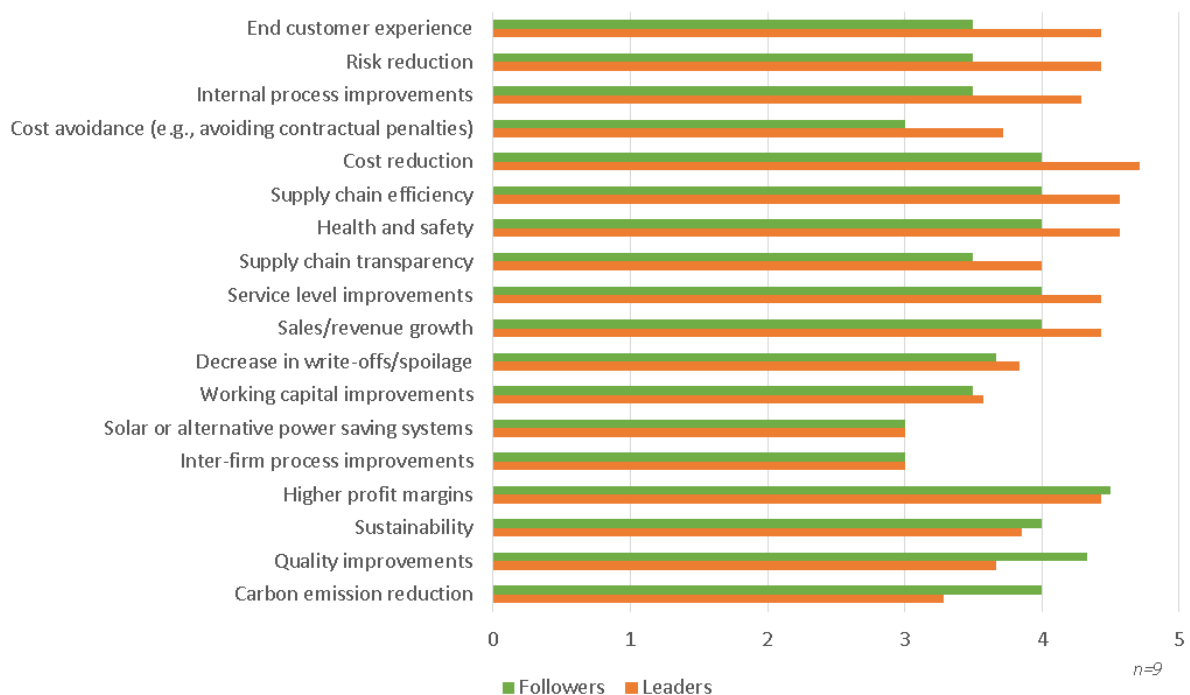
Particularly as they seek to create a business case for adopting technologies, firms will need to be aware of what drives value and how they can demonstrate a return on investment (ROI). It therefore becomes important to be able to identify these drivers and the value that may accrue from Logistics Technologies.

The Leaders appear keen to create more value in their supply chain and are being driven by this, along with other changes in their external environment that seem to be forcing a greater level of professionalism (Figure 8).

**Figure 8**

**How important are the following business drivers in your organisation when it comes to investing time/resources in Logistics Technologies?**

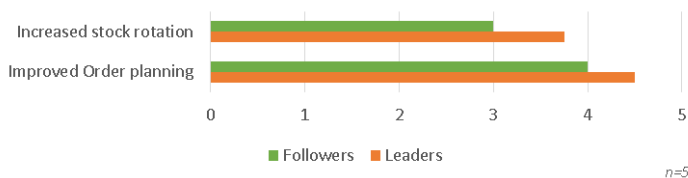
Very unimportant (1); Unimportant (2); Neither important or unimportant (3); Important (4); Very important (5).



**Figure 9**

**Manufacturers only - How important are the following business drivers in your organisation when it comes to investing time/resources in Logistics Technologies?**

Very unimportant (1); Unimportant (2); Neither important or unimportant (3); Important (4); Very important (5).



## Value and benefit from Logistics Technologies

Even when technology has been adopted, it is valuable to know what benefits are expected. Importantly, when making a business case, these expected benefits will need to be quantified and evaluated as part of a proposal. Therefore, it is not enough to adopt and implement technology; it will need to be monitored and evaluated to ensure the desired gains are captured. We can see from Figure 10 the Leaders appear to be more adept at measuring and evaluating the financial benefits associated with different technologies.

Interestingly, Followers appear unable to measure financial benefits. This begs the question: are they not able to measure a benefit as the technology has failed to benefit them? Or, are they unable to make the measurement itself? (Also note in reference to Figure 10, we had twice as many Leaders as Followers respond to this question, so we would expect their aggregated responses to be higher.)

Larger firms with better management would be likely to make measurements in projects as part of the overall project evaluation; furthermore, being able to demonstrate effectiveness in outcomes from one project will probably make it easier to justify or acquire funding for future projects. Therefore, the lack of responses by Followers may be indicative of their lack of measurement of changes in Logistics Technology, rather than their inability to secure benefits from the use of the technology itself.

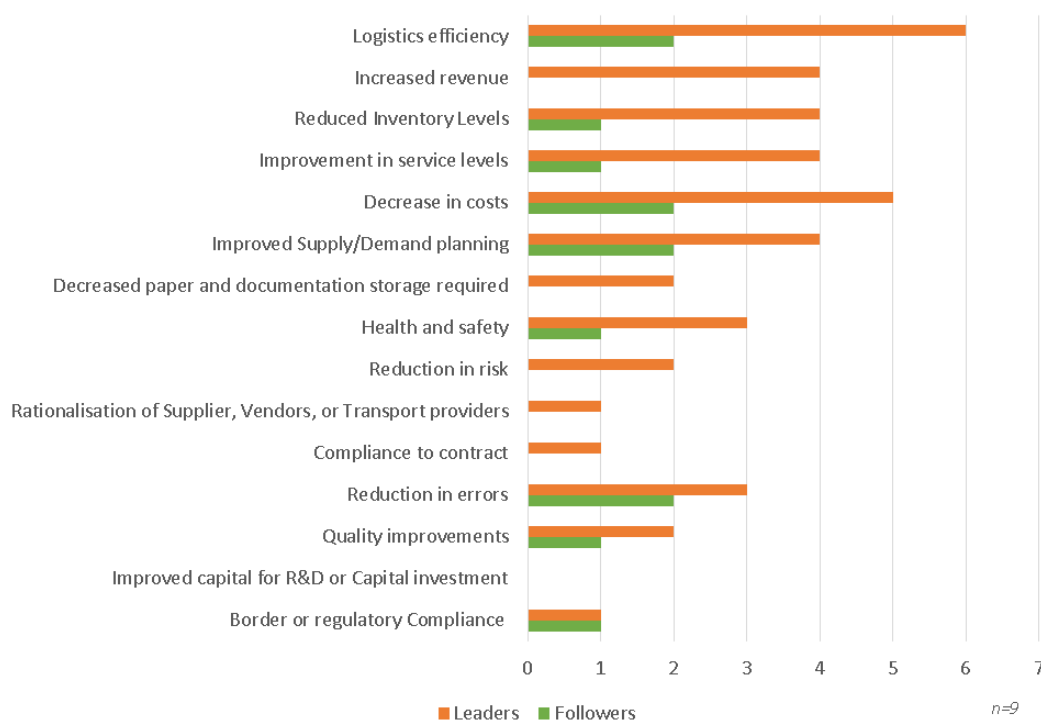
If we look at the mix of Logistics Technologies where there is measurable benefit (Figure 10), we see some similarities to the patterns observed elsewhere in this report.

Most of the measurements listed at the top of Figure 10 are associated with minimising costs. But, if you look at improved supply/demand planning, there is a significant improvement in the management of internal processes (see Table 1 in the section on International comparisons) Furthermore, it is encouraging that many of these benefits come through financial position, even if they are connected to improved internal processes, improved customer satisfaction and communication. Therefore, we believe the survey results reflect the wider international trends in technology adoption.

**Figure 10**

**Due to logistics technologies, for which of these elements have you been able to measure a financial benefit over the last 12 months?**

The total number of firms that responded to each element.



Understanding where firms have identified benefits from their Logistics Technologies activities is important. We can see in Figure 11 the areas of benefit for the Leaders have been strongly focused on value-creating or value-enhancing benefits, which we might anticipate a firm as using to drive or create greater value in their supply chain; (e.g., innovation; something that they can use to differentiate/be competitive with). We also see some where inter-firm process improvements are coming through; clearly, this may be unobtainable for the Followers, at lower levels of technology maturity. Figure 11 has been arranged where there is the greatest gap in responses between Leaders and Followers this is first; the end of the list shows the areas where the Followers rate as being more important than Leaders.

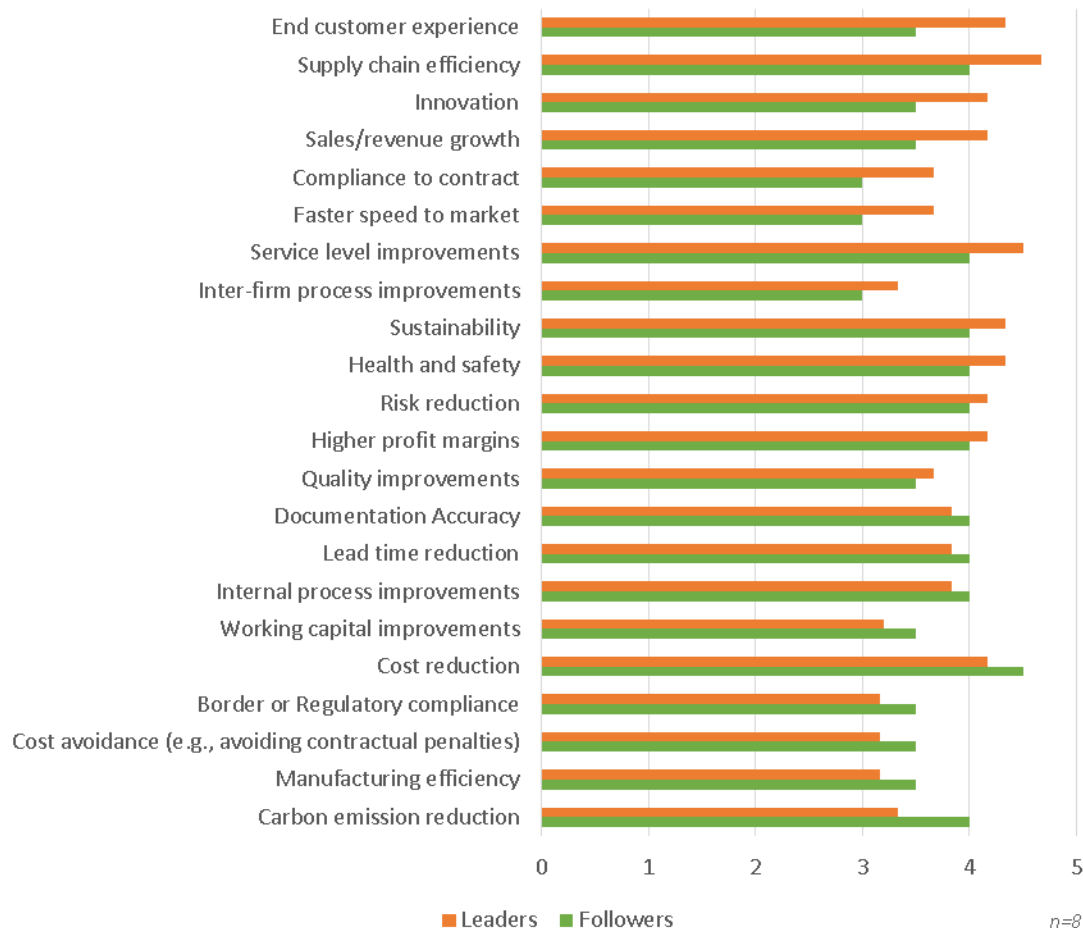
The patterns of responses provided by the Followers indicate they still seem to perceive the supply chain as a 'cost-driven' part of the business must be managed in order to cut costs. They do not yet perceive it as a source of value-added benefit for themselves and their supply chain partners.

Innovation stands alone – Leaders clearly feel innovation has already been important, and we see in Figure 12 they are less likely to believe it will be important in the future. Both Leaders and Followers feel benefits from Innovation will be 'about the same' but also quite important in the future, but with Leaders possibly already feeling as though they have already gained benefits from innovation.

**Figure 11**

**In which of these areas have benefits from your Logistics Technologies activities been important?**

Very unimportant (1); Unimportant (2); Neither important or unimportant (3); Important (4); Very important (5).



When we consider the areas where firms believe they will gain value from investments in Logistics Technologies in the next 12 months, we see a repeat of the theme coming through some of data, where Leaders anticipate greater **value** to be gained by expanding their business and sales growth, quality, compliance to contract, and faster speed to markets (Figure 12). Here, we might be able to interpret 'compliance to contract' as being able important to Leaders as it may allow them to secure further contracts through demonstration of exceptional capability, as opposed to avoiding penalties for failure to comply. This is an anticipation of growth and 'lifting the game';

Leaders display a greater focus on value (quality, faster speed to market), and compliance to contract may be 'avoiding penalty cost' but it could also be a competitiveness-based measure)

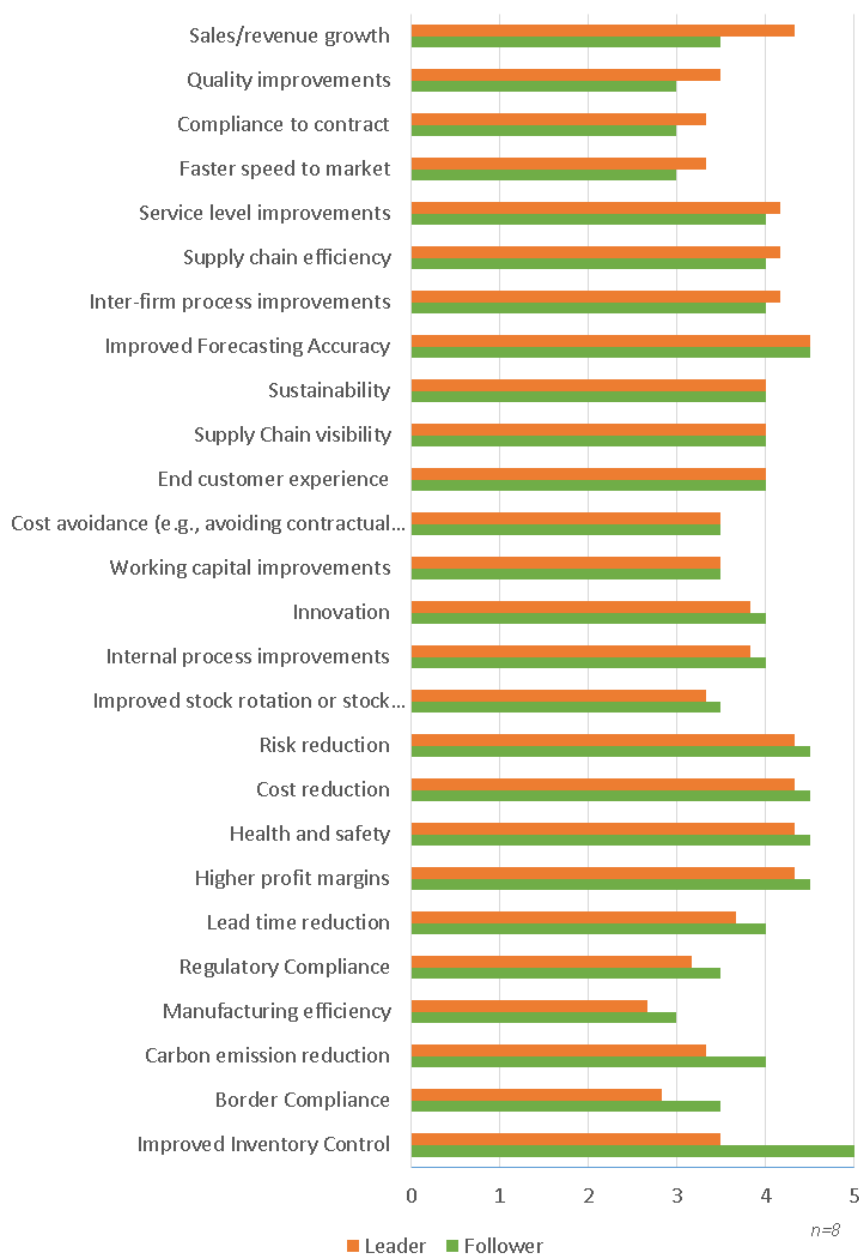
Followers are more focused on compliance or cost-driven benefits (e.g., inventory), with their interest being greater than Leaders in these categories:

- Improved inventory control
- Border compliance
- Carbon emission reduction
- Manufacturing efficiency
- Regulatory compliance
- Lead time reduction

**Figure 12**

**What do you see as the most important source of potential value from Logistics Technologies in the next 12 months?**

Very unimportant (1); Unimportant (2); Neither important or unimportant (3); Important (4); Very important (5).

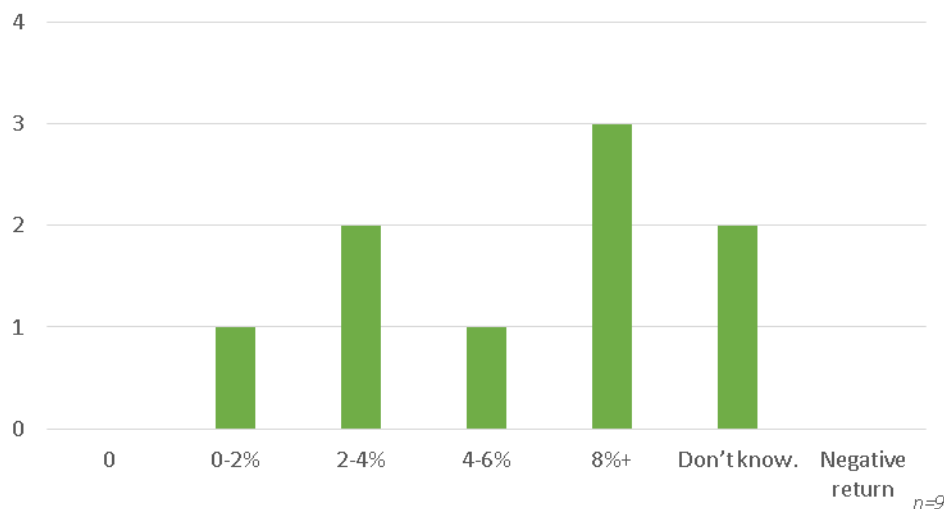


One possible insight would be the level of investment firms made in Logistics Technologies, as a proportion of their revenue. This may be a question that provides us with further insight in the future.

What we did ask about was an indication of the savings associated with Logistics Technologies, with the overall distribution shown in Figure 13. Interestingly, a number do not know the ROI they have achieved from Logistics Technologies. In other cases, there are some strong performers that achieved good ROIs in excess of 8%. Yet, there are also several firms that achieved only moderate ROIs. Smaller firms (or those classified as Followers) may be less experienced in evaluating ROI and may be struggling to report it.

**Figure 13**

**What is the average financial savings you have achieved as a result of Logistics Technologies over the last 12 months (defined as savings achieved post implementation)?**



International exposure, the level of transactions, and the New Zealand business environment may also constrain activity. IT requires a certain level of transaction capacity for organisations to gain the cost efficiencies and full benefits of adoption. Large organisations, where there are inefficiencies, can justify the IT investment and ROI internally within their organisations as minimum transaction volumes are present within the firm's processes. External applications provide additional profits where there are fewer costs to develop and drive the technology. Hence, radio frequency identification (RFID) adoption from traditional paper-based processes has the fastest return and maximum impact on supply chain effectiveness.

Many small businesses do not have the transaction levels required to justify the investment and longer period to make a ROI unless they can link immediately with external supply chain partners. For New Zealand, this scale of transactions required to make the investment suitable, in conjunction with the relatively small average company size may be considered a 'micro' enterprise, is a major barrier to adoption of many supply chain technologies. This is particularly true when we consider sophisticated material handling systems; e.g., automated storage and retrieval systems (ASRS).



## Preparing for the future

The use of Logistics Technologies may also help firms prepare for future changes. It could future-proof them, ensure they are up-to-date with international expectations, or ensure are ready to face new competitors.

Leaders are worried about (Figure 14):

- Skilled staff ...they also need exposure to more different types of IT/software
- International partners mandating specific software for orders/payments or IT in Logistics; this would be linked to the worry about losing significant accounts or volumes of business due to non-compliance.

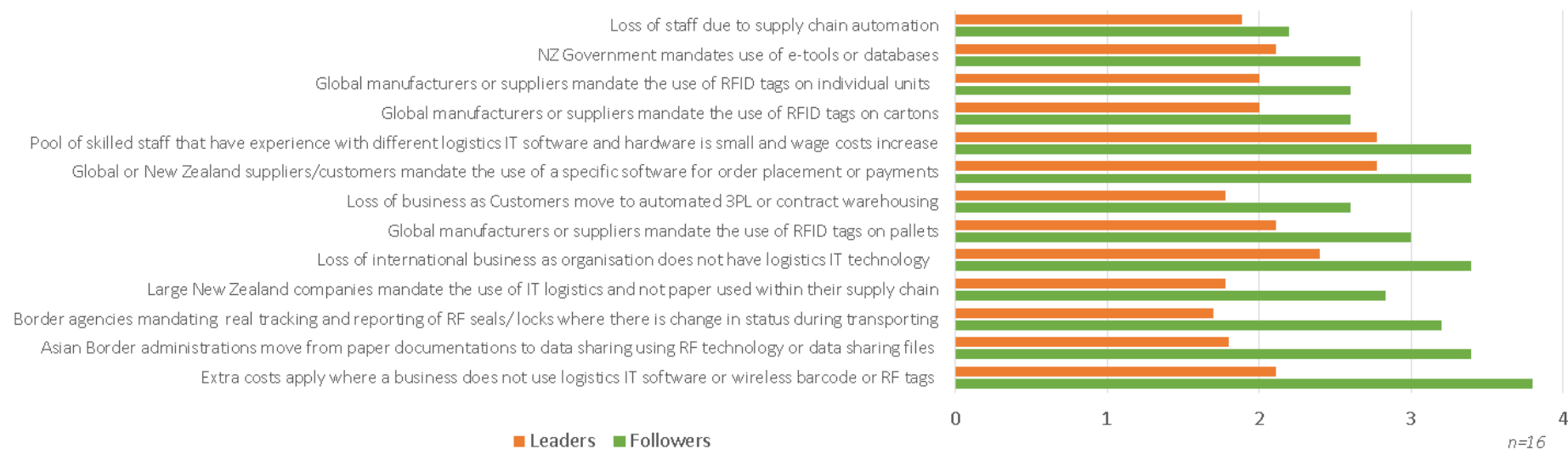
Followers have many concerns. This may be expected; they are probably aware of many of the gaps between their own capabilities and those of larger, better prepared competitors. Specifically, Followers reported concerns in:

- Extra costs applying where they don't use specific IT software or RFID (one of the largest gaps between Followers and Leaders);
- Movement towards electronic sharing away from paper; and,
- Loss of international business due to not having/using IT logistics technology.

**Figure 14**

**How would you rate the level of concern for your organisation if the following situations were to happen in the future (next 2-5 years)?**

**No Concern (1); Little concern (2); Some Concern (3); Moderate concern (4); Great concern (5).**



## Metrics and measures

The issue of measurement is an important one and it is needed to establish whether we are achieving success in our activities. While there are many measurements available, we wanted to understand a little more about the operational types of measurements or metrics used to evaluate whether Logistics Technologies are being effectively used.

When split between Leaders and Followers and presented in Figure 15, several observations can be made.

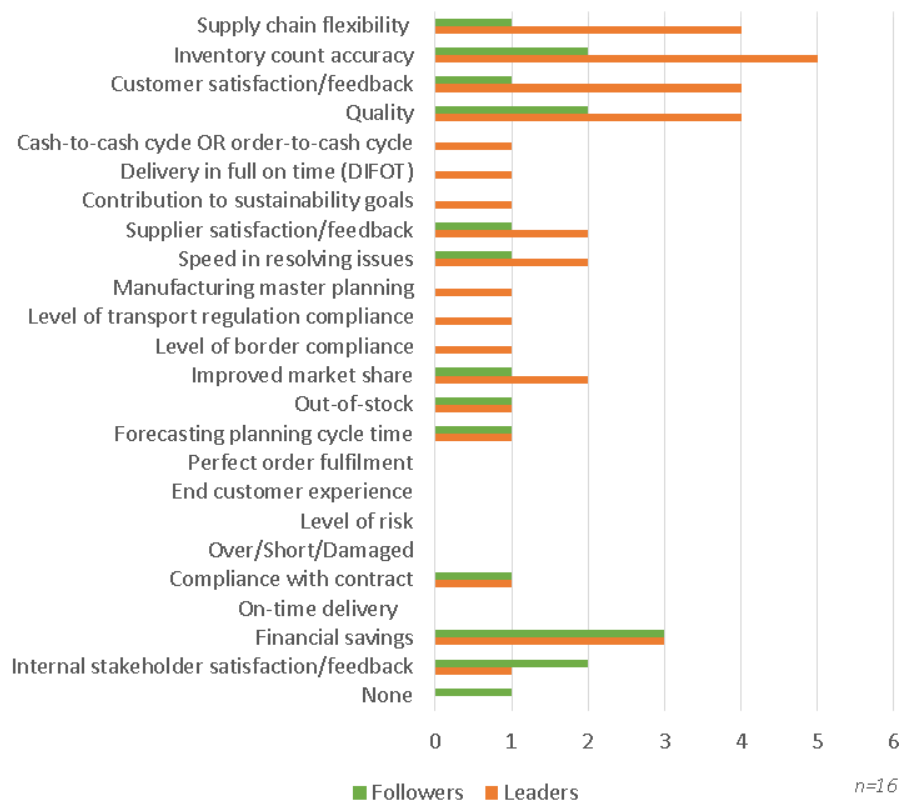
First, Leaders are interested in using more than simply cost-focused metrics; they also seek to understand risk, end-customer experiences, and internal process improvements.

Second, both Leaders and Followers did not rate inter-firm process improvements as an important metric for the evaluation of Logistics Technologies performance (Figure 18). The Followers indicated they are generally not using inter-firm KPIs to measure the performance of Logistics Technologies. In contrast, Leaders are using some inter-firm KPIs, at least to a moderate extent. There doesn't seem to be a trend towards significant use, although we see the more mature the management of the Logistics Technologies, the greater the interest in whether the use is successful. This may be reflective of the fact that many New Zealand enterprises still have a way to go before they extend their integration more completely between multiple firms, a high-level of supply chain maturity is required.

**Figure 15**

**Which of the following metrics do you use to track the performance of your Logistics Technologies?**

The total number of firms that responded to each metric.



**Figure 16**

**Leaders only - Which of the following metrics do you use to track the performance of your Logistics Technologies?**

The total number of firms that responded to each element.

**Figure 17**

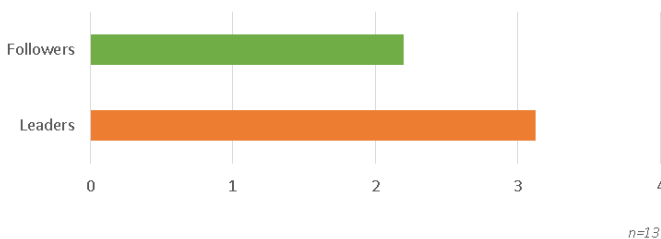
**Followers only - Which of the following metrics do you use to track the performance of your Logistics Technologies?**

The total number of firms that responded to each element.

**Figure 18**

**To what extent are you currently using inter-firm KPIs to measure the performance of your Logistics Technologies performance?**

Don't know (1); Not at all (2); Not very much (3); Moderately (4); Significantly (5).



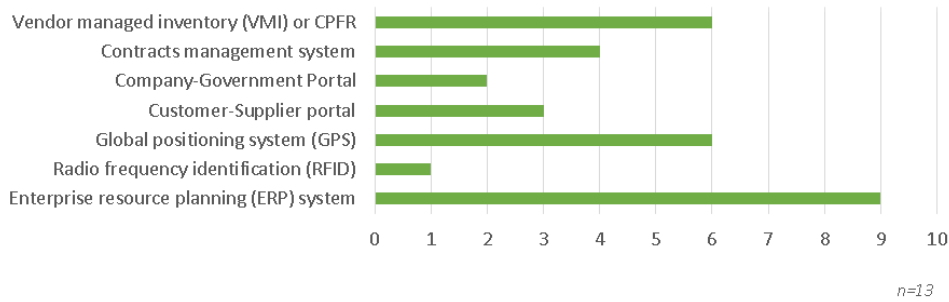
## Internal integration before supply chain integration

As noted, the ability to integrate internally is important to firms before they begin inter-firm collaborative activities. Many firms seem to implicitly recognise this, with most firms identifying the importance of an enterprise resource planning (ERP) system, which allows them to gather and use internal data, as a key support to other Logistics Technologies (Figure 19).

**Figure 19**

**Which of the following systems are you using to support your Logistics Technologies?**

The total number of firms that responded to each element.



## The Followers – Adopting a risk mitigation approach?

Our survey indicates a number of firms are either reluctant or unwilling to adopt new Logistics Technologies.

While we may have anticipated this, we have not explored it within this survey.

We can imagine that many New Zealand firms are ‘followers’ in terms of reducing their overall risk. If they do not adopt, they are able to sit back and see what other changes are required, or what other firms find difficult. Then, they can copy or more easily implement required changes. In other cases, where a change may be mandated, a particular deadline may be announced and it may make little sense for the firms to prepare and make changes before this date. Indeed, greater hesitation may be rewarded by having some further government support provided for the firms opting to change closer to the deadline.

As a large number of the survey respondents were from the Transport or Distribution sector, this could also reflect the changing global economic environment for many of the global companies dominating the sector.

However, since the middle of the 2000’s the New Zealand market as seen rationalisation of services and the global financial crisis has affected transport companies’ financial situations. Internationally, while IT-focused supply chains have advanced, many New Zealand firms have not adopted the changes due to lack of scale or low profit margins due to competition.

The New Zealand government investment in the Joint Border Management System (JBMS) has been one area where New Zealand firms are ahead of other trading partners as we are leading the way on Border portal implementations. However, this advantage will be diminished by increasing investment in wireless data exchange by the Asian border organisations.

## Skills for the future

The Logistics industry traditionally requires employees to know the business “from the ground up” and many employees gain formal qualifications later in their careers; common wisdom holds that a relatively small percentage of the New Zealand Logistics industry employees are qualified at the bachelor degree level or a higher. While the last five years following the Global Financial Crisis has generally seen employee numbers and wages remain static, as New Zealand business confidence increases many organisations are increasingly looking for logistics employees. The New Zealand Herald and the Robert Walter Industry overview of supply chain and procurement industry at the beginning of 2014 indicated there is high demand for professionals. “There 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) and this is creating opportunities for qualified overseas supply chain professionals; e.g., Procurement Managers are on the immigration long-term skills shortage list.

Figure 20 and Figure 21 show Followers focused on internal training practical on the job training, with some e-learning so employees have the essential skills to work efficiently within the organisation. The size of the organisation affects the organisation’s ability to financially invest time and manage staff leave for externally training opportunities. Many of these companies will struggle to keep good employees unless they can provide better training incentives and opportunities to develop their employee capabilities. Employment recruiters have indicated within the Freight Forwarding sector there are a number of openings for operational logistics employees with 2 or more years’ experience and staff shortages will start to appear in late 2014.

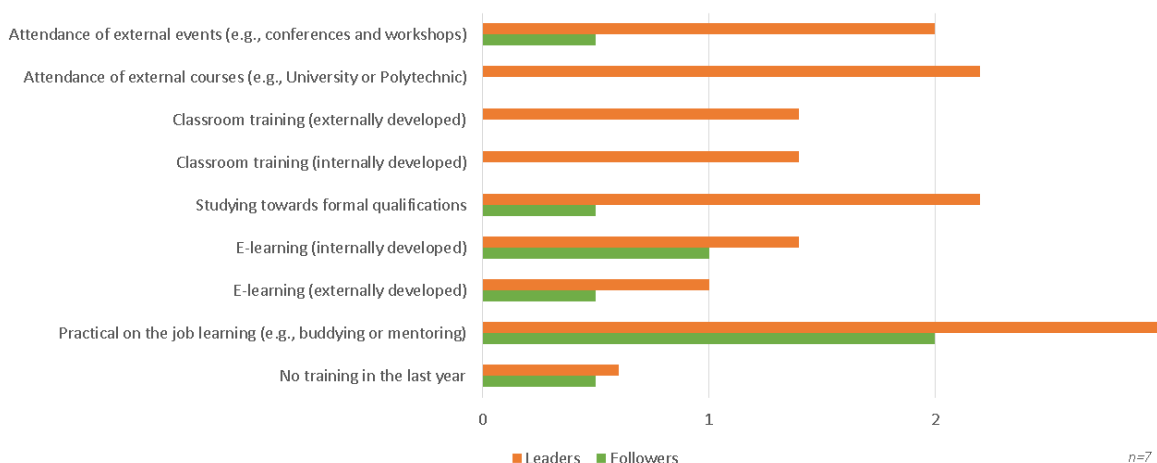
Leader organisations invest in practical in-house and significantly more external training opportunities. Within Leaders Company culture on-going training is an essential part of employment. Many global transport companies are offering employment opportunities for graduates with supply chain qualifications. Formal qualifications and Conference are providing Leaders' employees with opportunities to develop business networks access the latest research and therefore engage internally to identify areas for business innovation and growth. Even formal training is adapting and becoming more ‘active’ in contrast to passively listening to lectures (Wood & Reefke, 2010), which may be a good fit to the learning styles of staff already working in the logistics and supply chain management.

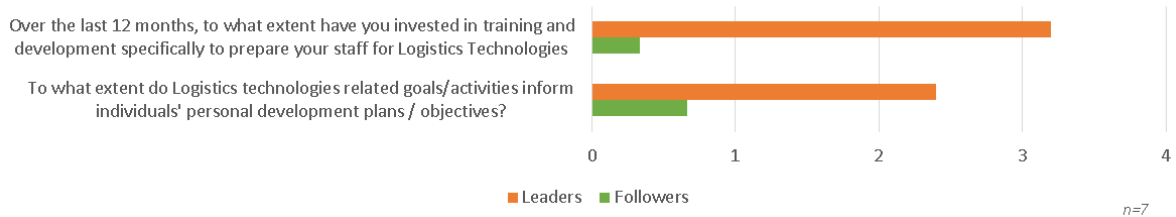
We believe if this gap between Leaders and Followers does not close, Followers will struggle to adapt as the Asia-Pacific region grows economically and trade agreements continue to create a more competitive marketplace. Furthermore, employees will be attracted to new positions with faster career progression.

**Figure 20**

### What form does this training take?

To little extent (1); To some extent (2); To a moderate extent (3); To a large extent (4).



**Figure 21****Training and development and the management of your staff****To little extent (1); To some extent (2); To a moderate extent (3); To a large extent (4).**

Looking forward, we see the opportunity for greater delivery of training and education using online technologies. This would enable a consistent delivery and use of training over a nationally (or globally) spread company. The costs of online delivery should also enable smaller organisations to participate and up-skill their staff as well. Such technologies may be similar to traditional, computer-based training. However, contemporary approaches to using online delivery are moving towards 'gamification' using methods of learning designed to be fun and draw on game-based elements to encourage greater interaction, particularly where using advanced artificial intelligence and design elements; e.g., a review of this approach is provided by Wood and Reiners (2013).



## Owners as managers

While the survey did not address owners as managers, other international research has indicated that owners as managers can function as a barrier for small- and medium-sized enterprises (SMEs) as they adopt new technologies. The Italian Logistics industry and research from developing nations has shown organisational development of information and communications technology (ICT) and processes is linked to the ability of owners or managers to champion process change.

The New Zealand transport and logistics sector is split between firms with a global focus (i.e., those trading internationally) and inland transport/logistics companies (i.e., those with a domestic focus).

The New Zealand Freight forwarding sector depends entirely on global organisations (e.g., DHL and Kneuhe & Nagel) which have clear internal processes and global IT network strategies. New Zealand companies, such as Mainfreight and Freightways, are investing and developing their rapidly growing global networks. Mainfreight's growth has been aided by acquisitions and being a listed company and the company is dominated by boards and will be significantly influenced by international events.

In contrast, the inland transport sector is dominated by New Zealand-owned small/medium transport/logistics providers. In many cases family ownership is retained, which can influence company investment and direction. While many of the larger companies (e.g., Hall's Refrigerated Transport, TNL, and Kotahi) have likely kept abreast of developments in relevant technology (e.g., GPS and tracking and developing their internal IT processes), many inland transport companies have invested in rolling stock only (e.g., trucks and trailers).

We believe the number of small, owner-operated businesses in the sector may reduce over time due to the still moderately challenging financial environment and large manufacturers rationalising the number of transport/logistics service providers they engage with as part of their supply base rationalisation activities.

## Comparison to international research and trends

International research surveys show global SMEs are faced with similar barriers, despite external influences varying greatly over the surveys (Table 1). While the initial investment cost and ROI is a crucial barrier for SMEs, they also struggled with internal resource/capabilities to manage a major IT project. Only the surveys from USA, Canada, and South Africa did not report this as a significant barrier. The South African survey indicated capital investment was easy to gain, especially for emerging African-American-owned businesses. The USA survey deemed a small business as being fewer than 500 employees; as the average New Zealand business is a 'micro' enterprise in comparison; we anticipate they will face resources and funding levels when establishing the required ROI for a project. Also, Canada and USA have well-developed capital markets.

A lack of technical experts to champion, drive, and commit to the internal process changes requires additional financial resources (e.g., external experts and on-going technical support) and demands too much energy or focus for many SME owners or managers. After the cost and ROI, the Owner/Manager context played an important role in most developed nations, excluding Italy. The Italian research was conducted over seven years and while the owner context appeared in the first survey (2005), the barriers highlighted in the more recent surveys are based on financial investments.

The supporting barriers clearly indicated for most SME internal planning and access to government funding were important to support IT adoption. Kollberg and Dreyer (2006) identified organisational planning as a key barrier for the adoption of IT by SMEs; in most SMEs the focus is on short-term planning while large organisations tend to encourage long-term planning. The SMEs' short-term planning focus can be clearly seen within our survey as both operational and technological delays are the enablers for Leaders to create the standards and grow their market share. Planning is critical to the success of any projected process change; without planning most firms will see cost overruns, time delays, and little chance of achieving the intended outcomes. Only three of the international surveys did not address this area.

This lack of planning was reflected in many SMEs as they generally have ad hoc process development and processes tend to be based on departmentalised needs. Basically, the focus is often on buying the service needed to drive business and then adding to the core as business develops. The owner or manager often decides when to implement these changes. In contrast, larger organisations tend to plan for additional capacity and resources in their systems and process over an extended period, upsizing their firms over planned stages. This long-term planning requires a champion for change as the process always progresses over the time horizon.

Little Government funding was the other support barrier which influence SME's IT adoption. While no specific funding was stated; tax-free incentives, subsidies and grants to engage IT expertise or research and development (R&D) incentives be all be of significant aid to many SMEs.

The international research clearly showed marked differences in the external factors influencing IT system adoption.

A Developing nation's greatest external enablers or influences to IT adoption were:

- Poor or no IT infrastructure or access to Internet, and
- The lag of legalisation in regards to IT effect on payment methods, fraud, piracy and confidentiality.
- Not suitable for their business at present.

A general lack of IT infrastructure has impeded the adoption of IT business solutions. Furthermore, as much business is still conducted using phone, fax, or written systems, there is little incentive to change. The relationship between IT development and updating legislation is clearly important and should not be underemphasised; particularly, where government agreements may require importers/exporters to adopt new technologies to meet emerging requirements. Disagreements over trade processes may delay the finalisation of the Trans-Pacific Partnership Agreement (TPPA); different countries are at varying legislative stages of mandating IT solutions and their enforcement of intellectual property rights (IPR).

A Developed nations greatest external enablers or influences to IT adoption were based on:

- Competitive Market environment;
- Economic Environment; and,
- Supplier chain relationships and integration levels.

Generally, SMEs in developed nations must adopt or die; survival has been based on maintaining market share and differentiating from the competition. This is clearly illustrated by RFID technology adoption which is a technology firms will adopt unwillingly, and normally only when mandated by larger firms; e.g., Wal-Mart. For many firms, technology adoption has simply been undertaken to keep their place in the market and guarantee the sale of products.

In contrast, Leaders will likely adopt technology to drive more value-added activities; thus, Leaders will be focused on technology use, while followers will adopt to survive and focus on cost. Success using RFID has favoured firms which are able to integrate their whole supply chain (i.e., with both up- and down-stream partners) so the economies of scale lead to reduced RFID tag cost and benefiting from data automation as it enables data sharing which reduces time and costs associated with many supply chain activities. RFID adoption will continue to slowly grow; however, the lack of international standards and global practises will continue to influence adoption trends.

The Economic Environment was identified as a barrier for adoption in several developed nations. It is not surprising to see external factors being influential in the surveys run in Italy, Denmark, Sweden, and South Africa; the years the surveys were conducted indicate we would see the on-going effects of the Global Financial Crisis and stagnant growth in these economies.

For non-English speaking countries, IT programming and software can be a barrier due to the predominance of use English language keywords which can be a barrier for some nations, and this came through as a key problem for adoption in Denmark.

Interestingly, the Canadian Atlantic Coast is the Canadian region with the poorest IT adoption. The study found IT adoption within SMEs in that region was greatly influenced by the “Owner or Manager” context and competitive influences. The size of business, low population density, and remoteness were influences affecting IT adoption.

Sri Lanka was a nation that indicated with the need for support from recognised international industry bodies and the role they can play to networking, collaborating and building capabilities within a small country. Also IT adoption was influenced by political influences, which would increase stability and develop economic growth.

New Zealand (and possibly South Africa) seems to straddle the developing and developed groups identified in the international surveys; we seem to have attributes shared with each group. We face many of the operational and technological barriers developing countries struggle with; however, we also face a number of the external influences found in the other developed nations. This indicates New Zealand firms may need to develop a solid foundation and build on internal capabilities before venturing outside and integrating over the wider marketplace. This clearly indicated the maturity model stage of New Zealand SMEs and the issues of being a small developed nation with limited resources and long supply chains lead many firms to focus on cost efficiencies while other successful firms find it valuable to provide quality- or differentiation-based strategies to supply key markets.

## The way forward

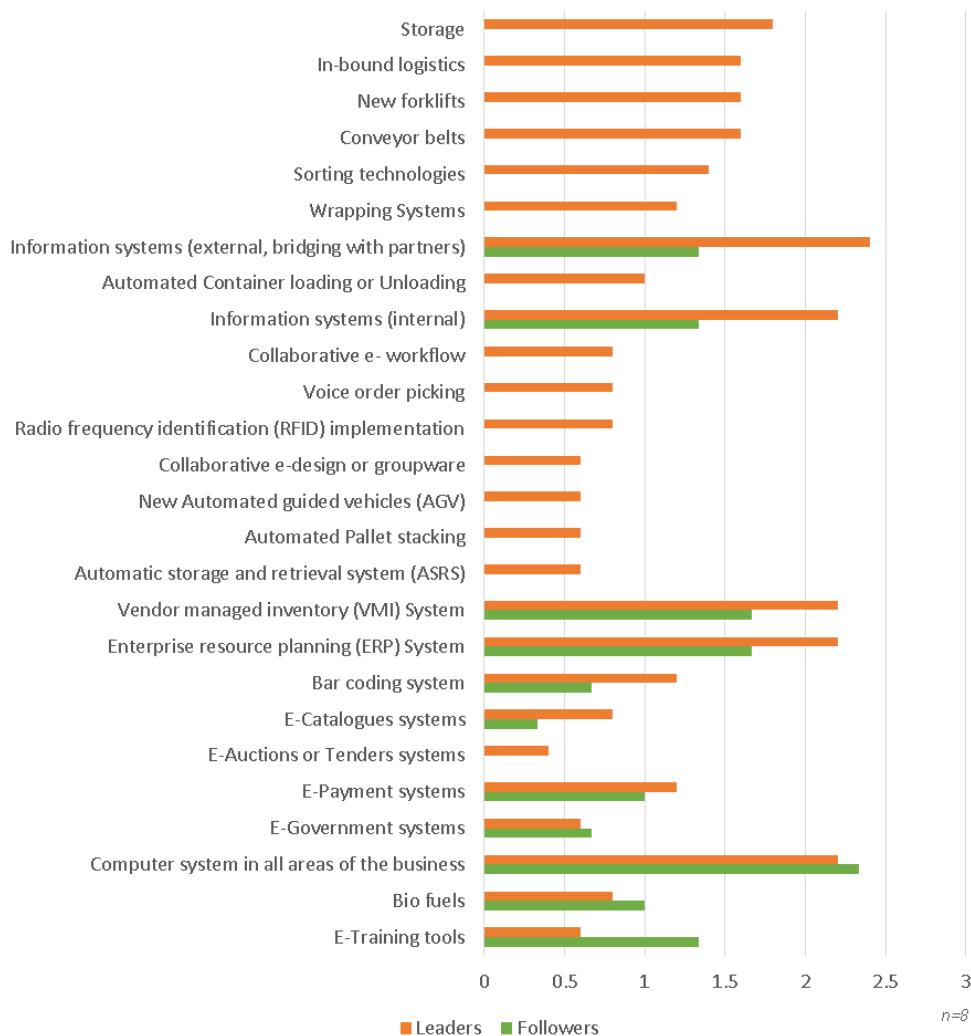
Figure 22 shows how over the Logistics sector many organisations have been investing in technology, with Leaders and Followers developing different areas due to the stage of IT integration development.

Many Followers are in the infancy stage of supply chain integration so development of “whole business IT processes” needs to be completed before the external development of downstream process integration can commence. Focus areas include e-payment and e-tools for in-house training, particularly those involving natural curiosity and the engagement of a ‘narrative’ learning style (Reiners, Wood, & Dron, 2014) will be more attractive to many users. The materials handling area for supply chain automation is not being considered as the internal processes are not in place or they have yet to meet the volume required to justify this capital investment. Indeed, future applications using learner-focused technologies may enable employees to engage with learning materials in their own time and work through materials at their own pace (Reiners, Wood, & Bastiaens, 2014).

**Figure 22**

**In the last 12 months rate the actual level of activity in improving logistics technologies in the following areas.**

**No activity (0); Little activity (1); Some activity (2); Moderate activity (3); Significant activity (4).**



The Leaders are in the developing or maturity stage of IT integration. The focus is on completion or refining their ERP or vendor-managed inventory (VMI) systems. The development of internal/external shared data by governmental agencies using (predominately) web portals are advancing, within the wider supply chain. Examples include the use of Joint Border Management Systems (JBMS) portal for international data transactions and I-government systems. While Followers are aware of these systems, many will wait until it is compulsory before changing.

Looking forwards over the next year, many Leaders are focusing on investment in material handling technologies (Figure 23). This may be due in part to increasing confidence in the economy, in manufacturing and business across the whole Asia-Pacific region, and improving business profits. The pace of IT development and particularly of wireless, RFID, and automation systems is reducing data duplication, reduced double material handling, and improving data integrity. Investment in material handling also improves compliance and health and safety and may also support quality and value as a differentiation strategy.

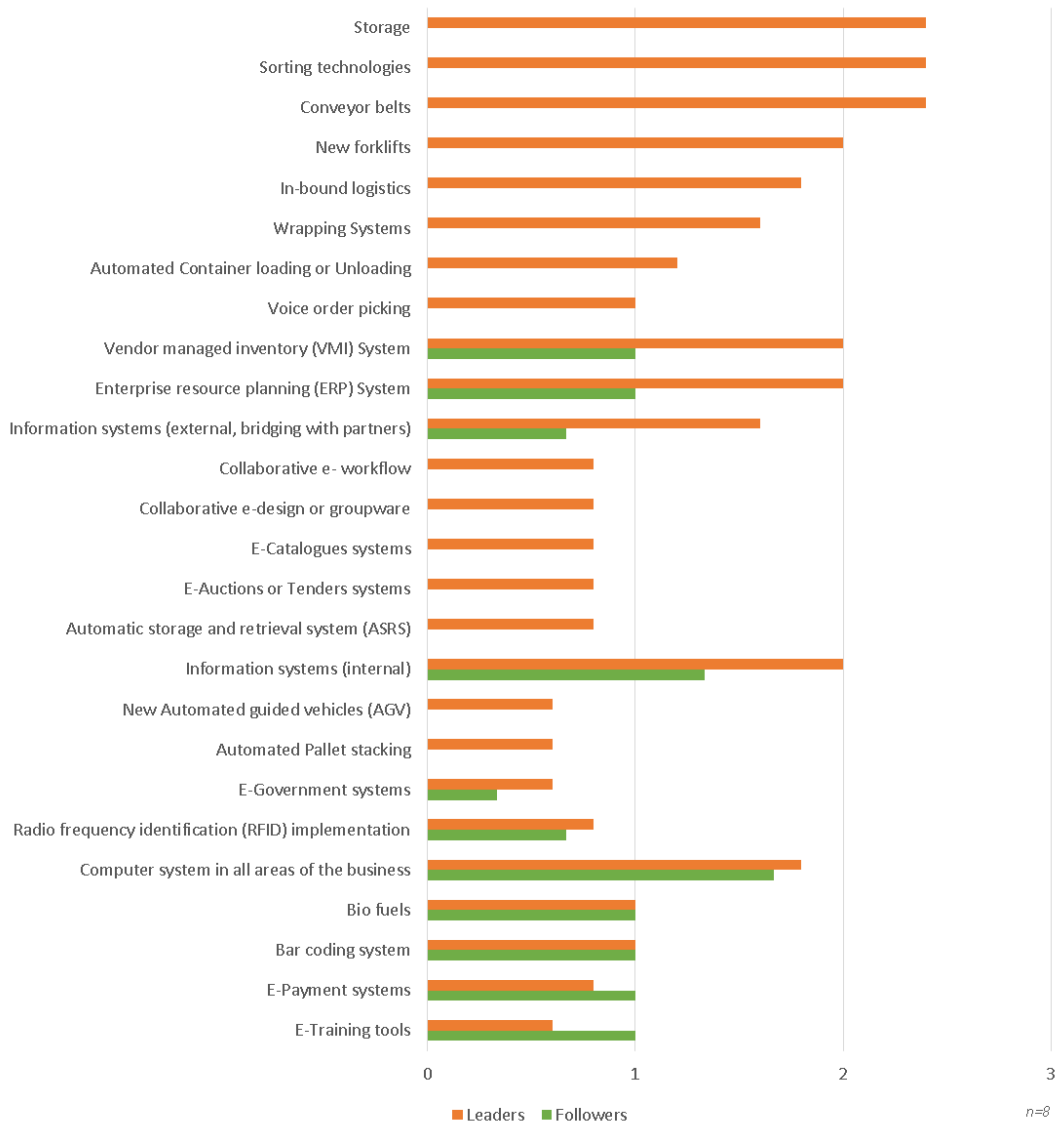
Interestingly, the development of upstream technologies to suppliers through e-auctions and e-tender systems is an area Leaders are yet to be developed; this may be due to the size of the New Zealand economy. Further insight may be provided by Stephen Rowe (CPO, Parmalat Australia), who noted “[t]he Australian market for suppliers is very small. There are very few suppliers in comparison to Europe, for example [in dairy products and the Australian Retail Market] [...]” and this may indicate that “e-tendering and e-auctions have never taken off in Australia because there needs to be a number of suppliers in the process in order for it to be worthwhile” (Scott, 2014).

In addition, advances in ICT enable firms to engage with marketplaces in new ways. Specifically, the ability to automatically monitor and analyse written data (Boese, Reiners, & Wood, 2014) could enable firms to identify, monitor, and use consumer-generated textual data (i.e., product reviews and comments about products) as part of their planning in manufacturing, logistics, and supply chain activities (Wood, Reiners, & Srivastava, 2013; Wood, Reiners, & Srivastava, 2014).

**Figure 23**

In the next 12 months rate the intended level of activity in improving logistics technologies in the following areas.

No activity (0); Little activity (1); Some activity (2); Moderate activity (3); Significant activity (4).



## International comparisons

A review of adoption of technology (both logistics-focused technologies and general ICT or e-commerce technologies) by SMEs globally was undertaken to supplement the survey. An overview is provided in Table 1.

A key factor that emerges is the influence – not the barrier imposed by – external factors, including:

- Competitive pressure: Adoption by competitors and mandated by industry (especially governments) can change the pressure on firms so they more rapidly adopt innovations they may otherwise avoid or delay adopting.
- Development of supply chain partnerships is critical to IT development and the extent of the integration is also important. Where there is strong integration, often controlled by a particular strong firm within the supply chain, roll-outs of technology may be required by firms desiring to stay part of the supply chain.
- Legislation in developing nations is not keeping up with the technology and the business IT solutions. At some point they will adopt new technologies and these will likely leapfrog the adopters in these countries beyond what our SMEs have adopted. An example may be the way many developing nations did not roll out a fixed-line telecommunications system and instead jumped straight to a mobile phone network.
- Regulatory changes and changes to legislation can rapidly change requirements on logistics companies. Examples include new trade agreements or countries mandating shipments must comply with particular requirements (e.g., providing the importer's government advance notification of contents of the shipment).

Results from our survey give us a framework presented in Figure 24. These factors are similar to those found in the Technology-Organization-Environment (TOE) Framework (Zhu, Kraemer, & Xu, 2003), and the Technology Acceptance Model (Davis, 1989). Furthermore, we draw on ideas concerning the use of measurements and external influences (Kaplan & Norton, 1996) and also ICT adoption in developing countries (Kapurubandara, 2009; Prananto, McKay, & Marshall, 2001) and developed countries (Scupola, 2012).

**Figure 24**

**Barriers to adoption and factors that influence adoption. Based on TOE and TAM frameworks.**

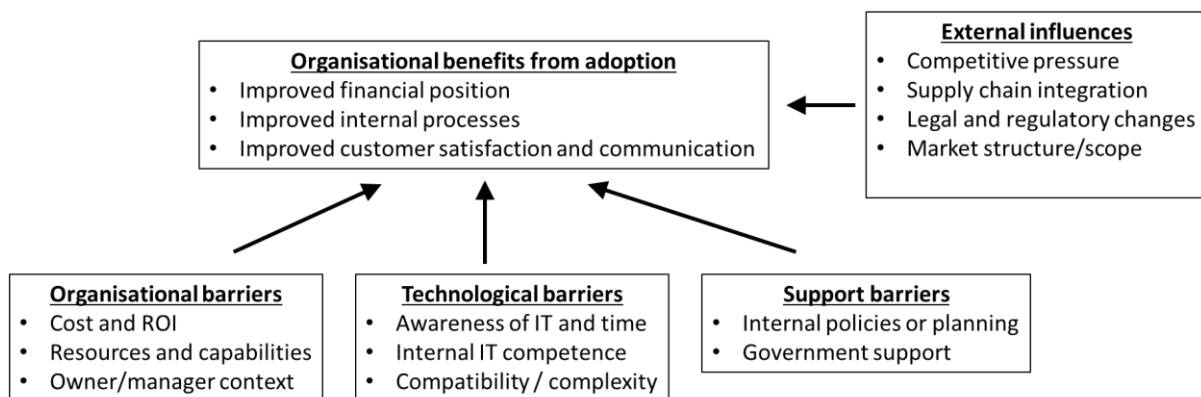


Table 1 International comparisons of technology adoption in various countries

	Patterson, Grimm, & Corsi (2003) USA; SCM Companies	Evangelista et al. (2005); Evangelista et al. (2006, 2013) Italian SME Logistics Industry	Al-Qirim (2007) E-Commerce Adoption in Small Businesses in NZ	Kapurubandara (2009) Sri Lanka SME	MacGregor, Bunker, & Kartiwi (2010) Australia & Indonesia SMEs	Scupola (2012) Denmark Facility Management with SMEs	Ifinedo (2011a, 2011b) Canada SME & Maritime Region of Canada	Park & Rim (2011) RFID Adoption, US, EU, China, Japan and Korea	Iddris (2012) E-Commerce adoption in SMEs in Ghana	Zilber & de Araujo (2012) E-Business adoption in Latin America	Gono, Harindranath, & Özcan (2013) South Africa SME Logistics & Manufacturing
<b>Research methods / tools</b>	Survey TAM	Survey & Focus Group	Survey & Focus Group	TOE eSME	Survey & Phone Interview	TAM Interview	Survey & TOE, DIT, & PLS Model	TOE, BSC Interview	Survey Interview	Case study and Survey	Survey Interviews TAM/RBV models
<b>Organisational Barriers</b>											
Not required or suitable for business		✓		✓	✓				✓	✓	✓
Cost & ROI		✓	✓	✓	✓	✓		✓	✓	✓	
Organisational Size	✓	✓	✓			✓					✓
Resource & Capabilities		✓	✓	✓	✓	✓		✓		✓	✓
Innovative Culture		✓				✓			✓		
Owner-Manager Context			✓				✓	✓	✓	✓	✓
<b>Technological Barriers</b>											
Awareness of IT and Time	✓		✓	✓	✓		✓	✓	✓	✓	✓
Internal IT Competence	✓	✓		✓	✓	✓		✓	✓	✓	✓
Compatibility/ Complexity		✓	✓	✓		✓	✓	✓	✓		✓
Access to external experts			✓	✓				✓		✓	✓
<b>Support Barriers</b>											
Internal Champions	✓	✓		✓		✓		✓			✓
Internal Policies, Planning	✓	✓	✓	✓			✓	✓		✓	✓
Industry Body Support				✓							
Government Support including Funding			✓	✓	✓	✓	✓	✓	✓		✓



	Patterson, Grimm, & Corsi (2003) USA; SCM Companies	Evangelista et al. (2005); Evangelista et al. (2006, 2013) Italian SME Logistics Industry	Al-Qirim (2007) E-Commerce Adoption in Small Businesses in NZ	Kapurubandara (2009) Sri Lanka SME	MacGregor, Bunker, & Kariwi (2010) Australia & Indonesia SMEs	Scupola (2012) Denmark Facility Management with SMEs	Ifinedo (2011a, 2011b) Canada SME & Maritime Region of Canada	Park & Rim (2011) RFID Adoption, US, EU, China, Japan and Korea	Iddris (2012) E-Commerce adoption in SMEs in Ghana	Zilber & de Araújo (2012) E-Business adoption in Latin America	Gono, Harindranath, & Özcan (2013) South Africa SME Logistics & Manufacturing
<b>External Influences</b>											
IT Infrastructure				✓	✓				✓	✓	
Political climate				✓							✓
Legal & regulatory				✓	✓	✓		✓	✓		✓
Cultural & Social - Customer			✓	✓	✓				✓	✓	
Competitive Pressure	✓		✓			✓	✓	✓		✓	✓
Industry Size	✓										
Market Structure/Scope	✓		✓	✓	✓			✓			✓
International Standards		✓	✓			✓					
Economic Environment		✓			✓	✓					✓
Supply Chain Integration & relationships	✓	✓	✓		✓	✓				✓	✓
<b>Where Implementation</b>											
<b>Organisational Performance</b>											
Improved Knowledge & Learning		✓						✓			
Improved Company Growth							✓	✓	✓	✓	
Improved Internal Processes	✓						✓	✓	✓	✓	
Improved Customer Satisfaction and communication		✓						✓	✓	✓	✓
Improved Finance Position Reduced costs	✓	✓					✓		✓	✓	✓

## References

- Al-Qirim, N. (2007). A research trilogy into e-commerce adoption in small businesses in New Zealand. *Electronic Markets*, 17(4), 263–285. doi:10.1080/10196780701635872
- Boese, S., Reiners, T., & Wood, L. C. (2014). Semantic document networks to support concept retrieval. In J. Wang (Ed.), *Encyclopedia of Business Analytics and Optimization* (pp. 431–442). Hershey, PA: Business Science Reference.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. doi:10.2307/249008
- Evangelista, P., Cioffi, L., & Sweeney, E. (2005). An exploratory study of ICT usage in small logistics service providers. In *Conference papers* (Vol. Proceedings of the 10th Annual Conference of the Logistics Research Network). Plymouth, UK. Retrieved from <http://arrow.dit.ie/nitlcon/39>
- Evangelista, P., McKinnon, A., & Sweeney, E. (2006). Technology influences on small logistics providers: A case study analysis. In *Proceedings of the 11th Annual Conference of the Logistics Research Network*. Newcastle, UK. Retrieved from <http://arrow.dit.ie/nitlcon/63>
- Evangelista, P., McKinnon, A., & Sweeney, E. (2013). Technology adoption in small and medium-sized logistics providers. *Industrial Management & Data Systems*, 113(7), 967–989. doi:10.1108/IMDS-10-2012-0374
- Gono, S., Harindranath, G., & Özcan, G. B. (2013). Challenges of ICT adoption by South African SMEs: A study of manufacturing and logistics firms. In *Proceedings of the Annual Conference of The Institute for Small Business and Entrepreneurship*. Cardiff, Wales. Retrieved from [http://www.isbe.org.uk/content/assets/ICT-Sinfree\\_Gono.pdf](http://www.isbe.org.uk/content/assets/ICT-Sinfree_Gono.pdf)
- Iddris, F. (2012). Adoption of e-commerce solutions in small and medium-sized enterprises in Ghana. *European Journal of Business and Management*, 4(10), 48–57.
- Ifinedo, P. (2011a). An empirical analysis of factors influencing internet/e-business technologies adoption by SMEs in Canada. *International Journal of Information Technology & Decision Making*, 10(04), 731–766. doi:10.1142/S0219622011004543
- Ifinedo, P. (2011b). Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. *Internet Research*, 21(3), 255–281. doi:10.1108/10662241111139309
- Kaplan, R. S., & Norton, D. P. (1996). Using the balanced scorecard as a strategic management system. *Harvard Business Review*, 74(1), 75–85.
- Kapurubandara, M. (2009). A Framework to e-Transform SMEs in Developing Countries. *The Electronic Journal of Information Systems in Developing Countries*, 39(0).
- MacGregor, R. C., Bunker, D., & Kartiwi, M. (2010). The perception of barriers to e-commerce adoption by SMEs: A comparison of three countries. In P. Bharati, I. Lee, & A. Chaudhury (Eds.), *Global Perspectives on Small and Medium Enterprises and Strategic Information Systems: International Approaches* (pp. 145–168). Hershey, PA: IGI Global.
- Park, Y.-J., & Rim, M.-H. (2011). The relationship analysis of RFID adoption and organizational performance. In *ICSNC 2011, The Sixth International Conference on Systems and Networks Communications* (pp. 76–82). Baelona, Spain: IARIA.
- Patterson, K. A., Grimm, C. M., & Corsi, T. M. (2003). Adopting new technologies for supply chain management. *Transportation Research Part E: Logistics and Transportation Review*, 39(2), 95–121. doi:10.1016/S1366-5545(02)00041-8
- Prananto, A., McKay, J., & Marshall, P. (2001). Frameworks to support e-business growth strategy. In *Proceedings of the 9th European Conference in Information Systems*. Bled, Slovenia: ECIS.
- Reiners, T., Wood, L. C., & Bastiaens, T. (2014). Design perspective on the role of advanced bots for self-guided learning. *The International Journal of Technology, Knowledge and Society*, 9(4), 187–199.
- Reiners, T., Wood, L. C., & Dron, J. (2014). From chaos towards sense: A learner-centric narrative virtual learning space. In J. Bishop (Ed.), *Gamification for Human Factors Integration: Social, Education, and Psychological Issues* (pp. 242–258). Hershey, PA: IGI Global.

- Scupola, A. (2012). ICT adoption in facilities management supply chain : The case of Denmark. *Journal of Global Information Technology Management*, 15(1), 53–78.
- Wood, L. C., & Reefke, H. (2010). Working with a diverse class: Reflections on the role of team teaching, teaching tools and technological support. In H. Huai, P. Kommers, & P. Isaías (Eds.), *IADIS International Conference on International Higher Education (IHE 2010)* (pp. 72–79). Perth, Australia: IADIS Press.
- Wood, L. C., & Reiners, T. (2013). Game-based elements to upgrade bots to non-player characters in support of educators. In A. Hebbel-Seeger, T. Reiners, & D. Schäfer (Eds.), *Synthetic worlds: Emerging technologies in education and economics* (pp. 257–277). Berlin, Germany: Springer.
- Wood, L. C., Reiners, T., & Pahl, J. (2014). Manufacturing and logistics information systems. In M. Khosrow-Pour (Ed.), *Encyclopedia of Information Science and Technology* (pp. 464–473). Hershey, PA: Information Science Reference.
- Wood, L. C., Reiners, T., & Srivastava, H. S. (2013). Expanding sales and operations planning using sentiment analysis: Demand clarity from social media. In *Proceedings of the 27th Australia New Zealand Academy of Management (ANZAM) Conference 2013*. Hobart, Tasmania (Australia).
- Wood, L. C., Reiners, T., & Srivastava, H. S. (2014). Sentiment analysis in supply chain management. In J. Wang (Ed.), *Encyclopedia of Business Analytics and Optimization* (pp. 444–455). Hershey, PA: Business Science Reference.
- Zhu, K., Kraemer, K., & Xu, S. (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems*, 12(4), 251–268. doi:10.1057/palgrave.ejis.3000475
- Zilber, S. N., & de Araújo, J. B. (2012). Small companies innovations in emerging countries: e-Business adoption and its business model. *Journal of Technology Management & Innovation*, 7(2), 102–116. doi:10.4067/S0718-27242012000200009