Editorial

Jack of old trades

SOME 150 years ago, New Zealand’s pioneering settlers worked mines and laboured in cleared fields and flax-covered swamp fringes to make a living from the land. But despite being an ocean or two away from the heart of the Industrial Revolution, they didn’t have to go far for a new quartz crusher or a replacement flax-dresser blade.

That was in part down to two engineers from Gloucestershire – Alfred and George Price. In 1868 the brothers set up an engineering works at Onehunga in Auckland. There they set about designing a machine to speed up the laborious process of extracting fibre from the tough leaves of the flax plant to make rope. With parts cast using sand from a nearby beach for moulds, the flax-milling machine transformed what was one of the country’s first export industries. A&G Price then moved south to the thriving goldmining town of Thames on the Coromandel Peninsula, and from a new workshop and foundry it sent out crushers and ore feeders, stamper batteries and pumps, boilers and steam engines.

Inevitably, the firm soon found timbermen among its customers. An early visitor to colonial New Zealand, the English historian James Froude, had been struck by the North Island’s vast kauri forests. He was of the opinion that the massive trees produced “the best timber for all purposes which grows anywhere on the globe.” It was fine-grained, tough, and durable, didn’t splinter, split, or warp, and was easily worked. Yet once felled, the mighty kauri was a formidable object to manoeuvre in rugged bush country using nothing more than levers cut from saplings.

A&G Price’s answer was to adapt a shipwright’s timber jack first employed in eighteenth-century yards. A variant of the story has Auckland miller Ebenezer Gibbons redesigning a North American timber jack and ordering prototypes from a local blacksmith. Either way, the path led to A&G Price, which made gradual improvements to the device, culminating in a robust, powerful, and lightweight jack that found lasting favour among gangs working in the heavily timbered North Island forests. In all, the firm built some 25,000 timber jacks, making it one of the colony’s earliest mass-produced items. Price’s jacks found their way to the East Indies, the Pacific Islands, and the west coast of America, and some even had a new lease of life helping Londoners rebuild their city after the Blitz of World War Two.

Despite A&G Price’s success, and its record of bringing to market products that helped reshape New Zealand industries, today’s researchers and policy makers would be unlikely to give the firm many points for innovation. That is because innovation these days is assessed largely by measuring investment in research and development, and because high-tech industries get a disproportionate amount of attention. Alfred and George Price operated differently – they were essentially low-tech, they engaged in trial and error and incremental improvement, and they involved users in product design.

This issue of the Business Review argues that we need to better understand how innovation works in traditional industries if we are to play to our economic strengths. It also has something to say about kauri that would have caught the ear of Froude.

Vaughan Yarwood
Editor
Submission Guidelines

The University of Auckland Business Review encourages insights, reflection and debate on contemporary business theory and practice. It reports on new and notable research, focusing on the implications for business professionals. The journal is published twice a year, in spring and autumn, by The University of Auckland Business School.

The Business Review is a forum for diverse views from various disciplines and aims to bridge the gap between research and practice. The journal publishes editorially-reviewed and peer-reviewed articles which, while based on research, should be clear and engaging.

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ISSN 1174-9946
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THE FORGOTTEN INNOVATION
Kenneth Husted

Innovation is widely recognised as an important catalyst of economic growth in both firms and societies. However, over the past three or four decades the concept of innovation has been hijacked by a high-tech bias, which is reflected in academic research, policy making, and even daily use.

Although the high-tech sector makes an important contribution to the economic wellbeing of society, this is often just the icing on the cake. Most economic value is generated in more traditional and long-standing industries that have accumulated deep knowledge about how to develop, manufacture, and distribute products and services to satisfy well-established needs in the market. These industries operate in sectors that include – but are not limited to – agriculture, forestry, seafood, construction, tourism, food, and transport.

In this issue of the *Business Review* Hartmut Hirsch-Kreinsen summarises the core findings of a large scale European Union-funded study on innovation in low- and medium-tech firms. In the study, he and his collaborators report that across Europe traditional industries remain the most important part of the economy, in terms of both economic activity and employment. The researchers also points out that the traditional sector is seriously engaged in innovation, but often of a type that would not register in most well-established innovation measures. To a much larger extent than elsewhere, traditional industries rely on a practice-related knowledge base and on learning through trial and error. This type of innovation activity is less likely to be noted as formal research and development and therefore often ends up below the radar.

In 2013, researchers at the University of Auckland Business School became interested in deepening the understanding of how innovation takes place in traditional New Zealand industries and how firms in these industries manage the innovation process and capture value from it. This topic is especially important in the New Zealand context where many firms have a culture of tinkering with products and services, yet see themselves as innovating in the formal R&D sense. This is discussed in Paul Woodfield’s contribution to this issue of the *Business Review*. In his article, Woodfield focuses on the economic contribution of traditional industries in New Zealand through innovation, and the implications of this for innovation policy. He also analyses how traditional industries often play an important role as users of high-tech solutions and so become an important factor in stimulating and commercialising high-tech innovation.

Lisa Gallagher’s article focuses on innovation in New Zealand’s red meat sector. One of her key observations is that innovation is vital to the sector. She also makes clear that the innovation process is organised differently from the science-
based model often used in high-tech industries. In traditional sectors the innovation process is guided by trial-and-error learning and draws heavily on knowledge built up over many years of activity in a particular market – a conclusion close to Hartmut Hirsch-Kreinsen’s findings. In other words, Gallagher confirms the need to develop specific innovation management tools for the traditional sector instead of applying tools and approaches created for the high-tech sector.

...firms in traditional sectors often fail to elicit input from their most advanced customers, such as lead users, and so have untapped innovation potential.

Firms in traditional industries are often expected to use their technology suppliers as primary source of innovation. For this to work well, there must be a close proximity between suppliers and customers. In the absence of such proximity, firms must adopt alternative innovation strategies. In New Zealand, such strategies range from the in-house modification of existing technologies to the development of new products in collaboration with customers, and even science-led innovation, as seen in the Manuka honey industry. One of the challenges with in-house solutions is that they are a relatively expensive approach to innovation. In addition, the full commercial value from such solutions can be difficult to capture.

In his interview on the future of forestry in New Zealand, Mānuka Hēnare points out the huge potential for science to help the forestry industry wean itself off radiata pine and introduce the commercial growth of native species such as kauri, rimu, and tōtara. The economic value of such a shift can be significant, especially if it is reinforced by entrepreneurial activities in forestry and related sectors that add further value to the native timbers prior to export.

Finally, firms in traditional sectors often fail to elicit input from their most advanced customers, such as lead users, and so have untapped innovation potential. European and North American studies document huge gains for firms that work systematically with such customers. In his contribution, Yat Ming Ooi shows how New Zealand firms in traditional industries have developed practices for capturing the innovation potential from their customers.

Traditional industries constitute a substantial share of employment and production in many developed countries, including New Zealand. The ability to innovate is crucial for the growth of firms in these industries and for the survival and longevity of the industries themselves. This innovation is fundamentally different from the more widely discussed innovation in high-tech industries. It is therefore vital that we develop knowledge and tools that are specifically designed to capture and manage such innovation.

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AS ADVANCED COUNTRIES and geographical regions such as the United States and the European Union evolve into knowledge societies, the ability to generate, use, diffuse, and absorb new knowledge is increasingly viewed as critical for economic success. Consequently, conventional wisdom regards high-tech, research-intensive, and science-based industries as the key drivers of future economic prosperity. The policy conclusion is that high-cost industrialised countries should concentrate their efforts on promoting these industries. So-called low- and medium-tech (LMT) manufacturing industries, by contrast, are deemed to offer very limited prospects for future growth, and as a result they receive less explicit policy attention and support.
Sectors with an R&D intensity below this threshold, such as appliance manufacturing, the food industry, and the paper, publishing and print industry are regarded as low-medium-tech. These industries can also be termed mature and non-research-intensive because they are well advanced in their life cycles.

**SURPRISING SIGNIFICANCE OF LMT MANUFACTURING**

In recent years, researchers have begun to investigate the innovative capabilities and prospects of low-medium-technology (LMT) manufacturing industries. The interest in LMT industries is primarily motivated by criticism of mainstream innovation research and policy, according to which high investment in R&D and in advanced technologies is the key driver of growth and prosperity. Of course, the growing importance and dynamics of research-intensive and high-tech industries in the context of radically changing social and socio-economic structures cannot be denied. However, studies of LMT industries highlight that the contribution of high-tech industries to employment and growth is greatly overestimated, whereas that of LMT manufacturing industries remains undervalued. This is supported by statistical data from Eurostat and the German Manufacturing Survey, which reveals that in 2010 LMT manufacturing contributed 51 per cent to the value add of manufacturing. By comparison, over the same period high-tech manufacturing accounted for only 12 per cent. In terms of employment, during the second half of the past decade nearly 12 per cent of the European labour force was employed in LMT industries; in manufacturing, this figure rises to almost two-thirds of all employees. Of course, the percentage varies greatly between countries. In Germany, approximately 50 per cent of all industrial workers were employed in LMT sectors in 2006, and these sectors accounted for nearly 42 per cent of the total industrial added value. It should also be mentioned that LMT manufacturing industries are strongly shaped by small and medium-sized enterprises (SMEs), and this holds true for the EU as a whole as well as for Germany where, in 2009, more than 60 per cent of all LMT companies had fewer than 250 employees.

**THE STATISTICAL BASIS OF THIS PERSPECTIVE IS THE INTERNATIONALLY ACCEPTED R&D INTENSITY INDICATOR, DEVELOPED BY THE OECD IN THE 1960S, WHICH MEASURES THE RATIO OF R&D EXPENDITURE TO COMPANY TURNOVER OR TO THE OUTPUT VALUE OF AN ENTIRE SECTOR.**
The significance of LMT manufacturing in advanced economies can be explained by their surprisingly high and specific innovative capability, and their relevance with regard to the innovation ability of the economy as a whole – something that is generally overlooked in the scientific, as well as in the public, debate. Thus the question arises: what are the features of low-tech innovations?

**Typical LMT innovation strategies**

To answer this question one must first define what the term "innovation" means. The economist Joseph Schumpeter conceived it as any activity that includes the development and successful marketing of new products, the introduction of new production technologies and services, and the technical and non-technical reorganisation of processes. Based on this definition, and on the main findings of LMT research – in particular, research conducted in the EU and in Germany over the past decade – various innovation strategies of LMT companies can be regarded as typical for the sector (see Table 1).

The first innovation strategy is characterised by the continuous further development of given products, and can be referred to as step-by-step product development. Typically, it concerns enterprises that manufacture products for relatively stable market segments – for example, for special applications in the automotive industry. This strategy is typical for manufacturing sectors with mature technologies and products such as fabricated metal products. Not only are the markets well defined, but the products are also well-established, and often standardised; production technology often remains unchanged for longer periods, and is at best gradually adapted to changed product requirements. In such sectors the processes have a high degree of efficiency, and price is a major factor in competition.

The second strategy involves innovation that is primarily directed at securing and improving the marketing situation of an enterprise. This holds good for the fashion-oriented design of products,
the functional and technical upgrading of products, rapid responses to changing customer wishes, the exploitation of market niches, skilful branding strategies, and the expansion of product-related service activities. Unlike the first strategy, enterprises pursuing this strategy belong to a relatively broad range of industrial subsectors, ranging from textile and clothing industries geared to anticipate fashion cycles to office furniture manufacturers that at very short notice accept orders for novel products from large retailers. This can be referred to as a customer-oriented strategy.

A third type is primarily directed at the technical and organisational structures of the production process and is used by companies that employ advanced, capital-intensive process technologies, often with a high degree of automation. Examples include sheet-forming companies, firms manufacturing plastic parts, mechanic components or parts made of aluminium, paper manufacturers and firms involved in food processing. Furthermore, under these technical and organisational conditions, the safeguarding and constant improvement of the product quality is seemingly achieved as a by-product.

<table>
<thead>
<tr>
<th>Step-by-step</th>
<th>Customer-oriented</th>
<th>Process specialisation</th>
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<tbody>
<tr>
<td><strong>Primary subject area</strong></td>
<td><strong>Improving the market position; creating new market segments</strong></td>
<td><strong>Introduction and utilisation of advanced process technologies</strong></td>
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<td>Incremental product development</td>
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<td><strong>Examples</strong></td>
<td><strong>Furniture manufacturing (Formway Design)</strong></td>
<td><strong>Fruit processing (Mr Apple partnering with Compac Sorting Equipment)</strong></td>
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<td>Animal management, (Gallagher), refrigeration (Temperzone)</td>
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<td><strong>Main conditions</strong></td>
<td><strong>A broad range of companies with turbulent market conditions</strong></td>
<td><strong>Companies with highly automated and integrated manufacturing processes</strong></td>
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<td>Companies with relatively stable market segments and efficient processes</td>
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THE RELEVANCE OF “ARCHITECTURAL” INNOVATIONS

In terms of their priorities and objectives, these innovation strategies cannot at first be fundamentally distinguished from those found in industrial sectors with markedly higher R&D. However, if one looks at innovation focus, their special characteristics can be demonstrated. Following up on the critique of incremental versus radical innovations by MIT researcher Rebecca Henderson and Harvard University’s Kim Clark, the strategies outlined above can be inserted into a broad spectrum of innovation modes, ranging from incremental innovation to architectural innovation. Both have in common the use of given technological core concepts and knowledge assets and their further development within the existing framework – for example, the step-by-step product development employed by standard manufacturers. The term architectural innovation, on the other hand, denotes the recombination of existing components to obtain a new product design or technical and organisational structure, without leaving the well-established technological development path. An example is the customer-oriented strategy which combines almost unchanged product components and units to a new product, thus meeting special customer requirements while opening up new market segments. Market-orientation based on architectural innovation is a promising strategy for LMT companies in advanced economies which enables them to stabilise and improve their competitiveness, especially against low-cost competitors in international markets.

THE SPECIFIC KNOWLEDGE BASE OF LMT INNOVATIONS

Knowledge is a key resource for innovation. However, in terms of LMT innovation, a distinction should be made between in-house and external knowledge bases and their corresponding information sources. LMT firms drawing on in-house knowledge undertake very limited R&D, and formalised processes of knowledge generation play an insignificant role. Instead, innovation activities proceed by means of pragmatic doing and using. Hence, the knowledge that is relevant for these enterprises can be regarded as being practical and application-oriented. Unlike scientifically and theoretically generated knowledge which orients itself on criteria such as theoretical relevance and universality, practical knowledge is generated in the application contexts of new technologies. It obeys validity criteria such as practicability, functionality, efficiency, and failure-free use of a given technology. These types of knowledge, however, are difficult to distinguish. To simplify matters: theoretical and scientific knowledge in enterprises – for example, in the form of systematically acquired engineering knowledge – primarily can be assigned to research, development and construction processes, while practical knowledge accrues in the context of ongoing operating processes. "Practical knowledge" stands for a complex bundle of different knowledge elements. It comprises both explicit, codified, and formalised elements, such as design drawing and requirement specifications.
for new products, and implicit elements, such as accumulated experience and well-established, proven, and tested routines for solving technical problems.

The relevance of this type of knowledge can be exemplified by referring to the strategy of process specialisation: the enterprises considered here make use of engineering knowledge that is incorporated and codified in their production facilities and operating instructions, although specifications and ongoing intervention and adaptation measures are necessary. An indispensable precondition is the available knowledge on the shop floor (for example, knowledge of the shortcomings of the production technologies already in use). Process innovations generally occur in the context of ongoing operative processes, and may be initiated and conducted by those who are responsible for ongoing functions, such as engineers, technicians, master craftsmen, and even workers.

However, the company’s external knowledge base plays an even more crucial role for LMT innovations. This is largely because LMT companies can compensate for limited R&D resources by simply adapting externally generated knowledge, and LMT studies show that customer input plays a large role in product innovations. But, not surprisingly, information and knowledge from suppliers are of greater importance to LMT businesses due to the significance for them of process innovations. In line with the seminal work on sectoral patterns of technical change, in 1984, by University of Sussex researcher Keith Pavitt, many LMT firms can be characterised as supplier dominated. Their innovative capability is largely based on the ability to adopt externally developed components for process technologies or new products – an ability that is also referred to as embodied knowledge – and to adapt it to their own requirements. Finally, scientifically generated, codified knowledge, such as that originating in research institutions, consulting firms and trade fairs, also plays a role in the innovation ability of LMT companies.

**SME-SHAPED KNOWLEDGE MANAGEMENT**

How firms use internally and externally available knowledge – that is, how they organise the innovation process – is of decisive importance for their innovative capabilities. Because of the dominance of small and medium-sized enterprises in LMT sectors, the innovation processes are strongly shaped by the structures and the resource and capacity limitations of these companies. They have limited capital and know-how, and the degree of management professionalisation is often
low. Furthermore, due to limited R&D capacities, their technological capabilities are rudimentary. Instead, innovation processes occur at a practice-oriented level and are generated by a small group of management representatives and technical experts. Therefore, as empirical findings show, the innovation courses and practices in LMT companies are characterised by a low degree of formalisation. This can be seen, for example, in the use of innovation-oriented incentive schemes, the integration of innovation-related performance figures into target agreements, selective qualification measures, and the existence of innovation-promoting forms of work organisation – such as innovation circles, teamwork and temporary project teams.

Also, cooperative relationships with external partners are often influenced by this pattern of SME-shaped knowledge management as these businesses prefer informal, personnel-based relationships. Indeed, informal cooperation practices are often a precondition for LMT firms identifying the largely unarticulated, tacit, and unreliable knowledge of their customers.
DEVELOPMENT PERSPECTIVES OF LMT FIRMS

These considerations lead to a new understanding of the significance and innovative capability of mature manufacturing sectors. The economic landscape of knowledge-based countries in the first years of the 21st century does not appear to be undergoing a wholesale structural replacement of “old” sectors with “new” ones. In fact, this process is evolving as a restructuring of existing sectoral and technological systems. It is not dominated by industrial activities for which competitive advantage, capability formation, and economic change are generated by front-line technological knowledge, but rather by what are often wrongly termed low- and medium-tech industries. And it is characterised by a specific combination and continuous re-combination of high- and low-tech.

LMT industries can play a decisive innovation role because the involvement of low-tech companies and products is frequently a core precondition both for the innovativeness of value chains and for the design, fabrication, and use of a range of high-tech products. As Paul Robertson and Keith Smith of the University of Tasmania convincingly show through their research into the processes of technological change in advanced economies, the relationships between high-tech and non-high-tech sectors are highly symbiotic, and the well-being of high-tech firms and industries depends heavily on their ability to sell their output to other sectors in developed economies. The use of advanced machinery and the transfer of knowledge is important for both product and process innovations in LMT firms, but these transfer processes are not unidirectional; relevant innovation impulses also travel in the reverse direction—from low-tech to high-tech. As Robertson and Smith state, these impulses result from the simple, but often overlooked, economic fact that profits from the sale of new technologies are vital for the amortisation and continuation of R&D investments by research-intensive enterprises. Furthermore, additional impulses arise from the specification of new technology application requirements. These impulses often influence the development of new technologies if the requirements of individual users coincide with those of many other users, thus broadening the application field for complex products. One can therefore speak of a high level of technological complementarity between LMT and high-tech industries that is central to the industrial innovative capabilities of an entire economy.

INNOVATION MODELS

To sum up, the research findings on low-tech innovations prove convincingly that the linear model of innovation with its dominant focus on high-tech, which is widely adhered to in the public debate, reflects industrial innovation only inadequately (see figure 1).

FIGURE 1: LINEAR MODEL OF INNOVATION

FIGURE 2: RECURSION MODEL OF INNOVATION
The essence of this model is the assumption that research and development activities are the starting point for any kind of innovation, and that scientifically-generated knowledge triggers the development of new technologies. This model regards research and development as fundamental and necessary innovation steps, which functionally and temporally precede the industrial process. It assumes that there is a clearly structured course of action, during which the knowledge of basic research is transferred, specified and utilised step-by-step, via applied research, and is finally employed in the form of concrete technologies in a certain implementation context. Following this model, an effective innovation policy must focus on R&D in order to encourage industrial innovations. It is then merely necessary to ensure that the new knowledge asserts itself to the point of concrete development projects and fields application by promoting appropriate transfer measures.

However, industrial innovations are seldom based on scientific knowledge. The relationship may even be inverted – that is, with technology itself creating the foundation for scientific knowledge. Furthermore, technological innovations are very often initiated by practical problems in the production process and, more importantly, by market and application demands. This has been shown by innovation research over many years – for example in the chain-linked model of innovation described by Stanford University researchers Stephen Kline and Nathan Rosenberg in 1986. An innovation model referred to as the recursion model of innovation (see figure 2) may therefore be a more useful guide to understanding the processes of technological innovation, and in particular the innovation patterns of LMT firms.

**KEY TAKE-OUTS**

- Low-tech manufacturing offers greater prospects for employment and economic growth in advanced economies than current policy acknowledges.

- The disproportionate support for high-tech, research-intensive industries fails to take account of the high and specific innovation capability of low-tech firms.

- Innovation does not necessarily begin with R&D activities centred on scientific knowledge, but may be driven by problems in the production process, or by market demands.

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INNOVATING IN TRADITIONAL INDUSTRIES

BRIDGING THE KNOWLEDGE GAP

PAUL WOODFIELD

More could be done to encourage capability-building in our neglected industries.

LENGTH: 9 min (2133 words)
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\begin{align*}
\beta^2 &= x^2b^2 + 2x(1-x)b^2 + (1-x)^2b^2 \\
A_x &= -xp^2 + \frac{1}{4}(1-x)^2 + \frac{1}{2}(1-x) - x(1-x)b^2 + 2x(1-x)b^2 - x(1-x)b^2 \\
&= -x(1-x)b^2.
\end{align*}
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According to the New Zealand Government’s Economic and Financial Overview (2014), primary industries alone contribute over 50 per cent of New Zealand’s total export earnings, with primary sector processing (food and forestry) making up more than 50 per cent of the manufacturing sector. Yet there is a view that we are overdependent on these industries and that the trajectory should be shifted to high-value products. This is an important debate and one that should not be taken lightly. Of particular note, we are encouraged to contemplate what Scandinavia has accomplished in growing from traditional industries toward high-value manufacturing. The gap in our knowledge is not so much whether more high-value manufacturing is needed to build economic prosperity, but how we can innovate in and around our traditional industries to this end. We need to understand the perceived barriers to innovation, and how traditional industries interact with other industries – for example, information and communications technology (ICT), engineering, and manufacturing.

**SUNSETS AND SWITZERLAND**

Policy makers, academics, and practitioners alike have toyed with the idea that traditional industries – in particular, farming and land-based industries – were on their way out. In the 1980s the then Prime Minister, David Lange, infamously exclaimed that farming was a “sunset industry” that would be eventually eclipsed by manufacturing and tourism. This was closely followed by Finance Minister Roger Douglas’s prediction that we would become the “Switzerland of the South Pacific.” The reality is that in the following years primary industries strengthened and made an increasing economic contribution while the anticipated Swiss status failed to eventuate. More
recently, physicist Shaun Hendy has championed the need to “get off the grass” and enter an age of high-value products. His arguments are founded on New Zealand’s positive attributes as a country with strong legal and political rights, a low level of corruption, and skills in enabling trade, yet one that struggles to innovate. This is considered the “New Zealand paradox”. Hendy refers to a 2014 report by the New Zealand Productivity Commission which identifies the paradox that lies in our average performance against key economic indicators as reflecting an underinvestment in knowledge-based capital – sometimes referred to as intangible assets. This average performance needs to be lifted, and I will argue that our traditional industries have an important role in accomplishing this.

**WHAT IS A TRADITIONAL INDUSTRY**

The boundaries defining traditional industries are not well articulated and terms such as “mature,” “sunset,” “low-tech”, and “non-research intensive” have all been used to describe them. Between 2002 and 2005 a project led by researcher Hartmut Hirsch-Kreinsen studied low- and medium-technology (LMT) industries. The Policy and Innovation in Low-Tech project (PILOT), recognised gaps in knowledge related to industries other than the more fashionable high-tech industries. The term LMT stems from the OECD classification for research and development (R&D) intensity – that is, industry sectors that are not research intensive or which have a low expenditure on R&D in relation to turnover. Building on this classification, we recognise that traditional industries can include those supplying high-tech products to LMT industries – which is a point of departure from the conventional OECD classifications. The same principle applies for basic and applied science that has been introduced into traditional industries, including chemicals, pharmaceuticals, and biotechnology. The idea that traditional industries are “carriers” of high-tech and/or knowledge-intensive science originates in the work of University of Sussex researcher Keith Pavitt, which classifies the innovation modes of different sectors. Broadly, traditional industries, including primary, manufacturing, engineering, and service industries, fall into the LMT category.

Policy makers, academics, and practitioners alike have toyed with the idea that traditional industries – in particular, farming and land-based industries – were on their way out. In the 1980s the then Prime Minister, David Lange, infamously exclaimed that farming was a “sunset industry” that would be eventually eclipsed by manufacturing and tourism.
So why do traditional industries matter? Key concerns arising from the PILOT research included a lack of awareness of innovation-supporting policies that were not focused on R&D; the need to improve measures and support activities to capture the knowledge base and capabilities of LMT firms; the need to develop the capabilities of firms to meet the demands of cross-company cooperation; and the need for policies to encourage generation and diffusion of knowledge across sectors and to promote stronger interrelationships between sectors.

The PILOT researchers noted that the innovation-generating activities of LMT firms are not always captured in R&D statistics. This would suggest that classifications such as that used by the OECD might not accurately reflect broader innovation in the economy.

**ARE WE REALLY THAT FAR AWAY?**

There is much talk about New Zealand’s great distance from export markets. However, a little reflection will show that this is not necessarily the case. In many instances we are no further from Asian and Pacific Rim markets than are Europe and the United States. Indeed, we are relatively close to some of the largest markets in the world with whom trade liberalisation agreements are being made. The government’s Business Growth Agenda (2014) strongly supports building high-quality free trade agreements (FTA) in the Asia-Pacific region. It is often mobility at borders that can adversely affect the timeliness of exports to market rather than physical distance.

In situations where the logistics is challenging, New Zealand’s distance to market has also spurred innovation. This was the case, for example, with the export of fresh foods, including meats, dairy, fruit, and seafood. Research by QPod Systems, which manufactures pallet-sized refrigerated units for transporting fresh goods, showed that it was more difficult to control the atmosphere inside partially-filled refrigerated sea containers. The solution was a “refrigerated mini-container and returnable packaging system” that could fit inside containers or land transport alongside other goods. The QPods are designed to reduce spoilage in the supply chain and offer new opportunities for efficiencies – including the potential to lower costs by bypassing distribution centres and delivering directly to retail stores. The pods are not restricted to fresh foods but also have applications in the transportation of medical and biotechnology products. They are a good example of initiatives that mitigate the distance barrier while providing a solution that can have a radical impact on the supply chain.
Kenneth Husted of the University of Auckland Business School has argued that firms do not need a sizeable market in order to innovate, but they do require access to customers that are willing to collaborate and which have interesting needs that can be fulfilled through the development of new technologies. Once the needs of such customers are met, building scale for export is more straightforward. Husted points to his native Denmark – a country with similar demographics to New Zealand – as an example of a nation reliant on the primary sector that has successfully built up, and now competes in, high-value industries. Moreover one of New Zealand’s perceived weaknesses is a lack of advanced customers able to work with firms to co-develop new products. To a large extent this is true, particularly when it comes to industries that are new to New Zealand’s landscape. But this could be overcome if our politicians and industry lobbyists focused their energies on strategising ways to innovate high-value products through traditional industries. The country’s future science and technology development could first serve these traditional industries with a view to exporting globally.

One example of an outstandingly successful high-value manufacturer is Compac Sorting Equipment. The world’s second-largest maker of sorting equipment, Compac supplies machines and software, predominantly for sorting round-shaped fruits and vegetables. The company exports to 30 countries and employs some 400 staff globally, of which more than 100 are committed to R&D. Compac continues to push the limits of technology with sorting, imaging, monitoring, and software development.
A smaller enterprise that is also making significant headway is Fieldmaster. This company is best known for its grass cutting equipment, but also produces sweepers and vine trimmer/pruners. Its current technological developments include solutions for airport mowing, which must be done at speed due to time constraints – to put this in context, Auckland Airport has about 700,000 m² of grass that can only be mowed once a week during a four hour window. Fieldmaster is also working with the Bay of Plenty Regional Council to develop a hovercraft capable of mowing regenerative mangrove seedlings.

Companies such as Compac and Fieldmaster serve advanced local customers and export proven products globally.

The 2014 Technology Investment Network (TIN) report recognised the emergence of manufacturers servicing traditional industries, including RML Engineering, which produces automated equipment for packaging, and Metalform, which provides solutions for sheet metal processing. The report also profiles a number of well-established firms, including Gallagher, which is a leader in animal management, and Scott Technologies, which supplies automation to the meat industry and produces other products such as honey and wax separators. These examples suggest we do have world-class expertise, and that there is an opportunity for knowledge spillover that could encourage technological improvements in other industries.

WORKING WITH THE GOVERNMENT

It can be argued that targeted government procurement could stimulate innovation and encourage collaboration and the creation of networks among local firms. Around the world public procurement is a significant means for stimulating innovation, providing a clear signal about investment opportunities and helping governments to achieve their goals. Such opportunities may arise through a buoyant economy; however they may equally arise from disasters such as the 2011 Christchurch earthquake, or in response to challenges...
related to climate change. If conducted well, public procurement can create a demand for new and value-added products and services while nudging businesses toward innovation in a relatively low-risk environment. Ultimately the economy can benefit from increased technical proficiency, leading to the building of new capabilities and competitive advantages which may not have eventuated without such intervention. In particular, traditional industries can benefit directly when the aim of the procurement coincides with such things as: the built environment, including construction, infrastructure, and utilities; climate change and its effect on the environment; or the sustainability of New Zealand’s primary industries through government partnerships.

**DEVELOPING OUR KNOWLEDGE BASE**

As a country, we need to develop scientific and technological competencies around our traditional industries. By drawing on the knowledge base of these industries we will contribute toward building our high-value sector. There is, of course, room for entirely new industries to develop. However, the present argument is that the focus should not be on creating new industries, but on identifying and leveraging opportunities in industries in which we already possess a strong knowledge base. In other words, we need to recognise how existing technology and science in New Zealand can be adapted and implemented in traditional industries. For example, we are already seeing greater integration of digital devices in the primary sector – including new applications, automation and robotics, and cloud computing.

**Primary Growth Partnerships (PGP)**

The government is currently funding Primary Growth Partnerships (PGP) to encourage innovation in the primary sector. The Draft National Statement of Science Investment 2014-2024 addressed PGP as long-term programmes that are “primarily business-led and market-driven innovation programmes that work along the primary industry value chain”. They encourage collaboration between firms, research and industry bodies, and the government, with about NZ$65 million in matched funding available per year. The New Zealand Institute of Economic Research (NZIER) has estimated the economic benefits of these partnerships to be NZ$11 billion per year, from 2025. Current projects include harvesting technology for the seafood industry that can target specific fish species, and the size of individuals within them, and which deliver fish in better condition; steep-slope harvesting solutions for the forestry sector; science-based farming of Manuka plantations for honey production; value chain solutions in the meat, dairy, and wool industries; and solutions for waste in the red meat and forestry industries.

**Comvita**

Natural healthcare company Comvita has harnessed science to lift the value-add of its products. In 1974 the company began making honey-based products and quickly found that its natural health principles were a foundation for competitive advantage. Since then, it has produced ranges of shampoo and skincare, as well as ointments and supplements. During the 1980s and 1990s, Comvita began to experiment more intensively with bee pollen and bovine colostrum, employing a business consultant to formalise processes and systems, including the research programme. In the 1990s researcher Peter Molan of the University of Waikato found manuka honey to have high levels of antibacterial activity, and along with colleagues he established the Unique Manuka Factor (UMF) rating. Comvita seized the initiative, becoming the first company to commercialise manuka honey for its medicinal elements. The company continued to diversify, adding olive leaf extract, broccoli extract, and omega-3 fish oil to its product line. Through its commitment to R&D, Comvita set an example for other manufacturers which increasingly are testing natural products for human consumption and remedy.
AgriSea

Seaweed products company Agrisea has initiated an R&D programme to further legitimise its products by establishing the nutrient value and other qualities of its Ecklonia radiata seaweed. As an industry forerunner, Agrisea not only engages with technology and science to develop its own competencies and competitive advantage, but is also laying a foundation for the industry as a whole. Agrisea has made a significant investment in research and relies on the kiwifruit industry and others to trial and test its products. Having adopted an evidence-based strategy, the company is now working towards validating its products for human consumption and is taking particular care to ensure that the research is rigorous and credible. Meanwhile, its core offerings are showing excellent results in industries that have a commitment to continuously monitoring environmental impact. Agrisea’s ultimate goal is to achieve mainstream commercialisation of its seaweed-derived products.

Scientific research has also proven to be useful for validating traditional products – for example, those based on honey and seaweed (see sidebars on Comvita and AgriSea). Comvita, the first company to commercialise manuka honey using the scientifically-based UMF (Unique Manuka Factor) rating, fostered research collaborations through Comvita Innovation and progressed to conducting clinical trials on olive leaf extracts. In doing so, Comvita created a significant price premium for its honey and olive oil extracts. Similarly, AgriSea is focused on validating products for human consumption and highlighting their medicinal properties. Its research extends to collaborating with scientists to establish a sustainable practice, other than shoreline gathering, for harvesting seaweed.

WHAT WE NEED TO FIND OUT

The purpose of this article is to provide an overview of innovation in traditional industries and to identify gaps in our knowledge and understanding, and to outline some of the perceived barriers to innovation in these industries. It is evident that we need a better understanding of how innovation occurs in traditional industries and that there should be discussion about what policies should be established; what funding is required; and how researchers from universities, CRIs, and industry bodies could best collaborate with firms. We now understand that low to medium-tech (LMT) industries are not void of high-technology components, and that traditional industries typically are below the radar from an innovation...
perspective. Furthermore, there are large industries, such as forestry, where little is known compared with their counterparts in places such as Scandinavia. Others, such as the equine industry, which contributes some $4 billion annually to the New Zealand economy, are all but invisible.

We also need to remind ourselves that some technology firms began life servicing needs in traditional industries. PowerByProxi, for example, started out providing wireless power technology to John Deere’s forestry harvesting equipment and it continues to sell into the agricultural, forestry, construction, and mining industries. And one of the country’s most prominent technology companies, Xero, has partnered with farm software specialist Figured, to offer a service called “Farming in the Cloud”. Examples such as these need to be brought into the forefront of discussions when seeking ways to establish a robust high-value sector. In summary, we must strategise with what we already have, take a long-term perspective, and embrace the certain – if slower – growth that innovation in traditional industries offers.

**Acknowledgement**

The Innovation in New Zealand’s Traditional Industries (INZTI) research was made possible through the support of the UABS Strategic Themes Research Fund (Innovation and value creation).

**Key Take-outs**

- A better understanding is needed of the interplay between traditional industries and technology suppliers
- Traditional industries often play an important role in stimulating and commercialising high-tech innovation
- The government should consider procurement policies that stimulate innovation
OUT OF THE WOOD

IWI LOOK BEYOND PINE

NEW ZEALAND’S large-scale commercial plantations of radiata pine appear increasingly at odds with the spiritual, cultural, environmental and economic aspirations of their Māori owners. Associate Professor Dr Mānuka Hēnare, Director of the Business School’s Mira Szász Research Centre for Māori and Pacific Economic Development, discusses a bold new plan for forestry collaboration and innovation with Business Review editor Vaughan Yarwood.

Mānuka Hēnare

Māori landowners see a bright future in indigenous forestry

LENGTH: 12 min (3037 words)
**Business Review:** Northern hapū-iwi are developing a new forestry model that they say is better aligned with Māori values and needs. What is the current industry model?

Mānuka Hēnare: The current model of forestry is based on one species – *Pinus radiata*. New Zealand wanted to diversify its economy and planners got it into their heads that there was all this land available in the central North Island. The problem was that the land was owned by Māori. So the government of the day basically confiscated it and planted the big Kaingaroa forest, and others, using radiata pine. And out of that grew an extraordinary forestry sector.

But that model of business is problematic, because Māori owned the land but not necessarily the trees and so received only stumpage fees. As a result of the Treaty settlement process and a number of court cases over the past 20 years, all the forests from Taupo north, and some smaller forests further south have been returned, or will be returned, to Māori. However, it remains a messy, convoluted political and commercial process. At the same time, there continued to be a rather narrow view of forestry, centred on one species. You cut the top and bottom off the trees and sold logs. Very little processing was done in New Zealand. Now Māori have become the owners of the trees and the land, but there are still another two or three cycles to go in the existing contracts. In other words, they are committed to pine trees for another 60 to 90 years. However, that is useful because it gives you a chance to plant replacement species, so that when the pines are gone another forest is in place. So that is the context of the discussions at the moment.

**BR:** Apart from that model being dubious because it was based on commodity export, what needs was it failing to address for Māori?

MH: Has anybody seen a Māori greet a pine tree? That is a cultural way of saying the tree is functional; it has commercial value but little cultural purpose. Kauri, tōtara, rimu and other native species, however, are ancestors to a lot of tribes. So you treat them very differently. When Māori foresters say prayers over them before felling, they are saying: "we have to make a living, so you have to sacrifice yourself." Metaphorically speaking, the tree offers itself for the good of the Māori community. That cultural dimension is quite significant. So, having got ownership of the pine estates, Māori are now saying that their cultural needs are not being met solely by pines. That then leads to the question: "why don’t we start planting in a systematic way to restore the heritage forests?" And some of those heritage forests will never be cut down.

**BR:** Let’s talk about the T e Taitokerau Forestry Innovation Cluster. What was the thinking behind taking the process forward in that way?
MH: From the Business School end, knowing that this was going on – that is, the phenomenon of suddenly we own the trees as well as the land – and meeting with all those tribal groups where many of our Māori postgrad students come from, through the postgraduate programme of Māori development, you hear people talking about these issues. That is how we were becoming increasingly informed about the dynamic in the Māori world. So some of our academics started looking for a new model. About 18 years ago, we won a significant FRST research project on innovation in the seafood sector. That was a joint project between NIWA, the Business School and the Mira Szászy Research Centre for Māori and Pacific Economic Development. That study found no apparent culture of innovation in the seafood sector, even though Māori had become 50 per cent owners of the quota management system. There were examples of innovation, yes, but no culture of innovation.

With the ICEHOUSE business incubator, we scoured the world for another model of business and we came up with innovation clusters – an idea that was coming out of Harvard Business School, and North Carolina and elsewhere. A business innovation cluster is not an incubator, it is a cluster of existing companies that want to transform themselves into something else. And as part of that there is always incubation, because you have got new companies so you create a different context. You couldn’t get Māori owners to stay in the Auckland suburb of Parnell [where the ICEHOUSE is located] for incubation purposes – that is just impossible. So we looked for a flexible way of taking incubation and innovation to them. They had to be willing companies, because otherwise the process would be like trying to coordinate a lot of alley
cats. So you bring in research capabilities – in this case the Business School – then you bring in an investor. That becomes the cluster. The investor can then inform the companies on opportunities, and the academics provide R&D, which New Zealand firms are weak on. So that is the basis of the Tai Tokerau Innovation Cluster. We are developing others on seafood and tourism based on the same principle.

BR: Forestry hasn’t been known for innovation in recent years. What are the barriers to new thinking in the industry?

MH: Well, they are hooked on old models, with huge plantations of trees requiring big mills, trucks, roads, all that infrastructure. However, there are a number of companies – not just Māori ones – saying we should be doing more with trees. So, in the light of all that, it struck me that someone should sit down and craft a new philosophy of forestry. And that is where I have come in. I have started exploring it and testing it out. What has been interesting is the number of non-Māori who say that is terrific, we like that. Māori are not the only ones worried about the concentration on a single exotic species.

BR: How do you integrate all the new perspectives and insights from around the world that are ripe for introducing into the new model? Does the cluster itself have the capability of doing that?

MH: The cluster is really at the kindergarten stage of learning; it is nowhere near mature. And don’t forget, New Zealand doesn’t have a history of innovation clusters. What we found in the earlier study of the seafood sector is that everyone, including the government, was using the word “cluster”, but what they really meant was forming coordinating committees. So you aggregate a whole lot of them and half are unwilling. They are there to stop the others getting an advantage. That is why we said, you have to bring together those who want to change, and let the market deal with those who don’t.

BR: Given that there isn’t a tradition of cooperation in New Zealand, isn’t it also necessary to educate people about how it can work effectively?

MH: One of the things you have to do is ask: “what are our shared values?” Even in a Māori context you can’t assume that the shared values are all on the table and agreed on. So in response to that, we came up with a Harvard-inspired strategy map, and we applied the Māori vision of a business, which is the four wellbeings: spiritual, environmental, kinship and social, and economic – and that was written and designed after a two-year series of retreats. That strategy map contains some assumptions. If you are going to join this group, these are the core values: commercially-driven, design-led, research-based, culturally-focused. Spirituality is also important. In terms of individual firms, there are financial and administrative criteria. What are the KPIs for these four wellbeings? We have Masters and PhD students working on that now. From the economic point of view, we moved into the capabilities approach of
the Nobel Prize-winning economist Amartya Sen, which asks: "What are people and sectors capable of?"

**BR:** Obviously, the economic imperative looms large. What research is there to suggest that there is no contradiction between cultural needs and economic needs? That one will not jeopardise or compromise the other?

**MH:** One of the things I have done is to look back at the Nobel laureates in economics over the past 25 years to spot differences or changes in economic thinking. What you find is that the behavioural sciences have had a huge impact over time. Initially I didn’t like Gary Becker’s approach – it was a little too economistic. But from studying human capital, researchers have gone on to look at social capital, then cultural capital, and finally spiritual capital. All because Becker and others long ago had identified capital other than material capital. Remember he was addressing the issue, among other things, of poverty. And Amartya Sen received his Nobel Prize because he introduces ethics into economics. Well, Adam Smith did that in Volume One of The Wealth of Nations, but everyone reads Volume Two, on the creation of wealth, not his moral imperative. That is a misuse of Adam Smith, because he said the economy is an extension of moral thinking. That is where Māori are: from the spiritual world comes your material world. And when we looked at all of that, we thought we can now develop a Māori sense of the economy, drawing on tradition and on what the new economists are saying. It is post-neoclassical economics. A whole area of global economics and ethical pluralism. So we are in a lovely new ball game.

**BR:** You mentioned that Māori have a 90-year grace period, when you can develop other tree species. How far has your thinking progressed? Is much science-based research needed before that can go ahead?

**MH:** Remember that in the model of the innovation cluster you bring science labs together. In this case the science lab is Scion – a world-leading forest research institute, and it has been involved from the outset. Scion has come up with new scientific models of plantations. It is a matter of being able to say to the scientists this is what we need to know, as opposed to the scientists in splendid isolation coming up with ideas and trying to tell the market. One of the tasks the Māori group put to Scion at the outset was to suggest what the infrastructure should look like, and they are still working on that. One possibility is that forests are cut down selectively.

**BR:** When you talk about different species and new types of logging, implicit in that are new products and processes, and indeed a new high-value supply chain.
MH: Well, manufacturing is now on the table. You put a small mill near that forest. In the philosophy we are asking how do you use 100 per cent of every tree, so there is no wastage any more. And 100 per cent of the whole forest. This is a huge transformation. At the Business School we are fortunate to have a memorandum of understanding with Scion, so it is a close relationship.

BR: Is there interest elsewhere in what you are doing in terms of the new model, for example among hapū-iwi in the central North Island?

MH: Yes. The Business School recognised the innovative work being done by the Central North Island collective, CNI. That is the group that has been co-ordinating the return of Kaingaroa forest, and all of that is in transition now. They realise that they can fragment that forest into little tribal interests or they can keep it together, and so aggregate the assets and keep the mana where it lies. CNI is one of what we call our tribal alumni. I keep in touch with them and Scion works with them. They have huge forests, but all the same issues. So in many ways we are a small lab. There is no reason why one day there couldn’t be a cluster of innovation from Taupo north, but they have to be willing.

BR: What would you like to see happen in terms of collaboration with suppliers of machinery and other technologies?

MH: In some parts of forestry you are seeing technological development. When I was working in forestry in the late 1960s in Waipa State Mill, Rotorua, both as a labourer and later as a work study officer, it was very labour intensive. But now, there has been technological development. The remarkable thing is, why has it taken so long? Is that going to be the normal pace of technological change? Because it is quite clear that in other sectors we don’t seem to have entrepreneurs who can anticipate where the sector is going to go. Where are the incentives supposed to lie. Is it with government, the private sector, or the individual sector itself? Ideally, you would hope that the sectors themselves would do it, but they are not.

BR: The dairy industry, which has been quite innovative, is driven by farmers, who are naturally self-reliant problem solvers. You wouldn’t expect a forester to tinker with machinery.

MH: If we were cutting significant forests of native species I suspect that we would have to export them to be turned in to something, because that capability is not here.
There are some small companies – I can think of a niche manufacturer in Kerikeri, that produces furniture made from native trees, but we need dozens of these. There is a Japanese company, Juken NZ, in Kaitaia, North Auckland that produces a high-quality triboard – 3-layered panel boards, using glue from Denmark. Since 1992 Juken, formerly known as Juken Nissho, has developed new kinds of mills, in Masterton and Gisborne, and it employ around 1,000 New Zealanders. The puzzle is why haven’t others imitated that?

**BR:** Is New Zealand too small to incubate those sorts of industrial solutions?

**MH:** My instinct is to look for cooperatives committed to continuous innovation along the value chain. The Meat Board, the Wool Board and the Dairy Board are old New Zealand cooperatives that get reborn every now and again. They have their ups and downs, but they actually come back don’t they. You then get a whole-sector approach. So you have Juken, a foreign company coming in to process logs. And you have the Talley’s Group, an old South Island New Zealand family that prides itself in its small businesses. It started out in fish processing but has now expanded into food harvest and processed vegetables and meat and has units in Motueka, Timaru, Westport, Blenheim, and Moerewa in the Bay of Islands.

**BR:** So you envisage small companies filling niches within forestry?

**MH:** Yes, but there needs to be a more coherent sector understanding that we are going to transition from a single commodity to many diverse products. And that has to be built in, so you begin breaking down the big into smaller units – I call them clusters for want of a better word. But it could be new types of cooperatives – which is actually the New Zealand story. We have done well as a nation because of cooperatives. The added dimension is the commitment to continuous innovation.

One thing some Māori entrepreneurs are looking at is planting trees further apart so that sunlight can get in and you can grow crops – ginseng, for instance – without waiting 30 years to get a financial return. Others allow livestock in. So you are getting multi-use of the land. Trees over 30 years, cows and sheep on a daily basis, and also food products.

**BR:** I suppose the question is whether native trees can thrive in that plantation environment.

**MH:** We won’t know until someone applies tree science and tries.

**BR:** And that is separate from heritage forest?

**MH:** I wouldn’t be too hard and fast on that. Some people say that in a heritage forest, we’re never going to cut the native and endemic trees down. But that doesn’t preclude running sheep through one part of it. So instead of having all sorts of low-lying plants in there, you have grass
and mix it up a bit. The key point is, more intensive land use through collaboration and entrepreneurship.

**BR:** We are physically isolated from the world. Is it a case of not being close enough to the dynamic heart these global industries, as a result of which we have become price takers on commodities?

**MH:** I'm not sure we are doing enough to find out what customers really want. Companies in Northland are now exporting the stumps of swamp kauri to China for quick money, and the Chinese are getting the value from turning that into products. Other countries put a ban on that sort of export and force the sector to innovate. In Iceland they banned the catching of fish in certain ways. The government is there to protect the interests of the country and force people to innovate. Most of the Scandinavian countries do that. Iceland banned the bulk export of fish.

We have this notion of a so-called free market, where we are aping big countries that have a scale we don’t have, and which can have a free market in the sense of many companies competing and the creative thinking that comes from that. In a small country you require the state to work with the private sector in order to achieve that. You don’t want the state to run everything – that would be disastrous. But neither do you want the state pulling out of everything. We need to be able to say we will not export logs, period. And 100 per cent of a fish must be used. That forces our scientists to answer the problem: what do we do? How do we use every part of the fish? That is what Iceland does, and it is what all of those countries have ever done.

The traditional industries are still around. They remain the dominant part of our economy. The question should be: how do we build a knowledge sector along with dairy, forestry, tourism and the manufacturing around those? There is no reason why the knowledge economy can’t create knowledge for those sectors. ■

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**KEY TAKE-OUTS**

- As a result of Treaty settlements and court cases most North Island forests are being returned to Māori.
- The current model of exotic plantation forestry does not align with Māori spiritual, cultural, and economic needs.
- A new collaborative model is being investigated, which calls for heritage and mixed production forests, and innovative manufacturing to minimise waste and deliver high-value products.

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The red meat sector must innovate, but the obstacles are vast

LENGTH: 9 min (2304 words)

ONE HUNDRED YEARS AGO firms in New Zealand’s red meat sector changed the way beef and sheep meat were consumed in the United Kingdom through the adoption of discontinuous product, process, and business-model innovation built on the commercialisation of refrigeration technology. By-products of the wool industry were transformed into chilled carcasses for a secure and growing market, slaughtering chains were introduced, and partnerships were developed between existing farming and shipping businesses. Large-scale distribution channels were created and new organisations, in the form of industrial-scale abattoirs and intermediary stock agents, were established to secure seasonal supplies of cattle and sheep. The resulting processed goods were then shipped to highly-regulated markets half way around the world.
In the face of fluctuating commodity prices and rising operating costs some dry-stock farmers have vertically integrated into boutique production, processing, and marketing businesses, converted to dairy farming, or left the industry. Each of these responses, while inherently logical for the individual farm owner, has contributed towards a reduced volume of beef and lamb available for processing. Given an existing 50 per cent processing overcapacity, the current business models for dry stock farmers, meat processors, and distributors appear to be unsustainable in the medium- to long-term.

Over the past two years I have worked with students to understand the challenges in the country’s red meat sector, drawing on innovation management theories to propose ways the sector might innovate to address these challenges. During this time, we have had the opportunity to speak with senior executives from firms with processing, and marketing and distribution capabilities, and research managers tasked with making R&D investments to support future growth.

Two broad questions have guided our investigations:

1. What patterns shape the types of innovation that occur in New Zealand’s red meat sector?

2. What management theories might inform the way innovation challenges can be addressed?

INEVITABLY, BUSINESS ENVIRONMENTS CHANGE. Unrestricted access to UK markets disappeared in the 1970s, and process improvements since then have increased efficiency, leaving fewer ways to reduce production costs.
WHY INNOVATION IN RED MEAT MATTERS

According to the Meat Industry Association’s 2009 Meat in Focus report the New Zealand red meat sector generates about $8 billion in export earnings annually, with 92 per cent of lamb, 82 per cent of beef, and 95 per cent of venison exported. Together these product categories account for around 27 per cent of New Zealand’s primary exports. At the same time, the industry faces eroding profitability due to commodity price fluctuations, land use pressures, and increasing production costs.

Innovation matters because it can play an important role in addressing these challenges by exploiting opportunities created by changing customer needs in existing and emerging markets, and by adopting new production and organisational practices, and new business models. Yet the innovation needed in the sector differs somewhat both from what has occurred in the past and from current innovation in other industries.

A useful distinction in innovation types is that between incremental, synthetic, and discontinuous innovation, as outlined by organisational theorists Michael Tushman and David Nadler. Incremental innovation refers to small improvements to standard product lines or process improvements, such as added features, new versions or extensions, that lower production costs or increase quality. Incremental innovation exploits an organisation’s existing knowledge. Generally the red meat sector has been very good at incremental innovations — for example, by adjusting animal husbandry practices to local conditions and by grading carcass quality by eye. However, the limitation of focusing on incremental innovations is that over time the opportunities for small improvements become fewer and the organisation’s knowledge can be made redundant. The adoption of data-driven farm management practices using app-based large data sets, for example, provide more reliable data for decision-making than relying on the experience of individual farmers. While local knowledge about soil conditions and animal health (such as fertility, disease resistance, and growth rates) remains important, the financial value that can be created from data-driven techniques is significant.

Synthetic innovation uses existing ideas or technologies in creative ways to originate significantly new products or to increase the size, volume, or capacity of well-known production processes. For synthetic innovation, marketing and production skills are more important than technological ones. Historically, New Zealand meat processors have been very good at synthetic innovation, particularly that which produces volume and capacity outcomes. Such innovation includes the integration of new packaging...
technologies into existing slaughter chains to increase product shelf-life, and the upgrading of production processes to reduce carcass wastage. However, synthetic innovations are most effective when marketing and production skills are integrated in the innovation process. New Zealand’s red meat sector generally recognises that marketing skills are weak, particularly in terms of market intelligence, market validation, and market entry strategy.

Incremental product and process innovation dominates the red meat sector’s current product portfolio.

Discontinuous innovation involves the development or application of significant new technologies or ideas to products or processes, resulting in wholesale changes across the organisation in the form of new skills, processes, and systems. And it often leaves existing capabilities redundant. Such discontinuous innovation — in technologies, products, or business models — has the potential to significantly add value and may provide a means of addressing current processing overcapacity. But discontinuous innovation is risky, and demands large investments over long periods of time, leading to uncertain outcomes.

**Patterns of Innovation**

While New Zealand’s red meat sector historically has used a range of innovation types, to understand better what innovation is needed in the future it is useful to consider the ongoing effects of two factors: industry maturity and low R&D investment.

**Industry Maturity**

According to the industry life cycle theory, innovation in mature industries tends to be low compared with that in entry and growth industries, and is usually dominated by large firms.

Lower innovation can be explained by the well-known principles of product life-cycles. As Tushman and Nadler revealed, once economies of scale and production cost reductions are achieved through product design and process improvements, and once markets become saturated, firms tend to focus on incremental improvements because the return on investment for larger spending becomes harder to justify. At the same time, firms are reluctant to make large investments into discontinuous innovation since these might make existing products or processes redundant. Thus, firms lock themselves into path dependence — they become focused on exploiting previous investments, and usually fail to see opportunities associated with new ones.

Incremental product and process innovation dominates the red meat sector’s current product portfolio. Since the 1980s, the automation of killing chains has reduced labour costs and injuries, reducing major variable costs, and increasing the accuracy of meat cuts. This, in turn, has enhanced the product consistency demanded by large overseas customers, such as British multinational retailer Tesco, and has reduced the quantity of unusable waste cuts. And the adoption of packaging technologies, such as the FoodCap system, has reduced temperature fluctuations, flavour tainting and meat discoloration, thus reducing wastage and increasing shelf life for overseas markets by up to 14 weeks — a necessary development given the shipping industry’s adoption of slower sailing times to contain fuel costs.
While incremental innovations are important for short-term performance, they do little to address processing overcapacity and the need to add value to what is a commodity product. According to the industry life-cycle theory, the red meat sector’s continued reliance of incremental innovation can only lead to its decline.

The second characteristic of innovation in mature industries is that it tends to be dominated by large firms, and this can be explained by both industry and product life-cycle models. Carnegie Mellon University researcher Steven Klepper has found that in mature industries there are fewer growth opportunities for all firms, which leads to shakeouts among underperforming incumbents. The power gained from agglomeration through mergers affords large firms the ability to dominate innovation through market share and control of resources. New Zealand’s red meat sector has a long history of mergers and acquisitions – a history that is described in detail in Mick Calder’s and Janet Tyson’s 1999 book *Meat Acts: the New Zealand meat industry, 1972-1997*.

Dominating market share and control of resources enables large firms to respond aggressively to competition through price wars. This is enables them to protect their investments in both incremental and discontinuous innovations.

**LOW R&D**

The second factor of low-to-medium technology industries is a tendency toward utilising low-technology innovation supported by low (or no) R&D investment.
Generally the level of business R&D investment in New Zealand is low, at around 0.64 per cent of GDP, and, according to recent analysis of OECD data by the New Zealand Productivity Commission, it rarely exceeds 0.5 per cent in sectors associated with low-to-medium technology industries. However, some parts of the red meat sector appear to fare worse. The 2012 *High Value Manufacturing and Services* report, which included red meat as a sub-section of high value manufacturing in food and beverage, found that only 12 per cent of firms in the Food and Beverage sector had active R&D.

Low (or no) private R&D investment is problematic because R&D is known to be an important investment for organisational learning. The theory of absorptive capacity, advanced by Wesley Cohen of Carnegie Mellon University and Daniel Levinthal of the University of Pennsylvania, explains organisational learning as an organisation’s ability to “recognise the value of new, external information, assimilate it, and apply it to commercial ends”. In studies of mainly high-technology sectors, R&D investment is positively associated with absorptive capacity; firms that invest in R&D develop organisational capabilities to look beyond existing markets to search out ideas, technologies, and new market opportunities, assess which of them support the organisation’s strategy, and integrate and re-organise the firm to produce synthetic and discontinuous innovation.

However, firms in the red meat sector tend to be debt laden and to face constant revenue variability. So, how can such firms invest to develop their absorptive capacity in order to understand new idea technologies, markets and business models, and shape value propositions that will drive future profitability when current low profitability blocks the necessary R&D investment?

**ADDRESSING THE CHALLENGE OF MATURITY AND LOW R&D**

Innovation management theories offer a number of insights and analytical tools that can help overcome the barriers to innovation in the red meat sector. The final section of this article outlines two responses that can offer ways forward for low-to-medium technology industries.

**COLLABORATIVE INNOVATION**

Collaborative innovation occurs when ideas, knowledge, expertise, and opportunities are shared across firms. It can provide a way for firms and industries to compete because capabilities for existing innovation, and the costs of developing new ones, are shared. In addition, collaborative innovative exposes firms to the ideas, processes and technologies used by local competitors, suppliers, and customers, and thus presents the opportunity to learn about alternate (and potentially competing) innovation, and to break path dependency.

Collaborative innovation is not a costless approach to innovation; it require investments in capabilities to
coordinate and manage relationships, and firms must contribute their share to R&D investment in new capabilities. The Ministry of Primary Industries’ Primary Growth Partnership, which provides matched funding on industry-led initiatives, is one recent, and potentially constructive, intervention. Though innovation capabilities take time to develop, such collaboration provides a way to make high-risk investments that single entities would not undertake alone.

Since the discontinuous innovations that are likely to reinvigorate the red meat sector exist in distant emerging markets, including China, India, Southeast Asia, and Russia, and differ culturally from existing North American and Western European markets, and since they involve different product categories (for example ingredients as functional foods), and use new technologies, (such as extracting by-products for biomedical and healthcare applications, and nanotechnology for packaging), collaborative innovation offers a way of organising learning. Such an approach suggests there is also an increased role for universities and Crown Research Institutes.

ENTREPRENEURIAL COOPERATIVES

The second means of addressing industry maturity and low R&D investment - and one that is related to collaborative innovation – is to better understand how organisational structures support innovation.

A number of initiatives at the firm-level use organisational structures to address productivity issues in the red meat sector. Greenlea Premier Meats uses contracting arrangements with other processing firms, such as Wilson Hellaby, to manage production peaks and capacity issues. To re-balance returns to suppliers of high-end meat cuts, Greenlea has negotiated supplier contracts with iwi-owned farms for such cuts to be returned and marketed under tribal brands. Other processors, including Silver Fern Farms, Ovation, Progressive Meats, Lean Meats and Firstlight Foods, have introduced fixed-price contracts to improve income security for farmers and increase security of supply for processors.

While these organisational arrangements address immediate needs, it is not clear that they are able to support the discontinuous innovation required. Such
investment in ideas, technologies and markets, requires collaboration among large and small farmers, processors, marketers, and distributors on a level that has not been seen in the sector before.

My colleague Frank Siedlok and I are currently investigating whether entrepreneurial cooperatives provide a useful structure for supporting collaborative innovation. Historically, collaboration in primary producer industries has been achieved through user-owned and user-controlled cooperatives such as the recent farmer cooperatives in the South Island. However, traditional cooperatives are usually commodity oriented and tend towards risk aversion, thus, are less likely to support collaborative innovation.

More recently, a new form of entrepreneurial cooperative structure has emerged; one that is customer-focused and innovation-oriented, and which includes engagement in R&D activities that would be beyond the scope of any single member organisation.

Recent farmer surveys have reported wide support in the red meat sector for adopting the Fonterra model. While the red meat and dairy sectors might share similar sales growth and low private R&D, differences in the nature of the commodity present different challenges. Unlike fresh milk, which can be broken down into constitute elements and stored for years as dried milk powder, fresh meat has a three-month shelf life, and current freezing practices significantly reduce the product value. Thus, consideration of the entrepreneurial cooperative structure should address whether it is capable of supporting the type of collaborative innovation needed to meet sector-specific challenges.

KEY TAKE-OUTS

- Lamb, beef, and venison make up 27 per cent of New Zealand’s primary exports.

- Industry maturity and low R&D investment are challenges to fostering appropriate innovation in the red meat sector.

- Collaborative innovation and entrepreneurial cooperatives offer two possible routes to industry profitability.
Engaging customers in product design can deliver big rewards if done right.

Users of products have long been recognised as sources of innovation. Take the 34th America’s Cup, for example, where users (sailors) worked closely with shipbuilders to develop the AC72 wing-sail catamarans needed for the competition. The user-innovation principle provides useful methods for firms to engage, access, and tap user-driven and user-created innovations. New Zealand firms operating in traditional industries, including automotive, food, forestry, fishing, textiles, and construction materials, have long used this principle in their innovation processes. It is now time for these industries to better understand the methods and practical implications of adopting user-innovation in their innovation processes.
INNOVATION IS A SYSTEMATIC AND DELIBERATE PROCESS OF COMBINING AND RECOMBINING DIVERSE RESOURCES AND COMPETENCIES TO CREATE INNOVATIVE OUTCOMES.

Conventionally, innovation is viewed as a closed and linear process, where a firm’s research and development (R&D) efforts are focused on developing and pushing new products and services to meet perceived market needs. Customers are normally involved in testing new products, or to provide feedback for improvements on existing products. Customers usually play, at most, a peripheral role in the actual research and development stages of the innovation process. This is especially so in more traditional industries, such as agriculture, manufacturing, and construction. However, anecdotal and empirical evidence shows that more distributed and collaborative innovation processes now punctuate this model of innovation, with an increasing number of firms actively seeking diverse sources of knowledge in all stages of their innovation activities. In the mid-1970s, Professor Eric von Hippel of Massachusetts Institute of Technology (MIT) observed an interesting anomaly in the scientific instrument sector and found instances where users of scientific instruments frequently invented, prototyped, and tested the instruments before passing them on to the manufacturer for refinement and production. The findings sparked a stream of research into what is now termed “user innovation”. Today, firms from diverse industries, including textiles, industrial products, and automotive, are utilising various tools and methods to engage users in all stages of the innovation process.
The adoption of distributed innovation processes is gaining traction in many developed economies because firms are finding conventional ways of innovating insufficient to navigate through a globalised and fast-paced market. New Zealand-based firms – especially those in traditional industries – are not exempted from this development, and having a more user-centric view, and adopting relevant user innovation methods and processes, could set them on a path of reduced wastage and more competitive, market-relevant products. But before delving into an explanation of the various user innovation methods, it is important to first explain what user innovation is and how it differs from conventional technology-push and market-pull innovation models.

WHAT IS USER INNOVATION?

"User innovation" is an umbrella term used to define innovations driven or created by users. Professor Nikolaus Franke summarised it succinctly in the 2013 edition of the Oxford Handbook of Innovation Management, defining user innovation as an innovation driven or created by those who will benefit from using it. Users in this context could be intermediate- or end-users of a firm’s products and services. They are not restricted to individuals, but may include other firms – especially in business-to-business markets. A group of users worth mentioning is lead-users. Lead-users have advanced, latent needs beyond the current market, which increases the radicalness and novelty of their innovations. Working with lead-users is likely to provide firms with radical innovations, as illustrated in the user innovation initiative at 3M described below.

In the late 1990s, the product development team at 3M was tasked with developing an innovative disposable surgical drape to prevent the spread of infectious diseases in the surgical room. 3M worked closely with medical professionals in less than ideal environments to understand the problems associated with stopping the spread of infectious diseases. Then, the team identified innovators at the leading edge of the trend toward cheaper and more effective infection control. Surprisingly, such innovators were found in fields outside human medical surgery, such as veterinary hospitals and even film-making. Working with these users not only allowed 3M to develop new product lines, but also to identify a breakthrough approach to infection control. The rest as they say is history, and today 3M has a suite of solutions for infection prevention in its health care market segment. A key takeaway from the 3M case is that successful implementation of user innovation methods and processes relies heavily on identifying users with the right skills and knowledge. 3M identified two main groups to work with throughout the product development stages: users operating in adverse conditions; and users at the forefront of the trend but located in other industries. Working closely with these two groups enabled 3M to see the big picture of what was needed.
Identifying the right users is only part of what makes user innovation useful for 3M. Another feature that differentiates it from conventional technology-push or market-pull innovation is the involvement of users at very early stages of product development. Conventional technology-push innovation normally seeks user involvement from the prototyping or trial stages onward; while firms adopting a market-pull model will only strive to obtain inputs from past usage behaviours to predict future market needs. However, product developers at 3M were out observing users in the field when identifying the problem, and they continued to involve users at the development and trial stages of product development. This is significant, as 3M product developers were able to tap the tacit knowledge of diverse groups of users in various sectors, learn from them, and develop truly innovative products that served the different market needs.

Closer to home, New Zealand firms in traditional industries are also beginning to adopt user-innovation principles. Take the example of the ZAMMR handle. The handle was designed, prototyped, and tested by sharemilker Grant Pearce who needed a more durable product that allowed for easier set up of electric fences and gate breaks. The ZAMMR handle is now sold by Tru-Test as part of its electric fence products, and Pearce receives a royalty payment for each handle sold. Picking up the user-created ZAMMR handle, which complements its existing products, allows Tru-Test to concentrate its limited resources on core innovation problems.

WHY USERS INNOVATE

Von Hippel has proposed that users innovate because they have the necessary skills and knowledge to do so – including the know-how and know-why of a particular product or need. Being users of the product, they have intimate knowledge about how and why the product works to meet users’ needs. While some information is explicit and easily observable by firms, other information – such as usage patterns and behaviours – is tacit. These skills and knowledge form the basis of von Hippel’s “sticky information” argument, the logic of which is that, having the skills and knowledge, users will innovate because it is difficult to transfer their innovation-related skills and knowledge to producer firms. Neither firms nor users can easily download or upload the users’ innovation-related skills and knowledge with the click of a button, especially the tacit components. According to von Hippel, this is one of the reasons why users innovate in the first place.
The second reason users innovate is that they will benefit from the innovation. According to Associate Professor Marcel Bogers of the University of Southern Denmark and his co-researchers, the benefits that users receive from innovating are twofold. Users innovate because they will benefit from using the innovation, especially if it solves a problem that existing products have failed to meet. They may also reap monetary benefits – for example, as a result of selling a user-created innovation to other users.

METHODS FOR USER INNOVATION

There are three approaches that firms could adopt to engage users in their innovation processes.

LEAD-USER METHOD

Lead-users are important sources of innovation for firms. The lead-user method enables firms to systematically search for user innovations and breakthrough opportunities. First introduced by MIT Professors Glen Urban and Eric von Hippel, the lead-user method has four phases: 1) Specifying lead-user indicators; 2) Identifying the lead-user group; 3) Generating the concept with lead-users; and 4) Trialling the concept.

In Phase 1, firms need to grasp the existing market or technological trend to determine the attributes that distinguish lead-users from ordinary users. Next, they must define the measures used to assess the benefits that lead-users would expect as a result of solving a specific need. Firms can use three indicators to measure the level of expected benefits: 1) Evidence of user product development or modification; 2) Dissatisfaction with existing products; and 3) Speed of innovation adoption. In Phase 2, firms could utilise the metrics developed in Phase 1 to identify lead-user groups or subgroups that are relevant for the innovation problem at hand via tools such as a questionnaire. Phase 3 involves working closely with the selected lead-users to derive product concepts and prototypes for testing. Face-to-face sessions and workshops ensures maximum interaction with, and between, lead-users to create an innovative and viable product concept. In Phase 4, the concept is tested on ordinary users in the target market. As lead-users have needs beyond the existing market, testing among ordinary users will predict the acceptance and usefulness of the product concept to the general market.
The Danish toy manufacturer Lego offers a useful illustration of the lead-user approach. Lego works closely with lead-users to develop and improve its Mindstorm range of products. The company harnesses lead-users to develop and test new products by including them at the various stages of the innovation process. Although Lego operates in a traditional industry – toy manufacturing – it has successfully adopted user innovation. The results are evident; in addition to manufacturing Lego sets, the company runs theme parks and produces animated movies.

**TOOLKITS**

Toolkits are essential tools that firms offer to users, enabling them to design products according to their personal preferences. Toolkits usually take the form of software or online-based platforms that allow users to visually design their own products and provide instant feedback during the design process. Using toolkits, firms outsource product design and focus instead on the manufacturing process. While users are rarely given absolute freedom, toolkits allow for product customisation within acceptable parameters. A good example is the jewellery sector, where online toolkits such as Ponoko and Shapeways allow users to design jewellery and other products through 3D modelling. Throughout the design process, users can obtain instant visual feedback on how the design fits the user’s preferences and the producer’s manufacturing limitations. Designs that conform to acceptable production parameters can then be produced and shipped to users.

Swedish furniture-maker Ikea offers an online toolkit called Home Planner. Home Planner allows users to design a complete kitchen – from cabinet choice to preferred appliances. While the choices are limited to the company’s wide range of kitchen products, Home Planner provides users with an instant 3D visualisation of how the selected kitchen would look before they place an order for delivery and installation. Thus, by avoiding the impossible task of designing unlimited kitchen configurations, Ikea is able to innovate in other ways, such as by creating breakthrough modular products, improving its processes, and focusing on designing furniture solutions.

**CROWDSOURCING**

The idea of crowdsourcing is to harness the skills and knowledge of the “crowd” to obtain the best solutions to innovation problems. Crowds are valuable because they comprise contributors with a wider range of skill sets, perspectives, and solutions heuristics than employees in
the firm. Crowdsourcing is particularly useful when the problem is ill-defined, ambiguous, and requires substantial creativity to solve. Crowdsourcing the solutions for such problems allow firms to tap a wide array of contributors who compete to have their solution adopted. Utilising crowdsourcing requires firms to go through the following steps: 1) Identify the innovation problem; 2) Broadcast the problem to source solutions; 3) Evaluate submissions; 4) Reward the winning contributors and adopt their solution.

A recent example of crowdsourcing in New Zealand is life insurance company Sovereign Assurance’s “Be the difference challenge”. The online crowdsourcing platform aims to generate innovative ideas, solutions, and concepts to improve the wellbeing of New Zealanders. In return, Sovereign is offering scholarships worth $5,000 each to five winning ideas or solutions in the innovation contest.

**USER INNOVATION IN TRADITIONAL INDUSTRIES**

**PRACTICAL IMPLICATIONS**

Just because some firms are adopting user innovation, does not mean that other firms should rush to implement it with the hope of obtaining innovations for free. There are still practical issues to be considered, such as the innovation problem, intellectual property (IP) rights, and the internal organisation of the firm.

Specifically:

- The methods mentioned above are not mutually exclusive. Firms can adopt a combination of them.
- The choice of whether user innovation is appropriate largely depends on the innovation problem that the firm is trying to solve.
- Firms can follow two basic principles: 1) If the innovation problem is multifaceted and ambiguous, firms are better-off harnessing the power of crowdsourcing which will increase the range of ideas and solutions likely to be received; 2) If the innovation problem and expected user benefits arising from its solution are well-defined, then the lead-user method will enable firms to access radical ideas and product concepts.
- Firms need to assess the expected value of the user innovation. If it forms a core product or technology, the firm might consider taking the time to transfer

**IRRIGATION SYSTEMS**

are essential for dairy farming. The uniqueness and harsh conditions of New Zealand dairying increase the need for firms to harness innovations created by farmers. There are instances where lead-users – innovative farmers – install unique configurations of existing irrigation equipment to increase efficiency. Industry organisation DairyNZ understands the importance of these user-created configurations. Rather than ignore innovative practices and compete with lead-users to devise better irrigation systems, DairyNZ decided instead to work closely with them to develop best practices that could be adopted by the wider dairy-farming community – a process that perfectly illustrates user innovation.
the IP through lengthy documentation and procedures. However, if the user innovation complements or is an add-on to existing products, then the licensing option would be more realistic.

• A bureaucratic structure is unlikely to foster the external sourcing of user innovations because the red-tape will subject staff to intense rules and procedures in order to steer radical, external ideas or solutions through the heavily-regulated organisational channels.

• Firms can always facilitate user innovation through better communication channels (such as that between front-line and research departments) to ensure that user inputs are communicated clearly. Better communication channels also allow for better inter-departmental collaborations when needed. Practices that reward staff for successfully commercialising innovative user ideas and solutions also send clear signals to staff and act as incentives for them to work more closely with users.

Firms need to understand that there is no one-size-fits-all method, and that employing user innovation requires them to first understand the innovation problem and IP issues before choosing their user-innovation method or mix of methods to employ. Many firms exploiting user innovation ask the users involved to relinquish all IP rights to the ideas or solutions that they created. But the difficulty of transferring these IP rights might not be worthwhile if the user-created innovation only solves a minor innovation problem. Taking into account the problem will enable firms to choose the most appropriate user innovation method(s) which, in turn, affects how IP rights should be managed.

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KEY TAKE-OUTS

• Overseas firms in traditional industries have been adopting user-innovation principles for years, and New Zealand-based firms are beginning to do the same.

• The most appropriate user-innovation method depends on the type of problem that needs solving.

• Firms need to ensure that the intellectual property of user-driven innovations is managed accordingly, whether through buy-out or licensing arrangements.

• To succeed, firms need conducive organisational structures and complementary practices that facilitate access and transfer of user-driven innovations.
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