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**AUCKLAND**  
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**BUSINESS SCHOOL**

**UABS INSIGHTS SPECIAL ISSUE ON**

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# Supply Chain Management

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# Welcome



Welcome to this new issue of UABS Insights, where we are having a special issue focusing on supply chain management. As an export-focused country, New Zealand (NZ) lives and dies by its supply chains. We trust you will find the articles here both thought provoking and inspiring.

We are on the brink of a new Industrial Revolution, yet some of NZ's supply chains seem stuck in the 20th century. The articles in this issue explore supply chain and managerial innovations and what they mean for NZ's supply chains. Mechanization, electrification, and computing each drove dramatic and disruptive progress in the production of goods and services. Industry 4.0, a term first coined by the German economic development agency GTAI, is so-named to promote the idea that we are at the dawn of a new industrial revolution brought about by the connection of the physical and digital realms.

In the first article, we explore issues around supply chain strategy, and whether the collective hand-wringing around NZ's log (and similar commodities) exports is justified. The second article, by Dr O'Grady, explores ideas of adaptive management and how they are successfully applied at Mainfreight. Then Drs Zhong and Zhang describe the Internet of Things and what it means for NZ agri-food businesses; they argue that it is reaching a tipping point for NZ. Finally, Professor Robb calls for New Zealand firms and educators to enhance their capabilities in supply chain management to meet a growing demand and critical skills for supply chain talent. He encourages exemplary practice from thought leaders in New Zealand and recent research.

The University of Auckland Business School's vision is to shape the futures of people and organisations for the benefit of Aotearoa New Zealand and the world. One important part of shaping NZ's future is helping improve NZ's supply chains and so move the dial on the performance of NZ Inc. We hope that the ideas in this issue will both challenge your thinking and improve your supply chain knowledge.

## **Professor Tava Olsen**

*Head of Department of Information Systems and Operations Management at the University of Auckland Business School.*

# Are we doomed to sell low value products like logs and milk powder?

By **Tava Olsen** and **Mojtaba Mahdavi**

Each group needs its own supply chain strategy

Unimproved exports like the massive piles of raw logs at Tauranga port can often seem a wasted opportunity to add value. The New Zealand government, with its move towards investing in high-value manufacturing, apparently agrees. But disinvesting in exports like raw logs to promote alternatives like high-value furniture goes against traditional supply chain (SC) strategy theory, according to which commodity-type exports are a logical consequence of New Zealand's remote position in the world's SC. As demonstrated by Marshall Fisher's framework from the 1990s, commodity-type products like logs or milk powder are best served by efficient SCs, while innovative high-value products like custom furniture or high-tech products are best served by responsive SCs that can react quickly to changing customer demand. Key to a responsive SC is providing a short lead time, however this is challenging to do from New Zealand.

Developing a deeper understanding of this dilemma was the focus of Professor Tava Olsen's Marsden grant, which supported Mojtaba Mahdavi's PhD thesis. Does the Fisher framework doom New Zealand to be an exporter of low-value products? Is the theory sound? In this article we explore our findings on this topic. In particular, we begin by explaining Fisher's theory in more depth. We then discuss the SC strategy literature more generally and how Fisher's theory fits within it. Next, we apply the theory to the case of New Zealand. Finally, we conclude with a brief summary of our findings and recommendations for New Zealand.

## Fisher's Framework

A key challenge in operations strategy is designing an effective supply chain structure that aligns with the company's business model. The supply chain management literature provides a number of techniques and guidelines for developing effective supply chain strategies. A famous 1997 article by Marshall Fisher profoundly influenced the literature by presenting a framework that matches product type (i.e., functional or innovative) with supply chain strategy (i.e., efficient or responsive). This taxonomy initiated a large number of studies on product-driven supply chain strategy. However, when we reviewed these studies we found little modelling work that directly contributes to this area. This gap was the focus of the second author's thesis. We discuss our findings in this regard further below, but first we review Fisher's framework in more detail.

As mentioned above, Fisher recommended classifying products into two distinct groups, namely, functional and innovative products. A long life-cycle, stable and predictable demand, and low contribution margin are the main attributes of the first group. Conversely, products in the second group have a short life-cycle, volatile and unpredictable demand, and high contribution margin. According to Fisher, each group needs its own supply chain strategy. The functional products require an efficient and lean supply chain with a cost reduction approach, while the innovative group calls for a responsive and flexible supply chain with high delivery speed. Table 1 shows the characteristics of the two product types.

**Table 1.** Functional versus innovative products [Adapted from Fisher (1997)]

Aspects of demand	Functional (Predictable demand)	Innovative (Unpredictable demand)
Product life cycle	More than 2 years	3 months to 1 year
Contribution to margin	5% to 20%	20% to 60%
Product variety	Low (10 to 20 variants per category)	High (often millions of variants per category)
Average margin of error in the forecast at the time production is committed	10%	40% to 100%
Average stock out rate	1% to 2%	10% to 40%
Average forced end-of-season markdown as a percentage of full price	0%	10% to 25%
Lead time required for made-to-order products	6 months to 1 year	1 day to 2 weeks





Fisher used Campbell Soup Company, a producer of canned food, and Sport Obermeyer, a supplier of fashion skiwear, as examples of companies that provide functional and innovative products respectively. Highly predictable demand for products that have been in the market for years allowed Campbell Soup to satisfy nearly 98% of demand immediately from stocks of finished products. On the other hand, Sport Obermeyer was bringing a range of products to the market each year, 95% of which were totally new. In contrast, only 5% of Campbell's products were new. As a result, demand forecasts for Sport Obermeyer products could err by 200%. In addition, because the retail season for ski gear is very short, the company had very little time to react if it misjudged the market.

Designing a physically efficient supply chain requires a minimum level of stability and predictability of demand as the basis for scheduling the production plan and corresponding replenishments. Stable relationships with suppliers and high production volume will decrease the variable costs for products with a sufficiently long lifetime. Logically, a functional product is best suited to these conditions. The market for such products will be price sensitive, so effective strategies that enhance production efficiency and cost reduction in the supply chain are necessary to maintain a competitive advantage in the market.

On the other hand, this approach will not work if the product is innovative. Because of uncertainty and volatility in demand, relevant information from the marketplace needs to be swiftly gathered to reflect any corresponding changes in demand so the supply chain can respond to the market as quickly as possible. Due to the short life cycle and high profit margin for such products, competition will no longer be based on price. Instead, lead time, service level, flexibility, reliability, and quality will determine competitiveness. Thus, responsiveness to the customer's specific expectations (which makes them willing to pay more) is the crucial characteristic of the supply chain for innovative products. Table 2 summarises these two types of supply chains.

**Table 2.** Physically efficient versus market-responsive supply chains [Adapted from Fisher (1997)]

	Physically efficient process	Market-responsive process
Primary purpose	Supply predictable demand efficiently at the lowest possible cost	Respond quickly to unpredictable demand in order to minimise stock outs, forced markdowns, and obsolete inventory
Manufacturing focus	Maintain high average utilisation rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimise inventory throughout the chain	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten lead time as long as it does not increase cost	Invest aggressively in ways to reduce lead time
Approach to choosing suppliers	Select primarily for cost and quality	Select primarily for speed, flexibility and quality
Product-design strategy	Maximise performance and minimise cost	Use modular design in order to postpone product differentiation for as long as possible



For a company seeking to establish an appropriate supply chain strategy, managers first need to determine whether their product is functional or innovative. Table 1 is helpful for this step. They should then review their current supply chain according to the guidelines provided in Table 2 to determine if it is physically efficient or market responsive. The next step is to figure out whether the product and the supply chain match. Figure 1 helps companies to locate their position in relation to matching supply chain with product.

**Figure 1. Matching supply chains and products [Adapted from Fisher (1997)]**

	Functional products	Innovative products
Efficient supply chain	match	mismatch
Responsive supply chain	mismatch	match

The upper right hand cell and lower left hand cell of Figure 1 demonstrate the conditions of a mismatch and thus predict problematic conditions. However, we rarely see companies mismatching functional products with a responsive supply chain because conventionally, companies will be concerned about efficiency in their supply chain. However, if a company decides to introduce innovations to their products, usually to reap higher margins, they often neglect to restructure their supply chain accordingly. As a result, they start delivering innovative products but still using efficiency-focused supply chains. This can lead to significant opportunity costs in the chain. We next provide some helpful tips for successfully maintaining each supply chain strategy.

## I) Tips to maintain a physically efficient supply of functional products

Cost reduction and efficiency improvement are not new ideas in an operational context and there are a wide range of strategies, e.g., lean manufacturing, which companies can follow to cut total cost throughout the supply chain. However, some important points should be taken into account to create an efficient flow of functional product to the market:

- Improving inter-organisational coordination with suppliers and distributors works better than aggressive cost cutting. Electronic networks and information systems infrastructure provide considerable advantages in this regard.
- Maintaining predictable, stable demand is better than running occasional promotional programmes to increase sales. The latter can create an addiction to incentives that turns simple predictable demand into something more chaotic.
- Both cooperative and competitive models between partners in a supply chain can lead to substantial profit due to strong sales of a functional product. However, using both models with a partner at the same time is not sensible as they require fundamentally different behaviours.

## II) Tips to maintain a responsive supply of innovative products

Dealing with uncertainty in demand is the main issue for innovative products. Companies should first accept this uncertainty as intrinsic to their products and then aim to capture the opportunity of a high profit margin by designing a responsive supply. The following coordinated strategies can be employed to cope with uncertainty:

- Using market mediation models to reduce uncertainty by continuous observation of demand.
- Cutting lead time and increasing the flexibility of the supply chain to mitigate uncertainty. The final configuration may be able to be delayed until a point when demand is as accurate as possible.
- Establishing buffers on inventory or spare capacity in resources at levels that can react to the remaining residual uncertainty.
- Mass customisation is a strategy that allows the company to quickly deliver a variety of products at high volume and close to mass-production prices. This strategy combines the concepts of efficiency and responsiveness, but it does not work for all companies and also has its own challenges.





## Supply Chain Strategy

The origins of the discussion on how to effectively align a company's supply chain with its business model can be traced back to a 1974 article by Wickham Skinner titled "The focussed factory". Skinner argued that US manufacturers were trying to be all things to all people, and therefore failing at doing anything particularly well. This idea was subsequently picked up by others, resulting in an extensive literature on aligning operations with competitive priorities. Later contributions to manufacturing strategies include the emergence of the lean paradigm and mass production, which profoundly changed manufacturing systems, especially in the auto industry, and the introduction of agile manufacturing, which has been promoted as the strategy for 21st century enterprises.

Returning to Fisher, his framework has been widely considered in the supply chain management literature, and extended from both conceptual and practical points of view. A number of quantitative studies have empirically explored the framework in different sectors and countries, and it has also been analysed mathematically in a few studies. However, despite the fact that Fisher's framework has received significant attention and support from the literature, some questions remain that require further exploration, and especially from an analytical viewpoint.

The most common key issues arising from the literature with regard to Fisher's proposition are: 1) the need for hybrid supply chain strategies that deliver intermediate products with both functional and innovative characteristics; 2) insufficient dimensions for characterising supply chains by product type; 3) companies with product-supply chain mismatch do not necessarily underperform compared to those with matching conditions; and 4) the framework has not been thoroughly validated mathematically. The final point was the subject of the second author's PhD thesis.

In addition to Fisher's work, the supply chain management literature offers other strategies for structuring logistics and manufacturing processes according to product characteristics. For instance, a large group of researchers have discussed and extended Naylor and others' 1999 idea of developing supply chains with lean, agile, or leagile approaches, whichever best matches demand/market requirements. A lean supply chain is in many ways

analogous to an efficient supply-chain, while an agile supply chain equates with a responsive supply chain. However, "leagility" combines leanness and agility in a supply chain by strategically positioning the "decoupling point", which is where product differentiation occurs. A

classic example is HP's decision to delay putting the power source and manuals in with their printers until they receive orders from specific European countries. In other words, they maintain a lean printer supply chain up to the point of in-country differentiation, and then an agile supply chain within Europe. Fisher and Paykel Healthcare in New Zealand follow a similar strategy for many of their products.

Moving the decoupling point closer to the customer enables efficiency in the supply chain, improving

capability for reducing costs. Further, this delay in product differentiation is essentially a postponement strategy, whereby products are tailored for the market closer to end-user demand. On the other hand, positioning the decoupling point further from the end-user (closer to the main supplier) creates more capacity in the supply chain for customisation, i.e., a manufacturer may follow a make-to-order or engineer-to-order strategy. Mass customisation is another product-driven strategy that allows for both variety and volume, i.e., customised products at a mass production price, and requires a simultaneous focus on cost and pace.

Overall, the current acceleration in competition in the marketplace means that high speed and low cost are not sufficient to create competitive supply chains, possibly because these two factors are now more market qualifiers than market winners. To achieve a sustainable competitive advantage, Hau Lee suggested the Triple-A supply chain strategy in 2004. This strategy incorporates "agility", i.e., quick responses to short-term changes in demand or supply, "adaptability", i.e., design adjustments to accommodate market changes, and "alignment" of all firms in the supply chain to improve the entire chain. The success of Wal-Mart, Amazon, Dell, and Seven-Eleven Japan confirm that Lee's theory is particularly apt in the current era where "it is supply chains that compete not companies" and supply chain decisions are becoming more strategic than transactional.

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High speed and low cost are not sufficient to create competitive supply chains; these two factors are now more market qualifiers than market winners

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## The Case of New Zealand

In the international market place, New Zealand is well-known for its dairy products, meat, and logs/timber. These three product groups have been New Zealand's top exports (in value) for many years. As primary products, their main feature is having very low value-adding capacity, leading to low contribution margins. These classic functional-type products are attractive to manufacturers and traders because they usually guarantee a minimum average demand, which in the long term is relatively high. Overall, 70 percent of all goods exported from New Zealand are primary products, with the balance made up by manufactured products.

From an economic point of view, we might criticise this reliance on exporting low value-added products when higher value-added items could make our international trade more profitable. The case of Fonterra is frequently mentioned in the media. Fonterra exports significantly more low-profit milk powder than high-profit infant formula. Moreover, according to the International Farm Comparison Network (IFCN) 2014 report, although Fonterra is the world's second largest milk processor in terms of milk intake (million tons/year), it holds sixteenth place in terms of average turnover (\$/kg milk). The New Zealand government's response to this issue was to set a 40% target for exports as a ratio of GDP, to be achieved by 2025. A key focus of the strategy is "strengthening high-value manufacturing and service exports".

However, the government's agenda of investing in high-value manufacturing exports may be in conflict with Fisher's framework. Due to New Zealand's geographical remoteness from all its potential markets, it has low physical connectivity, making a responsive supply chain difficult to build. Furthermore, according to Statistics NZ, only 0.45% of the country's enterprises have more than 100 employees and only 0.5% have between 50 and

100 employees, making 93% of New Zealand businesses micro according to the European Commission's criteria. Businesses of this scale are usually concerned with leanness and cost efficiency, which makes exporting innovative (high value) products a significant challenge.

At this point it is helpful to look at two highly successful New Zealand export companies, namely Zespri and Fisher and Paykel Healthcare. Zespri sells a fundamentally functional product with an efficiency-focused supply chain. However, due to their focus on R&D and marketing, they are able to command a price premium of around 30% for their quality product. Thus, while Zespri is not an exact "match" according to the Fisher framework, they are a company many of our primary industries could do well to emulate. Fisher and Paykel Healthcare, on the other hand, focuses on highly innovative products. The company gets around the distance to its markets by having both a significant

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New Zealand has low physical connectivity, making a responsive supply chain difficult to build

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manufacturing operation in Mexico (which also has much lower labour costs than New Zealand), and by being willing to airfreight product around the world as needed. They therefore have a responsive supply chain that focuses much more on product availability than supply cost (as Fisher recommends).

Overall, we find a match between Fisher's recommendations and these two examples from New Zealand with two key caveats. First, as illustrated by Zespri, it is possible to create high(er) margins by producing a quality product, even for a fundamentally a functional product being supplied by an efficient SC. Second, a responsive SC is indeed possible from New Zealand, for either (a) products that can be airfreighted, or (b) service industries where no physical product needs to be sent. New Zealand has thriving IT and digital design industries that should clearly be encouraged further because they represent high-value opportunities with few issues of distance to market.

Finally, because New Zealand is very efficient at farming trees, we probably don't need to be wringing our hands over the logs that leave Tauranga, but there are other concerns. In particular, both NZ Post's printing division and the GIB wallboard made by Fletcher's use paper imported from Australia because they can't source paper of the right quality and price locally. Paper is a functional product that we should be efficient at producing, and it is worrying that we cannot meet the needs of even our own local companies. Indeed, many of the manufacturing companies we have visited in the course of the research seem to be 20 years behind in their quality and efficiency practices. New Zealand manufacturing needs some serious upskilling if it is to compete on the world stage, but that is the subject of a different article.





## Summary of Research Findings and Conclusions

The examples in the previous section reflect the challenges that managers face when making decisions on building their supply chain strategies. For product-driven strategies, Fisher's framework is one of the most well-known tools, and it has been widely employed in various industries/countries over the decades. We now have a clearer understanding of potential developments/improvements to effectively update the framework, from both empirical and analytical perspectives. We have also explored the framework mathematically, and how we can further analyse the framework by including additional factors, e.g., product life cycle. Analysis of Statistics NZ data with respect to the framework has shown that, for NZ exporters, improvements in responsiveness are uniformly good but there is such a thing as too much efficiency.

Thus far in our research, we have not seen anything to significantly disprove Fisher's thesis. The mathematical models we have produced tend to back-up his ideas. While there are caveats and middle grounds, fundamentally any New Zealand firm looking to export an innovative product with unpredictable demand is going to need to find a way to supply it with a responsive supply chain. This may involve using airfreight, or moving inventory or manufacturing closer to the source. For New Zealand

manufacturing, the tyranny of distance is real and we are not going to overcome it by simply coming up with more smart ideas for high-value products. That said, it is possible to sell functional products with efficient supply chains and still receive a premium price in the market, as has been effectively demonstrated by Zespri. Our red meat industry, in particular, could get smarter about how it markets itself internationally.

In general, our companies need to get better at both their manufacturing and supply chain practices. It is surprising that Fisher and Paykel Healthcare's SC division is only about seven years old, while Sanford Fisheries only set up an SC division in the past couple of years. Many New Zealand companies are not well informed about SC best practices, and we are particularly lagging in terms of modern SC collaboration techniques according to a recent IBM survey. Fortunately, the University of Auckland Business School is well positioned to help companies upskill and we see this as a significant part of our mission. We invite companies to engage with us further on the issues raised in this article.

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There is such  
a thing as  
too much  
efficiency

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# Moving logistics forward with adaptive management

By **Winnie O'Grady**

The logistics industry is facing a time of rapid and unprecedented transformation. Technological developments are impacting all stages of the supply chain and transforming the way third party logistics (3PL) providers operate. Delivery drones, parcelcopters, driverless trucks, high-speed magnetic levitation (maglev) trains and the internet of things (IoT) are but a few of the technological developments driving change across all phases of the logistics process. Additionally, logistics companies face ever-increasing customer expectations and competition.

Changes such as these reflect the volatility, uncertainty, complexity and ambiguity (VUCA) faced by logistics operators, and their impact is not easy to predict. The challenge for companies operating in a VUCA world is maintaining the stability of current operations while adapting to continually emerging conditions. When yesterday's experience won't necessarily ensure future profitability, companies may have to develop new management models to achieve success. One such alternative is the adaptive management model.

## Adaptive Management

The term adaptive management refers to a non-hierarchical approach to managing business performance that relies on self-regulation and self-organisation of autonomous operational units to enhance organisational flexibility and responsiveness (Hope, Bunce, & Roosli, 2011)<sup>1</sup>. The most comprehensive description of adaptive management is provided in the beyond budgeting literature (Hope & Fraser, 2003). This management model combines a flattened organisational structure, aspirational purpose, flexible and responsive management planning and control processes, and strong corporate culture and values to create a performance management approach that is more adaptive than approaches based on hierarchies, rigid and static processes and codes of conduct.

The adaptive management model is distinctly different from the traditional command and control approach to performance management. Radical decentralisation is one of its most obvious characteristics, i.e., the creation of a relatively flat organisational structure in which key decisions, including strategy, are devolved to autonomous front-line teams. This structural change partitions the overall complexity generated by VUCA environments

into smaller chunks that are manageable for individual units. Accordingly, operational units are relatively small compared to strategic business units and more able to respond quickly to changes in the business environment. For example, in one company, their branch offices range in size from a handful to no more than 200 employees.

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Adaptive processes enable managers to respond flexibly to unanticipated business conditions

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An equally important but less visible characteristic of an adaptive management model is an organisational culture in which employees are trusted and empowered and core values are highly visible. Organisations trust that individual employees are capable and willing to make decisions in the best interests of the company. They empower employees by giving them authority to make decisions and providing them with the training, resources and information needed to be successful in their

work roles. The company is clear about what it stands for, including the behaviours and attitudes it expects of employees, providing guidance that can be applied in a wide range of day to day decision making contexts.

To ensure that decentralised units can exercise autonomy, organisations need to ensure their performance management processes are also adaptive. Adaptive processes enable managers to adapt action plans and respond flexibly to unanticipated business conditions. Adaptive organisations rely more on broad statements of strategic direction, and goals and management processes are inherently more flexible than formal plans, detailed budgets or fixed performance contracts.

Adaptive management advocates for goals that extend beyond a one-year time horizon. Setting such goals reduces the risk that managers will treat shorter-term targets as the desired outcome, thus motivating them to continue their efforts once initial targets are met. Adaptive management approaches rely on relative performance assessment in place of fixed performance contracts. Actual performance is evaluated in relation to the performance that could reasonably be expected given the actual operating conditions, the performance of similar units within the organisation, or the performance of competitors. Relative performance evaluations motivate managers to continually search for opportunities and modify action plans to maintain performance parity. Adaptive management avoids traditional annual budgeting processes. Dynamic resource allocation

<sup>1</sup>Beyond Budgeting (Hope & Fraser, 2003); The Leader's Dilemma (Hope et al., 2011).



processes enable managers to acquire resources as opportunities emerge throughout the year, thus allowing action plans to be continually adapted. The availability of near real-time performance information allows managers to monitor and control their own performance by modifying action plans as required. Team based rewards ensure everyone shares in the benefits produced from the team's efforts. Shared rewards also encourage all employees to be alert to opportunities to improve performance. Adaptive processes thus provide managers with the flexibility needed to continually adjust plans and actions in response to the prevailing conditions, and the opportunities and risks they entail. Adaptive management processes therefore provide a stark contrast to traditional performance management processes that focus on adherence to fixed plans, targets and budgets.

The Beyond Budgeting Round Table (BBRT) promotes the adaptive performance management model. The current membership of BBRT is around 6,000. The industries represented by BBRT organisations vary considerably and include, for example, banking, logistics, food production, manufacturing (e.g., toys, cars and tires), tertiary education, and oil and gas production. Among the member organisations<sup>2</sup> listed on the BBRT homepage are Handelsbanken, the World Bank, Mainfreight, Volvo, Michelin, Statoil, Maersk, Astra Zeneka, Lego, Michelin, HoltCat, Stanford Hospital and Clinics, and Copenhagen Business School. The majority of organisations engaging extensively with adaptive management appear to be based in Scandinavia or Europe, with fewer adopters in North America and Australasia. This variation in uptake and design of adaptive management approaches has been addressed in the literature. For example, Johanson (2013) suggests that the North American and Norwegian approaches to beyond budgeting reflect fundamental differences in the relative power, and coalitions, between shareholder, employee and management interests.

While the BBRT would argue that the adaptive management model can benefit all types of organisations it appears particularly well suited to those that can structure their operations as a network of distinct, autonomous profit centres and is less suited to organisations that need longer planning cycles for managing resource commitments and/or inventories. The following case study illustrates how the adaptive management model has been implemented by one New Zealand company.



## Mainfreight

Mainfreight is a highly successful international logistics operator headquartered in Auckland, New Zealand. It was established in 1978, and listed on the New Zealand stock exchange in 1996. In 2019, the company generated NZ\$2.95 billion in revenue, operated 260 branches in 24 countries throughout the Americas, Europe, Asia, Australia and New Zealand and employed over six thousand team members<sup>3</sup>.

The company aspires to be an international logistics company that is still operating in 100 years, and to become New Zealand's largest company by size and market capitalisation by 2028. It was previously recognized as the top New Zealand transport/logistics company in the 2018 Deloitte Top 200, which ranks companies by revenue and profits. The relative 2018 figures for New Zealand transport and logistics companies are presented in Table 1.

Mainfreight's operations are segmented into three main divisions, namely, domestic freight, international freight (or Air and Ocean) and logistics. The company handles freight but does not typically own trucks or associated modes of transport, relying instead on its network of owner drivers and external rail and shipping providers to transport the freight. The corporate structure is relatively flat with just four levels of management, comprising the executive team and country, general and branch managers. Of these levels, the branches play the most important role as they are the units that drive corporate profit. Accordingly, Mainfreight's performance management system is designed primarily to support branch managers. The company's approach to managing performance provides a local example of the adaptive management model in action.

**Table 1.** 2018 Ranking of New Zealand logistics/transport companies

	By revenues		By profit	
	\$(000)	Rank	\$(000)	Rank
Mainfreight	2,618,000	15th	108,000	28th
Freightways	581,000	72nd	62,000	45th
Toll Group	401,000	107th	5,000	156th
DHL Holdings	319,000	125th	1,000	165th

<sup>2</sup> Member organisations can be found at <http://bbrt.org>

<sup>3</sup> The term used instead of employees

Source: <https://www.top200.co.nz/wp-content/uploads/2018-DELOITTE-TOP-200-INDEX.pdf>





## Culture and Values

The company's culture and fundamental beliefs are set out in the Three Pillars of Mainfreight. The pillars are labelled culture, family and philosophy and each has a list of associated principles, which include: avoiding bureaucracy and hierarchy; allowing individuals to participate in decision processes; using teams to drive profitable performance, solve problems and to share rewards; preferring to promote internally; the need to work hard, maintain quality service and keep learning and innovating; and caring for customers, the environment and the community. In short, the pillars set expectations about the attitudes and behaviour expected of team members. They are expected to focus on the quality and profitability of the services they deliver, respect and help each other while working towards this purpose, and consider the broader impact of decisions beyond corporate profits.

Learning about "the Mainfreight way" is part of the induction training for all new team members. Managers talk about the culture as a tangible thing with one stating, "The culture at Mainfreight is something that people can actually see and they can feel." Additionally, executives perceive the culture as a source of competitive advantage and work hard to preserve it. As one executive explained, "The one job I think I've got to do is to maintain the culture, to maintain the enthusiasm and the passion that the people have to grow this business into something more than what it is now."

While the three pillars are neither rules nor prescriptions, they do provide guidelines that can be applied to a wide variety of settings. Team members can draw on the pillars to determine what conduct is appropriate in different situations.

## Radically Decentralised Structure

Mainfreight operates through a radically decentralised structure. The company's 260 autonomous branches are set up as independent profit centres with their own general ledgers. Branch managers have extensive decision making authority and treat the branches as their own businesses. They set their own annual profit

<sup>4</sup>A full discussion of Mainfreight's approach to performance management can be found in O'Grady, W., & Akroyd, C. (2016). The MCS Package in a Non-Budgeting Organisation: A Case Study of Mainfreight. *Qualitative Research in Management and Accounting*, 13(1), 2-30.

targets—in line with senior management's expectation of a 15% operating margin. The executive team has also specified a set of key performance indicators for all branches, including standards for cash management and quality of service.

While there is competition between branches, overall Mainfreight's culture promotes cooperation and cohesion. Cooperation is enhanced by ensuring employees develop close relationships with other team members. There are many opportunities for individuals to develop work relationships, including, for example, as part of the cohort of new employees attending the same induction training course, through reciprocal site visits made by managers operating branches similar in size and operations (i.e., buddy branches), and through inter-branch transfers of team members.

The decentralised structure enhances the company's overall responsiveness and adaptability. Branches throughout the network encounter different opportunities and risks at different times and are able to respond as they see fit. It is branch managers who assess and respond to opportunities for service innovation in their local environments. Opportunities are typically driven by specific customer requests made at the branch level. Recent innovations include international transport of such items as live penguins and classic cars, and national delivery of items bought on the Trade Me platform or purchased from the Farmers department store chain. Successful service innovations introduced by one branch can be quickly diffused across the network. Similarly, it is local managers who determine what actions are required to keep operations moving when there are local emergencies, such as the Christchurch earthquakes, or the floods caused by Hurricane Sandy in New York.

Managers throughout the company continuously scan their local markets for new opportunities and implement those most likely to improve branch performance. In other words, Mainfreight expects and empowers local decision making. To this end, Mainfreight has designed performance management processes that preserve rather than reduce this decision-making autonomy. The key processes are described below<sup>4</sup>.



## Adaptive Performance Management Processes

Mainfreight's planning processes are relatively informal. The company does not have a formalised strategic planning process, but it does have a set of strategic targets for the next five years. The targets are published in the company's annual reports but there is no detailed, formal plan specifying how the targets are to be achieved. Instead, the executive team constantly monitors the business environment for developments that could impact strategic performance. It uses the scheduled semi-annual board meetings as opportunities to discuss emerging strategic issues with both country managers and directors. These discussions influence how strategy is enacted in the coming six months. This is a much more fluid approach to strategy than found in most organisations and allows the company to shift strategic focus if required. In the words of Mainfreight's CEO: "Does Mainfreight have a strategic plan? No they don't. Does Mainfreight understand its strategic direction? Definitely they do."

The strategic targets provide sufficient direction to managers at all levels to inform their day-to-day decisions. The lack of detailed planning motivates managers to continually search for opportunities that will help achieve the goals. Senior executives, for example, will assess countries for the location of new depots, general managers will consider where new branches should be opened, and branch managers will consider which new services to offer to customers. The absence of a formal strategic plan is not viewed as a negative; it simply means strategy is allowed to emerge as opportunities present themselves. New ideas are raised, questioned and scrutinised by team members in discussions facilitated by open plan offices.

To ensure funding is available to support potentially worthwhile projects, Mainfreight avoids the use of annual budgets. As new opportunities arise, branch managers have brief conversations with their up-line managers about the resources needed to pursue new initiatives and the expected impact on performance. Typically, expenditures are approved immediately if they are within the overall authorisation limit. According to Mainfreight managers, removing budgets does away with one excuse for inaction. A member of the finance team commented, "There are benefits with this approach. With budgets people get focused on the numbers, saying we can't do this because there is nothing left in the budget. We just don't have that. We can do anything. We just get on and do it." Mainfreight believes removing set budgets enables branch teams to pursue all good opportunities—even those not anticipated at the start of the year.

It is clear that Mainfreight's strategic intent is to grow the business, and to do this it relies on increasing profit by 15% per year on average. Branches are required to set their own annual profit targets in line with executive management's expectations. The expectation is that each branch will set a stretch target and commit to achieving it. Branch managers announce their profit targets to other managers at the annual branch managers meeting, a process that encourages and challenges managers to set targets in line with their peers. Relative performance evaluations (discussed below) ensure that managers continue to exert effort once targets are met.

Monitoring and controlling performance does not occur in relation to a budget, but rather the "weekly". This is an

abbreviated version of a profit and loss account prepared by managers to report their revenues, gross margin, operating expenses and net margin. Key weekly results are reported to up-line managers by phone at the start of each week. Weeklies are used by managers to monitor whether their branch is on track to achieve the profit target set at the beginning of the year, and to compare current performance to that in the same week of the preceding year.

Preparing the weeklies provides managers with near real-time information about their performance. It is expected that branches will consistently outperform results achieved for the same week the previous year. The weeklies make it immediately obvious to managers how their daily decisions are impacting profitability and alert them to situations requiring new action plans to get performance back on track. One branch manager explained the weekly system in this way: "The reality with Mainfreight is pretty simple. Basically all we want is to do better than last year...We're looking at 15% growth in sales and profitability." The monthly accounts prepared by the finance team provide a useful check on reported weeklies. Any discrepancies, either positive or negative, are investigated so that future weekly information is accurate and can be relied on for business decisions.

Mainfreight relies on relative performance measures rather than budgets to evaluate branch performance. Comparisons are made both between years and between similar branches. According to the CFO, "Instead of comparing against the budget we compare against last year... we compare against similar sized branches depending on type of operations, number of people, size of revenue... We do a buddy branch comparison and use that as a measure to see if the branch is performing well or not." League tables of key quality indicators are constructed so branches can evaluate their own performance in relation to their buddy branches. Relative performance evaluations motivate managers to deliver the best possible performance to maintain or improve their standing relative to peers, rather than simply trying to beat last year's results or meet current profit targets. Mainfreight managers continually modify action plans in response to emerging conditions.

Relative performance also impacts the size of the bonus pool used to reward branch teams. The base bonus is 10% of branch net profit shared equally amongst the branch team. There is also a discretionary bonus element that increases or decreases the base bonus pool depending on the performance of the branch relative to other branches with respect to KPIs. The bonus is shared equally by all members of the branch team, which means all members have a vested interest in identifying how to improve performance.

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The lack of detailed planning motivates managers to continually search for opportunities that will help achieve the goals

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## Coherence of the Adaptive Management Model

Mainfreight's management model enables the company to operate successfully in a VUCA world by integrating adaptive structures and processes into a coherent system. The key elements of Mainfreight's approach—namely organisational culture and values, radical decentralisation, and management processes that support flexibility—have been strong drivers of the company's profitability for the past 30 years.

The challenge for companies interested in developing an adaptive performance management approach is ensuring that individual elements are combined in a coherent way. Attention should be paid to coordinating changes to both organisational structure and performance management processes in order to produce an integrated management model. While increasing organisational flexibility through adaptive processes is important, it is equally important to ensure control is maintained through a strong corporate culture and values. As one member of Mainfreight's finance team noted, "You can't just say let's [change our management approach]. You need to have a culture which will be able to sustain it and other structures to support it..." It is evident from Mainfreight's on-going success that the adaptive management model is a viable alternative to the hierarchical command and control approach.

No one can predict how developments in technology, competition and customer preferences will impact the future of the logistics industry. However, companies that have moved toward an adaptive management model for managing performance are arguably better positioned to sense and quickly respond to upcoming changes than those relying on traditional, hierarchical management systems.

### Key Take-Aways:

- The adaptive management model is designed to enhance performance by providing greater flexibility to handle volatile, uncertain, complex and ambiguous (VUCA) conditions than traditional command and control approaches.
- The key requirements of the adaptive management model are radical decentralisation; a strong corporate culture and values; and planning, resource allocation, control, evaluation and reward processes that support flexible responses to changing conditions.
- The central features of adaptive management processes include planning that produces ambitious medium term goals, dynamic allocation of resources, control based on near-real time information, performance evaluation based on relative indicators, and team based rewards.





## Flying penguins: Mainfreight makes it happen

Mainfreight's adaptive management approach actively encourages branches to seek out and experiment with new service opportunities. In the words of an Auckland branch manager: "If we need to start a new service, we'll start a new service. We'll take a punt on it. It might cost us a little bit to start off, in the interim, but as long as we can see some benefit in it, we'll back ourselves. .... It might be an area where no one else is currently providing a service ... We are more than happy to try something new, to try to be innovative." This willingness to innovate and respond to market opportunities is exemplified by the case of the flying penguins.

Melbourne Aquarium had a problem. It asked whether Mainfreight could solve it. The aquarium needed to regularly transport live King and Gentoo penguins from Kelly Tarlton's in Auckland to its premises in Melbourne, so the penguins could star in its exhibitions and participate in the breeding programme. Mainfreight's International Airfreight division was able to develop a solution that ensured the penguins could be safely transported on the relatively short flight to Australia. Members of the Airfreight team and other team members designed special cages with purpose-built ice packs that protected the birds from overheating while in transit. This 'packaging' minimised the penguins' stress and discomfort as they were being flown to their new home on a Boeing 747 400 Freighter.

In 2011, Melbourne Aquarium presented Mainfreight with an even bigger logistical problem. It needed to find a way to export Gentoo penguins from its breeding programme to a similar facility in Copenhagen. The challenge for the Mainfreight team was how to maintain a stable and cool temperature over 33 hours of flying time, as well as during transit stopovers. Their solution was to design and build a customised 'chiller crate'. The crate was installed with specialised air conditioners that recreated the birds' Antarctic environment and maintained the temperature between 4-10°C. While in the air, temperature readings from the pod's in-built gauges were continuously monitored by a member of the airfreight team. Mainfreight has patented and continues to refine this temperature control technology and anticipates that more animals—maybe sharks and crocodiles—will be flying around the world in the future. More on this story can be found in the BBC programme, *Penguins on a Plane*

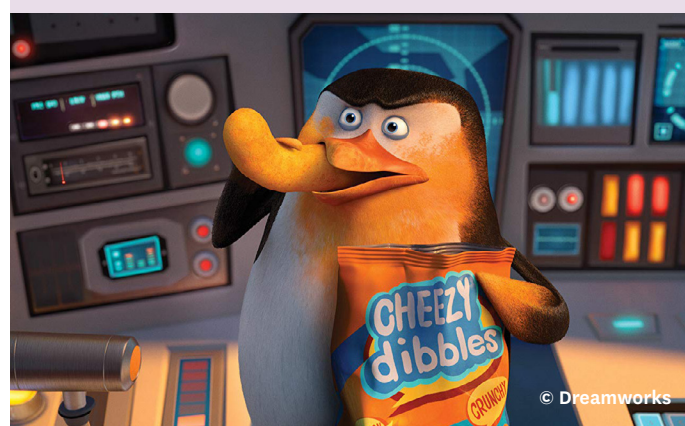
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# Implications of Internet of Things (IoT) for New Zealand agri-food businesses: a smarter future

By **Ray Y. Zhong** and **Abraham Zhang**

## Internet of Things: The Third Wave of IT Driven Transformation

Harvard Business School Professor Michael E. Porter, perhaps the world's leading authority on business strategy, recently shared his views on the latest developments in information technologies (IT) in two Harvard Business Review articles (November 2014, pg. 65-88 & October 2015, pg. 97-114), co-authored with James E. Heppelmann. He discussed how smart, connected products are transforming competition and companies, suggesting we are now on the brink of a third wave of IT-driven transformation: the era of the internet of things (IoT).

Computers brought about the first IT-driven transformation from the 1960s and through the 1970s. They dramatically improved productivity by automating many supply chain activities, from order processing and bill payment to computer-aided design and resource planning for manufacturing. The second IT-driven transformation happened following the rise of the internet, beginning in the 1980s. With its inexpensive and ubiquitous connectivity, the internet made it possible to efficiently and effectively coordinate and integrate spatially dispersed supply chain activities involving suppliers, channel partners, and customers. This second wave of productivity gains is still advancing very strongly, as evidenced by the extraordinary growth of e-commerce businesses, for example, US-based Amazon.com and the China-based Taobao.com.

Now, in the third wave of IT-driven transformation, products are becoming smart objects with sensors, processors, and software embedded. They also have connectivity components linking them to the internet or an intranet, for example, a product cloud that stores real-time product

data and runs applications to analyse the data for decision-making. Herein lies the essence of the internet of things. Products are now smart and they are connected to each other in what is literally an internet of things, rather than just an internet of computers as in the second wave of IT-driven transformation. This IoT era has the potential to stimulate more innovations and greater productivity gains than the first two IT-driven transformations.

The term IoT was first coined in 1999 by the Auto-ID Center of the Massachusetts Institute of Technology (MIT), a leader in radio frequency identification (RFID) research. Over the years, however, the term has evolved. The International Telecommunication Union (ITU) defines it as a new dynamic network of networks, enabling anytime, anyplace connectivity for anything. An IoT infrastructure consists of at least two levels. At the lower level, both physical and virtual objects are identified and integrated into the wider information network. Typical IoT components include one-dimensional (1D) or two-dimensional (2D) barcodes, RFID tags, global positioning system (GPS) sensors, and temperature and humidity sensors. At a higher level, through applications, IoT-enabled smart objects actively participate in business processes. Clearly, the concept of IoT has expanded far beyond RFID. Nevertheless, RFID is still an important component of IoT.



### 1960s - Computers

The first IT-driven transformation was brought about using computers from the 1960s and 1970s

## IoT Application Cases

IoT's importance and potential has been recognised worldwide. Often incorporating RFID, it enables real-time visibility and communication through reliably tracing and tracking physical assets. Sensors are available for monitoring a wide range of variables, including temperature, humidity, atmosphere, pressure, noise, brightness, and motion. When combined with microprocessors, software, and cloud connectivity, a product is converted into a smart object with enough intelligence to make autonomous decisions without human intervention.

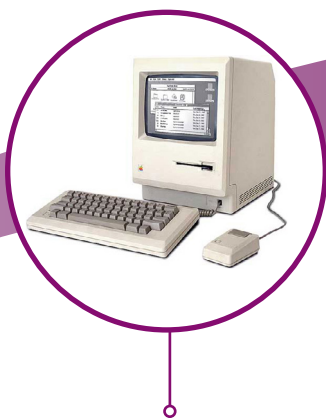
While many people may not be aware of it, IoT has already become part of our daily lives. For example, we can now monitor home security on a smartphone, and receive alerts. Smart ventilation systems are now widely installed in newly constructed homes to automatically adjust ventilation based on humidity and home temperature. Smart electricity meters can automatically send readings to service providers. Across the globe, many cities have embraced a smart city vision using IoT solutions to better manage their assets, including transport infrastructure, libraries, hospitals, water supply networks and other community services.

IoT solutions are taking off in supply chain and operations management. Several leading IoT solution providers, including IBM, Intel, Cisco, and Libelium, have successfully implemented IoT for a variety of supply chain functions to improve inventory management, logistics and supply chain traceability, and asset productivity, and to establish mistake-proof business processes.

- IoT in retail: Walmart, the world's largest retailer, has been using RFID for more than a decade to facilitate its store and inventory management. Because stock is now more visible and data collection more efficient, Walmart has reduced instances of running out of stock, the supply chain bullwhip effect, and administration costs.
- IoT in production planning and control: The University of Hong Kong's research laboratory for physical internet has developed an IoT platform that can

provide real-time shop floor visibility of work-in-process inventories and machine status to better inform scheduling decisions. Its implementation by manufacturers in the Pearl River Delta of China has significantly reduced inventory and improved productivity. It can also detect if a wrong part is picked up for processing and create an alert, thereby effectively preventing a machine operator's mistake from resulting in a defective product.

- IoT in-order fulfillment: IoT-based solutions can provide real-time visibility of goods as they flow from the production floor into the dispatching warehouse for order fulfillment, so that production and order fulfillment operations can be synchronised. They can substantially improve warehouse asset utilisation and, simultaneously, customer service.
- IoT in container shipping: In shipping management, it is important to keep track of containers at different stages of transport. IoT-based solutions can provide real-time information on the location of a container and the temperature and humidity inside it, as well as alerts for any unexpected openings, no matter where the container is. Cargo owners and logistics service providers can then proactively respond to abnormalities to reduce shipping risks.
- IoT in healthcare operations: IoT solutions can be used to monitor the condition of patients in hospitals and retirement homes and to alert healthcare workers of the needs of those under their care. They can also be used to track the status of important assets in real-time to improve asset management.
- IoT in component lifecycle, tracking and maintenance: Sensors embedded in products can provide crucial information on the state of the product and signal the need for preventative maintenance before they break down. This avoids the major expense that may result from the breakdown of critical infrastructure and machinery.



### 1980s - Internet

The second IT-driven transformation happened after the rise of the internet since the 1980s



### Now - Internet of Things

Now, in the third wave of IT-driven transformation, products are becoming smart, connected objects







## New Zealand Agri-food Businesses and IoT Implementations

The agricultural sector is a pillar of New Zealand's economy. It involves over 7,500 types of animal product and 3,800 dairy products, which feed over 40 million people. One of the most advanced agriculture-based economies globally, New Zealand's adoption of cutting-edge technologies has contributed to the success of its primary industries. However, New Zealand agri-food businesses are not immune to the challenges inherent in the supply chains for agri-food products. Agricultural produce is perishable and so often has a short harvest window and a limited storage and shelf life. Cold storage can preserve freshness to some extent, but has its limits. The US Food and Agriculture Organization estimates that roughly one third of food produced for human consumption worldwide is lost or wasted (approximately 1.3 billion tons per year). Both developed and developing countries lose or waste almost the same proportion of food. This problem is worst for fruits and vegetables, which are highly perishable.

Traditionally, the various agri-food businesses attempt to optimise their own operations, but there is little collaboration with upstream and downstream business entities. Much waste and loss occurs at the interfaces between different business entities. Over the past three decades, the focus on single echelons, such as for food production, has shifted to holistic supply chains with their greater efficiency and effectiveness. More and more agri-food businesses have started to realise the importance of integrating and coordinating activities across the whole supply chain. These activities typically include farm/orchard production, harvesting, pack house sorting and packaging, cold storage, transportation, customs clearance for imports/exports, market distribution, and sales to final customers. The term agri-food supply chain management (ASCM) invokes the efficient and effective management of all supply chain activities to maintain the safety and quality of various agri-food products and satisfy customer requirements. ASCM is more challenging than supply chain management for manufactured products, as agri-food products raise additional concerns such as food safety and freshness. In addition, while harvesting of produce is seasonal, consumption continues throughout the year. Further, a biological production process is susceptible to pests, disease, and extreme weather conditions and all these complexities are compounded in a global agri-food supply chain. Accordingly, the quality and safety of agricultural products relies heavily on efficient and effective ASCM.

The New Zealand government has been very active in promoting scientific and technological research and applications in agriculture. IoT technologies have great potential to address the complexities involved in ASCM. In fact, RFID, a key IoT technology, has been employed in the National Animal Identification and Tracing (NAIT) scheme since the early 2010s. Under the scheme, all cattle and deer in New Zealand are required by law to be traced using NAIT-approved RFID ear tags. The tagged animals are registered in a national database which records detailed information on animal location, history of movement between farms, and the contact details of the responsible person. It is mandatory for farmers to enter

any movements of tagged animals into the database, thus making individual animals traceable. If an animal is found to have a contagious disease, either on a farm or in a slaughterhouse, action can be taken very quickly to isolate other animals that have been in contact with the infected animal. This facility greatly enhances New Zealand's ability to manage biosecurity risks.

A few large national and regional agribusiness firms in New Zealand have pioneered or are testing IoT-enabled solutions. For example, the premium kiwifruit brand Zespri uses temperature and humidity sensors to track the storage conditions of kiwifruit in its global supply chain, from pack houses through cold storage to multiple transportation modes to regional warehouses. Zespri can proactively manage the quality of its produce along the supply chain to ensure a superior consumer experience.

A regional wine exporter is using IoT technologies to monitor the temperature in cases of bottled wine during ocean transit to their markets in the Northern Hemisphere. Intense heat from the sun on a sea voyage, especially when near the equator in summer, can adversely affect the quality of the wine as it needs to be kept at a constantly cool temperature. Wine quality deteriorates very quickly at temperatures over 40° C. Data provided by the IoT-based monitoring system allows the supply chain to better manage packaging and transportation to keep the temperature within an acceptable range, thus ensuring wine quality.

A leading New Zealand food exporter is now in the final stages of testing an IoT-enabled solution to establish real-time visibility of the temperature within its reefer containers while in transit to overseas markets. The initiative was triggered by a recent serious incident. The exporter had shipped a reefer container of meat to a major European customer. The container was unloaded at an intermediate port and stayed there for a few days before being loaded onto another vessel heading to Europe. This commonly used practice is called transshipment. It is not unusual for a container to be transshipped more than once before reaching its final destination. However, in this case, for some reason the reefer container was not plugged into a power supply during transshipment while waiting at the port, and nobody realised at the time. The outcome was disastrous—the European customer opened the container only to be overwhelmed by the terrible stench of rotting meat. The IoT-based solution under testing is designed to automatically and immediately signal any abnormal changes in temperature, as well as locating the container in real-time to prevent similar incidents from recurring.

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A biological  
production process  
is susceptible to  
pests, disease, and  
extreme weather  
conditions

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## The Future of IoT-enabled Agri-food Supply Chain Management

The adoption of IoT technologies in New Zealand agri-food businesses is approaching a tipping point. The IoT related success observed in a few large enterprises has led to many small- and medium-enterprises (SMEs) budgeting IoT spending in the next few years. Based on our conversations with some local farmers, many farmers also have plans to try IoT-based solutions in the near future to improve farm management. We believe that IoT adoption will be more than a one-off decision. As IoT technologies continue to advance and more types of sensors are invented, multiple waves of adoption will take place to bring New Zealand agri-food businesses into a smarter future. Local agricultural practitioners will benefit from cutting-edge IoT technologies and more intelligent IoT-enabled business models.

We envision fully-fledged IoT-enabled ASCM consisting of three dimensions: smart farming, smart logistics, and smart supply chain visibility and traceability. Smart farming will allow farmers to monitor and control more and more farm activities from their smartphones. For instance, smart irrigation is possible by deploying sensors to monitor soil moisture. The data from the sensors will be transmitted to a cloud and accessed by a mobile application that facilitates the management of remote-controlled irrigation equipment. The mobile app makes irrigation decisions by simultaneously evaluating soil moisture and weather forecasts provided by an external app. If soil moisture drops below a set threshold and no rain is expected on the day, irrigation will be activated automatically, with or without the approval of the farmer. However, if heavy rainfall is expected soon, irrigation will

not be activated. A farmer can also use the app to monitor and control the progress of irrigation. Regarding the management of animals, it is possible to extend the scope of the NAIT scheme to track more types of animal as RFID tags become cheaper and cheaper. Further developments can be made to the system to enable the use of a mobile app to incorporate more functions.

Smart logistics uses innovative IoT-based applications to increase the agility, sustainability, and efficiency of various logistics operations. Many agri-food products perish or are otherwise wasted in the transportation and storage stages of the supply chain. IoT technology can be used to monitor the storage conditions and maturity level of agri-food products. Combined with the use of big data analytics, it can predict the remaining shelf life of agri-food products for the purposes of proactive inventory management and promotion and sales decisions. IoT-based technologies can also facilitate horizontal collaboration between transport service providers, enabling them to share vehicle capacity to reduce the logistical carbon footprint and make assets more efficient.

Smart supply chain visibility and traceability will not only benefit business operations, but also enable consumers to make more informed purchase decisions. Using a smartphone to scan a 2D barcode on a product label, a consumer can instantly acquire information on the source, harvest date, storage warehouse, logistics history (with detailed temperature conditions), date on which it was put on the shelf, etc. Due to New Zealand's reputation as a high-quality producer, this will help New Zealand-based agribusinesses to differentiate their products to command a premium price. Further, in cases of product safety concerns, a product recall can be managed more effectively and efficiently, using IoT to quickly identify and trace affected products and so reduce the risk to consumers.

## Conclusion and Recommendations for IOT Implementation

To reap the potential benefits of IoT and minimise the associated risks, we suggest potential users carefully consider the following areas of strategic importance before they commit an IoT implementation.

- Sustainability in the agri-food supply chain: The rapidly increasing world population and rising living standard have put greater pressure on Mother Earth. It is simply not sustainable for human beings to continue to exploit and consume various resources of the planet as we have been doing. Agriculture has a major role to play in sustainability. To this end, agri-food businesses must seriously consider how to use technologies, including IoT, to reduce environmental impact, enhance agricultural waste recycling, and be open to the concept of a shared economy to improve sustainability. One option is to explore new collaboration mechanisms and coordinated development with other industries, like manufacturing.
- System interoperability: A supply chain needs to integrate its multi-stage activities to respond to market requirements as effectively as possible, which often means integrating the various IT systems of a given businesses. However, supply chain and IT integration poses risk in terms of becoming locked into a technology or IT platform. Traditional IT system architecture is not suitable for enabling IoT-based solutions, as it is not designed to incorporate a large number of digital devices, sensors, and (possibly) robots. IoT is still in its nascent stage. Competing solutions providers are developing different platforms and a uniform standard is yet to be established, creating the potential for big challenges when integrating IoT solutions developed by different providers. To minimise the risk of interoperability issues, it is worth considering IT system architecture that is built on open sources.
- Big Data Analytics: IoT-based solutions result in a huge amount of data generated from a wide network of deployed smart objects. Decision-making models need to be able to use this data to make precise and systematic resolutions. However, traditional approaches embedded in decision-making models are not able to deal with big data challenges – the computational time required by these models to process extremely large data input is too long. In addition, traditional models often optimise a single objective, either cost or profit. This is not enough as real-life business decisions require trade-offs between multiple objectives, including flexibility and risk minimisation. More advanced and intelligent models or algorithms, like

deep machine learning, will need to be integrated into decision-making models. Through training, learning, and calculating, they can select data associated with various objectives and their functions so that multiple objectives can be managed effectively. Furthermore, big data analytics can help agricultural companies to excavate the invaluable hidden knowledge in big data, and allow visualisation of the discovered patterns to better inform business decisions.

- “Cloud first” IT strategy: Cloud-based technologies have the advantage of virtually integrating spatially-dispersed supply chain activities using minimum resources. They allow the stakeholders involved to access various services, namely, software as a service, platform as a service, and infrastructure as a service. Through cloud-based solutions, people can share information and work collaboratively using basic computing and internet equipment. Clouds substantially reduce the amount of capital required for implementing IoT solutions and reduce the associated investment risks. Agri-food businesses may want to employ a “cloud first” IT strategy when investing in IoT technologies by deliberately choosing IoT assets that have cloud connectivity.

Despite the promise of IoT, one should not blindly jump into an IoT implementation for ASCM without first understanding its costs, benefits, risks, and challenges. Like other IT technologies, it is an enabler—it can transform supply chain operations, but it is not an Aladdin’s lamp. If a business is heading in the right direction and its processes are streamlined, IoT applications can make it even more successful. However, if it has not sorted out fundamental issues in operations strategy, human resource management, organisational culture, and business processes, it cannot expect IoT technologies to secure its future.





# The people side of supply chain management: critical needs and a prescription

By **David Robb**

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Demand fulfilment through supply chains extends across numerous organisational boundaries

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Have you ever wondered how 3D printing might improve the variety, quality, and availability of products and parts in New Zealand, or how the global intensification of robotics will alter the economics and location of production? Will intelligent transport or traffic systems and “uberised” or driverless trucking and drone delivery become widely adopted? How should New Zealand businesses respond to developments in on-line retailing and omni-channel distribution? These questions certainly raise new possibilities and in turn more questions about inventory location and impacts on supply chain design worldwide.

As if technology shocks weren't enough, recent disasters and supply chain disruptions, coupled with anti-free-trade and environmental movements, and increasing wages in some emerging economies, have encouraged a switch from globalisation to regionalisation of production and “re-shoring”. Further, consumers, shareholders, and governments

are increasingly demanding “green” logistics with lower environmental impact.

Each of these developments has a profound impact on supply chain management (SCM), which facilitates the flow of products, information, and finance across often vast networks of organisations. The orchestrators of these flows—be they procurement specialists, logisticians, IT professionals, inventory managers, or distribution centre staff—are facing a radically changing environment. Executives must respond with strategic decisions across a wide spectrum—from technology adoption to supplier concentration, and from manufacturing footprint to channel selection and sustainability, all of which depend on people for idea generation and successful implementation.

Such individuals appear in all kinds of New Zealand organisations, sometimes in surprising places—for example, while Rocket Lab hires plenty of astrophysicists, they also hire supply chain experts. As founder and CEO Peter Beck explains, “Everyone thinks it's rocket science. But whether it's a supply chain to do with fruit or a supply chain to do with a rocket, it's the same” (“Have space, will hire: Rocket Lab”, *NZ Herald*, 22 June 2019).

Here I outline the kind of people supply chains need to operate well, highlighting critical shortages in global supply chain talent, and research in the area. Then, based on presentations from five senior New Zealand executives at a 2016 summit, I provide suggestions on good practice around culture, leadership, development and retention of supply chain personnel. I conclude with recommendations for New Zealand businesses and educational institutions.

## What Kind of People Do New Zealand Supply Chains Need?

Supply chain environments are not only dynamic, requiring adaptability, but they can be high in terms of volume and/or complexity. For example, Fonterra, which exports an average of around 500 containers per day, seeks to effectively fulfil demand via three different but interrelated supply chains—ingredients, food service, and consumer brands. Each has differing customer needs in terms of product type, quality, price, and delivery. Distance further complicates the process of identifying and satisfying these needs.

Demand fulfilment through supply chains extends across numerous organisational boundaries—marketing, operations, purchasing, distribution, etc., and type of firm—suppliers, manufacturers, distributors, retailers, logistics providers, etc. Executives and recruiters will thus naturally seek individuals who know how the whole supply chain operates, e.g., from farm to fork. They not only need a good understanding of products, domestic and international customers (most importantly the final product and consumers) and suppliers, but also extensive, beyond parochial, vision. Along with creative and lateral thinking abilities and a questioning attitude, vision is needed for discovering synergies and leveraging them for process improvement outside the normal scope.

Analytical capabilities may also be deployed to generate benefit across organisations, e.g., calculating replenishment frequencies to optimise total costs for more than one firm. Supply chain improvements may also accrue to firms engaging in enhanced information sharing or contracting. Unsurprisingly, high trust and ethics are essential qualities.

The consummate supply chain professional is someone who has mastered both hard and soft skills, can work within and integrate teams, and communicate well within and across organisations. After all, they play an important bridging role between functions.

Examples from a *New Zealand Leaders on Supply Chain and Operations Management* conference hosted by the

University of Auckland in 2016 help demonstrate these ideas in a New Zealand context. The senior executive speakers represented five organisations with a combined staff of 36,000 people and revenues exceeding \$30 billion. They were Chris Foord (General Manager, Global Supply Chain Development, Fonterra at the time of the conference, now Chief Logistics Officer at The Warehouse Group), Roger Gray (then Group General Manager – Business Performance, now Group General Manager – Airports, Air New Zealand), Peter Reidy (then Chief Executive, KiwiRail Holdings, now CEO at Fletcher Construction), Jonti Rhodes (General Manager - Global Supply Chain, Facilities and Sustainability, Fisher and Paykel Healthcare), and Ross Darrah (then Chief Executive, healthAlliance (FPSC), now Founder of Pareto Toolbox Ltd). The senior executives described the skills and qualities they seek in supply chain personnel for their respective companies.

Fonterra needs supply chain personnel who can figure out how to get its consumer brands and food service products to market as fresh as possible, as it did several years ago with UHT milk—reducing the time from its New Zealand plants to distributors in China from 100 to 34 days.

Air New Zealand desires staff who can evaluate how to maintain appropriate levels of inventory, which a couple of years earlier had exceeded \$200 million across 119,000 line items. Running out of an item can ground an aircraft. On the other hand, one can end up with excessive holding costs including obsolete stock that might sell at 5 cents in the dollar. At the time of the 2016 conference, some \$23 million worth of inventory had not turned over in two years.

In moving both freight and people, KiwiRail seeks the kind of individuals who can reduce the proportion of empty containers being transported—as it did from 26% to 20% over a period of two years. It also needs people who can assist in building intermodal freight capability (containers for ship, truck, and rail), hubs, and partnering operations (e.g., for road plus rail, or improving the network resilience of Auckland) to relieve transport congestion and improve the economics. Other key attributes sought are an ability to understand how customers use intermodal freight and passenger rail services, and an ability to work collaboratively across the organisation and with contractors and customers.

Fisher and Paykel Healthcare is interested in people who can think up ways to simultaneously reduce inventories and improve product availability, which is often difficult for the healthcare industry in a world of ever increasing regulatory sovereignty. One example is delaying the differentiation of some products until they get closer to the customer. Language-specific labels and usage instructions are added only after the delivery destination is identified, e.g., India or China—reducing the need to hold additional country specific variants and associated safety stocks.

healthAlliance (FPSC) is a shared service provider and the only public sector organisation of the five organisations. It provides finance, procurement and supply chain shared service for the four northern region District Health Boards (DHBs). The supply chain operation is responsible for purchasing, distribution and inventory management to meet very diverse needs. Departments within DHBs have unique requirements depending on the service needs of the patients they look after, which in turn results in requirements across the full range of supply chain types. The DHBs demand Responsive models to meet variability in patient needs and Efficient models that can maximise the limited funding DHBs

receive. This work ranges from supplying operating theatres and moving products around the region, sometimes on an urgent basis in response to unforeseen events such as natural disasters (responsive service models), or managing food distribution and hospital administration products (efficiency being the key to lower costs). Ideal supply chain staff are those who can work with the variable needs of the DHBs and implement ways of responding to the challenges faced by our health system, in particular as most hospitals are currently running budget deficits.

## The Supply Chain Talent Gap

Given the broad range of qualities needed in an ideal supply chain worker, and the lack of visibility and perceived glamour of the profession, one might expect challenges in finding staff. Indeed, there are very high shortages of such people globally. In the US, a 2014 forecast estimated 350,000 new supply chain workers would be needed each year to reach a total of 1.4 million by 2018 (*Fortune*, 1 May 2014). In Canada, an estimated 65,000 SCM recruits are needed to fill new or vacant jobs every year—from manufacturing, to agriculture, to energy and transportation. China is facing a shortage of 6 million logistics personnel. Logistics engineers are in very high demand in China and command high salaries. Most come from other fields and few have professional training. According to executive search firm Stones International, personnel shortages extend to the most senior levels of the supply chain in China where salaries exceed NZ\$200,000 per year. Perhaps this in part explains why consulting firms are so engaged in supply chain. For instance, about one-third of McKinsey's consultants in Asia are in supply chain.

If the North American figures cited above are applicable per capita, there could be some 6000 new positions required each year in New Zealand. Viv Young, Managing Director at In Transit Consulting Ltd, believes this could easily be the case. In Transit specialises in staff placement for the transport, logistics, shipping, and international freight industries in New Zealand. So far in 2019, In Transit has only been able to supply 60% of its clients' needs. Demand is especially high in distribution, third party logistics, transport, shipping and freight-forwarding, equipment and service providers, the trading sectors of business, and the emerging 4PL sector. Increasingly overseas applicants are applying for these jobs.

The shortages in practice are mirrored by a dearth of research on people and SCM. A study published in 2016 in the highly-regarded *Journal of Business Logistics* (JBL) investigated the views of 141 SCM researchers on future SCM research. The most underestimated theme (i.e., the one with the biggest perceived gap between what *should* become important and what will become important) was the People dimension in SCM. Ethical issues were ranked #2, Human capital/talent management #5, and Behavioural issues #9. At the overestimated end of the list were Analytics (#35) and Big Data (#36).

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The consummate  
supply chain  
professional is  
someone who has  
mastered both  
hard and soft skills

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The research imbalance may be a function of the high proportion of SCM researchers with analytical strengths, but it may also stem from the complexity of the people dimension. Key questions for researchers concern ways to build resilience for handling imperfect information and disruption, and ways to foster creativity in, and acceptance of, innovation. Moreover, human aspects are linked to many other areas, e.g., Supply Chain Risk Management and Supply Chain Finance. How does one assess and respond appropriately to the risk tolerances and credit history and preferences of firms and individuals?

The JBL study also revealed that processes and relationships between individuals are often neglected. Respondents noted that supply chains are not “soulless machines”, but complex sociotechnical systems involving cognitive elements and which are impacted by face-to-face negotiations and conversations. This suggests that recruitment and staff development need to focus on enriching people skills.

## Exemplary Ideas from New Zealand Supply Chain Leaders

Our five New Zealand organisations represent quite different industries—dairy, air and rail transportation, and health products and services. Despite these differences, common themes emerge, including rapid evolution in their supply chains, support of people, and the simultaneous pursuit of financial and operational goals such as lead time reduction. So what were these leading New Zealand executives doing to develop their supply chain in regard to the people, especially given that many have in the past been quite “siloed”? The following are brief insights into some of the initiatives and practices the companies have pursued.

Fonterra sees the development of supply chain talent as fundamental to becoming the “world’s most trusted source of dairy nutrition”. It has a long-standing supply chain graduate programme providing real end-to-end supply chain experiences, knowledge and capability, and building a talent pipeline.

Air New Zealand regards an engaged culture as intrinsically linked to customer experience and commercial results. It does not see these two factors as antithetical. As an illustration of this, Roger Gray reflected that culture is the greatest issue in terms of the aforementioned inventory balance challenge. Some staff, perhaps those burnt by running out of inventory in the past, may adopt a “just in case” ethos and order or hoard more than is justifiable from a business perspective. Roger argued that providing the whole picture to staff and the rationale for any change is critical for engagement. Indeed, this is part of the high performance engagement (HPE) process Air New Zealand has pursued since 2014, bringing staff and unions together to cooperatively address issues.

In a similar manner, KiwiRail has adopted a bottom-up culture, modelled closely on the Air New Zealand HPE process. Asked whether KiwiRail’s priority was efficiency (often viewed as the primary objective for SCM) or culture, Peter Reidy retorted with the aphorism, “Culture eats strategy for lunch,” then added, “Culture is without a doubt first, then customers and then efficiency. But if we’re not efficient, we won’t be relevant.”

Fisher and Paykel Healthcare promotes the core values of Life, Relationships, Internationalism, Commitment and Originality in its staff. Digging deeper, one discovers its team of “self-motivated, empathetic and committed individuals”. This is evident in the company’s supply chain, where a critical decision relates to the allocation of products between its two manufacturing sites in New Zealand and Mexico, which support distribution in more than 120 countries. Historically, Mexico has handled the more mature product lines. However, staff there have proven highly dedicated and efficient and need volume to support building and exporting full containers, resulting in the decision to manufacture and deploy a number of new products from Mexico in recent years. Allocating a broader range to Mexico is not only consistent with the value placed on people by the company, but consistent with its objective of diversifying risk by offering dual manufacturing supply sites in conjunction with the development of a hub and spoke distribution model for its global sales environment.

healthAlliance (FPSC) attributes its success in part to getting the right data into the hands of the right people, who are invested with the responsibility and power to make the right decisions. This includes ensuring that managers don’t micro-manage, and that they operate at the right level of materiality to make effective decisions in an efficient manner. Ross Darrah recounted a supplier credit issue that was escalated to the CFO and CEO, consuming five hours of their time. The credit amounted to less than \$100. healthAlliance works hard to develop cross-functionality that is also efficient, e.g., seeking to ensure suppliers communicate with the appropriate individual in the organisation—rather than sending emails to multiple respondents. It also seeks to devolve responsibility and empower staff, while at the same time guarding against a culture of fear over making mistakes.

healthAlliance (FPSC) also stresses the value of offering leadership development to its supply chain people, assisting them progress through seven levels, from people who: 1. Need an opportunity to utilise their skills, 2. Need a mentor, 3. Need experience (projects, accountability and empowerment to grow over time), 4. Need exposure to customers and the board; to people who are: 5. Mentors who have time to give things back, 6. Strategists, and 7. Directors. Ross considers himself an “invisible leader”. As the conductor of the orchestra, he trusts his management staff, offers them resilience, concern for their well-being and that of their families, and makes the “hard calls”. He considers that engaged staff will provide great ideas and answers to open-ended questions.

## Supply Chain Talent Development for New Zealand

In light of the challenges facing supply chains and the shortage of skilled workers in the area, how should we respond? To encourage folk to enter and flourish in SCM careers, we must first provide a better understanding of what SCM is (some still see logistics as only referring to the military), and promote it as a profession with great career prospects, locally and globally. In this regard, according to Viv Young, businesses could improve career path planning and training, and lift salaries to be more commensurate with often long hours.

In addition to considering the practices outlined earlier, companies and individuals could make use of a variety of resources. For instance, the Chartered Institute for Logistics and Transportation and the Association of Supply Chain Management (which now has more than 45,000 members in 100 countries) offer various qualifications, training, accreditation, and certification. Organisations such as Supply Chain Asia are also very pertinent given New Zealand's trade environment.

University SC programmes must be kept current to meet rapidly changing needs. Based on interviews with 145 supply chain executives, Weber State University professors Amydee Fawcett and Stanley Fawcett identified a talent deficit, especially around collaboration, that isn't aided by an academe-industry disconnect. Programmes were weak in relation to change management, dealing with ambiguity and complexity, fostering creativity, and collaboration. The authors argue that experiential learning needs to take a much greater role in universities, and faculty need to be less protective of their curricula, e.g., by allowing advisory boards to have more input (supplychain247.com, 28 July 2016)

As an example of this, and closer to home, Jonti Rhodes argues that communication and change management are such important enablers that supply chain education should be focused not on tactical execution, but on developing people who can "read the manuscript 10 bars ahead and bring the orchestra together to deliver a symphony of supply chain excellence".

Bearing in mind the need for staying current and developing breadth across both analytical and behavioural capabilities in SCM, individuals, perhaps sponsored by companies, might consider enrolling in appropriate university programmes. Several New Zealand universities have undergraduate and postgraduate SCM offerings. Prompted by shortages in the talent pool, the University of Auckland's Centre for Supply Chain Management and Graduate School of Management have put in place a highly regarded programme to develop mid-career SC professionals. Overseas, specialist programmes include Kühne Logistics University in Germany, and top-ranked graduate programmes in the US—including at Michigan State, MIT, Penn State, Arizona State, Tennessee, Ohio State, Carnegie Mellon, Purdue, Michigan, Stanford, and Georgia Tech.

New Zealand businesses might consider cooperating with educational institutions, including high schools, to promote supply chain management as an exciting career with good prospects locally and internationally. This could involve delivering guest lectures (as some of the companies above along with The Warehouse and Tru-test have done in my own classes), or creating internships and applied industry projects for students.

A laudable goal would be for New Zealand supply chain education and research to become world leading. One could argue that our context, which includes a high level of trade, low population density, challenging topography, and requires experience in dealing with long lead times, perishable items, and the cool chain, provides an ideal environment for this.

The needs and opportunities for attracting and developing SC talent in New Zealand are vast. Lifting our game will require businesses and educators to be intentional in developing our people by building practical skills and experience, effective communication abilities, sound technical understanding, and innovative approaches to addressing SC challenges. The losses in capability and personnel if we fail to make progress here will inevitably reduce competitiveness and performance in our supply chains and firms.

### Key Take-Outs

David Robb calls for New Zealand firms and educators to enhance their capabilities in supply chain management to meet a growing demand and critical skills for supply chain talent. He encourages exemplary practice from thought leaders in New Zealand and recent research.





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Tava has taught a wide variety of courses, including operations management, service operations, healthcare management, simulation, critical thinking, and project management, to a range of audiences from bachelors students to executives. She is currently the Director of the Centre for Supply Chain Management, an area editor for Operations Research and a senior editor of Production and Operations Management. She has previously served as an associate editor for both Management Science and Manufacturing and Service Operations Management. She is a past president of the Manufacturing and Service Operations Society and has twice been awarded the Auckland Business School research excellence award.



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Ray was awarded the 2018 IJPR Best Paper for "Big Data Analytics for Physical Internet-based Intelligent Manufacturing Shop Floor", and Best Conference Paper Award for "Analysis of RFID Datasets for Smart Manufacturing Shop Floors" at the 2018 15th IEEE International Conference on Networking, Sensing and Control. He also received the New Zealand Chinese Youth Scientist Award (NZCYSA) in 2017 and the Young Author Prize at the 15th IFAC/IEEE/IFIP/IFORS Symposium on Information Control Problems in Manufacturing in 2015.

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David Robb is Professor of Operations and Supply Chain Management, and Deputy Director of the Graduate School of Management at the University of Auckland Business School. He co-directs the Consortium for Operational Excellence in Retailing – Greater China. He was Associate Professor for five years, Visiting Professor for five years, and is now Research Fellow at Tsinghua University School of Economics and Management in Beijing.

He values and has drawn heavily on his experiences of living and working in both Canada and China for significant periods. He is an Executive Member of the New Zealand China Trade Association, and has consulted on operations to firms including Adams and Robertson Shoes, Dulux Paints, Fletcher Building, New Zealand Post International, and Zuellig Pharma, and was advisor (now alumnus) on the Beachheads Programme of New Zealand Trade and Enterprise.

David has been extensively involved with the Tsinghua-INSEAD Executive MBA (ranked 3rd globally by *The Financial Times*) and Tsinghua's International MBA (a collaboration with MIT Sloan) and has taught short courses for firms including Fletcher Building, Sanofi Aventis, Sinopec, and Whitcoulls.

His current research projects include last mile delivery, circular economy, retail operations, and perishable item inventory management.





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