

OUR BUSINESS

2017 INDUSTRY REPORT



AUTHORSHIP

This paper was prepared at ACENZ by Catherine Chong in April 2017. For more information, contact Catherine at catherine@acenz.org.nz or through LinkedIn at www.linkedin.com/in/catherine-chong

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Our Business 2017 is volume two of the first “Our Business” which was launched in March 2015 in response to our Members’ requests. The original 2015 edition of Our Business can be downloaded [here](#). This report is a neutral platform utilising multiple sources of research information and is not to be used for sponsorship benefits, only for the good of the industry.

5	19	33	45	51
<u>THE CONSTRUCTION SECTOR</u>	<u>DEMOGRAPHIC DISRUPTION</u>	<u>INNOVATIVE DISRUPTION</u>	<u>SKILLS DISRUPTION</u>	<u>OUR BUSINESS 2017 AND BEYOND</u>
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FOREWORD

KIERAN SHAW, ACENZ CEO

The first production of an ACENZ 'Our Business' report was formally launched at a function in Parliament hosted by Hon Dr. Nick Smith in March 2015. The document was subsequently widely distributed both within and outside of the construction industry. Many client organisations and public bodies, as well as member firms, praised the publication for providing a 'one-stop shop' to find meaningful information pertinent to the construction industry. We are now pleased to release a new issue of 'Our Business' which has been updated to reflect the rapidly changing statistics and dynamics that relate to the vibrant construction industry.

The New Zealand construction industry is a key contributor to the ongoing economic development of this country. The industry accounts for around 10% of employment, 7% of total national GDP and is growing faster than most other sectors of the economy. Relevant works completed by the construction industry amount to over \$14 billion per annum. An important and necessary asset for advancing the industry and towards progressing quality and innovation is the ready availability of accurate and current information. The industry professional services sector that is represented by ACENZ is an important source for the detailed data and design criteria that defines works undertaken by the industry. ACENZ member firms employ over 10,000 professional staff and have a turnover in excess of \$2 billion a year.

In order to keep our ACENZ membership up to date with industry matters our Association takes a lead role in accessing and compiling up to date information that paints a current picture of the industry, and also highlights the issues and trends that help define forward strategies for service providers, their clients and indeed many public sector agencies and government departments. I would like to praise our three ACENZ staff – Catherine, Holly and Katie – who have committed so much time and effort into putting this material and the associated coherent presentation together for the document. The 'Our Business' report has been prepared and produced totally 'in house'. However, we would also like to acknowledge all those entities and individuals that made available the valuable data that comprises the foundation of this report.



MIKE KERR, ACENZ PRESIDENT

We continue to see significant membership growth. This is strong endorsement of the value ACENZ provides to our Members, and the direction of our Association. This 'Industry Report' is an excellent example of how we can add value to our Members. The report outlines our strategy looking forward, to increase our influence, working alongside others to lift our profile and influence in our industry and our community. To broaden our Membership, welcoming other professionals that work in our industry. To empower the 10,000, utilising the collective of our Membership numbers (10,000+) to find more ways to harness the experience and wisdom within our Membership for our Members.

Secondly, the majority of our Membership are small firms. Therefore it is important we provide business support and also ensure we solicit feedback on issues. We have two initiatives to support this. The first is our Small Business Handbook, which is currently being prepared, bringing together our various ACENZ Practice Notes along with additional aides to create a usable tool for new and existing small firms. The second is our redefined Area Representatives (now called Regional Chairs) to strengthen and empower the role. The Chairs play a critical role in being a conduit for the issues of our members to the Board. This is particularly important for our small firms.

Finally, our industry is in a very strong position. We are in the largest construction boom in 40 years, which is currently strengthening all of our businesses. However, we can't be complacent. We work in a rapidly changing world. We need to be challenging ourselves to be nimble and open to change. We need to be the disruptors and not the disrupted. The report talks to some of these potential disruptions to our industry – well worth a read.

We still have a number of challenges ahead of us, examples being diversity – not just gender but also cultural and age demographic further requiring change in an increasingly challenging commercial environment. I look forward to working with you all to address these and other challenges over the next two years.

ACENZ - WHO WE ARE

The Association of Consulting and Engineering New Zealand represents business services and advocacy in the consulting industry for engineering and related professionals.

PERFORMANCE HIGHLIGHTS - 2016/17

We have the most number of members since ACENZ was founded in 1959.

184 Member Firms

An indication that the industry has bounced back since a bumpy ride in year 2015

10,000+ personnel

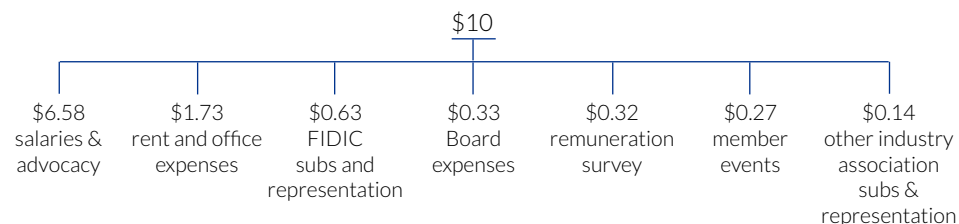
Increased subs revenue due to increased member firm total personnel

\$735k in subs

OUR REGULAR ACTIVITIES & INITIATIVES

- Provide Consultancy Conditions of Engagement
- Regularly review construction contracts and standards
- Influencing local and central government
- Young Professional initiatives
- Regional meetings, seminars, conferences, and President's Roadshow
- Newsletters and real-time alerts and Member advisories
- Industry awards (eg INNOVATE Awards, Future Leader Award, Student Award)
- Practice notes with regular updates
- Manage Producer Statements and certification practices
- Lobbying Government and promoting Member interests in legislation and process

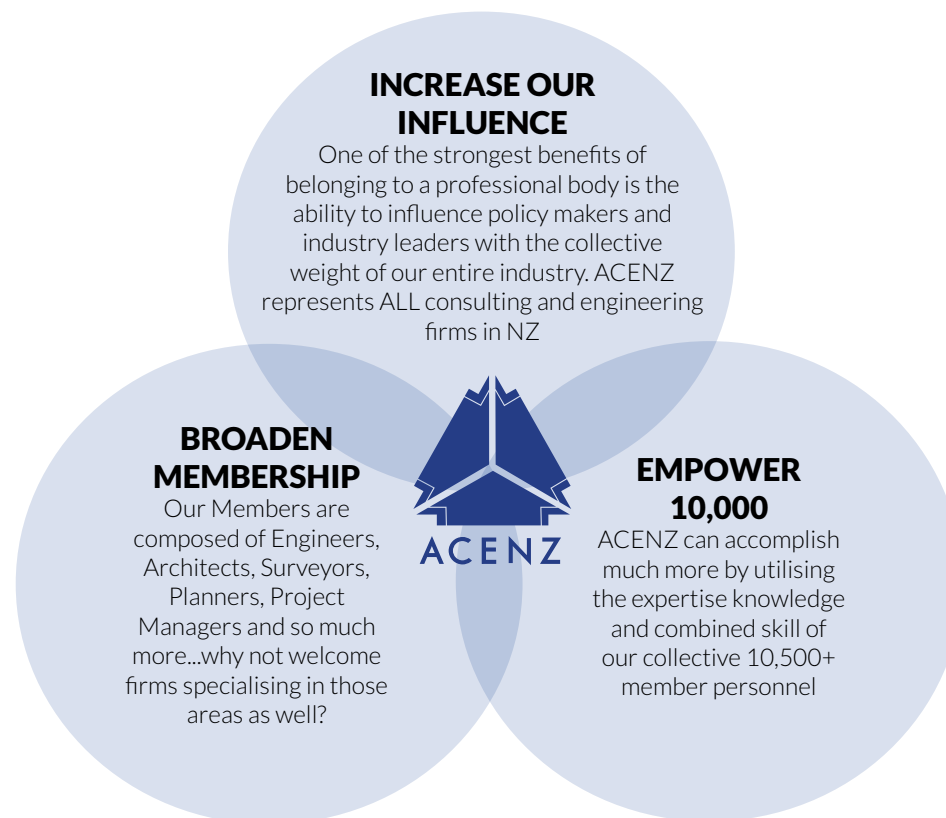
WHERE YOUR MONEY GOES WHEN YOU PAY ACENZ \$10



OUR VISION

ACENZ is the Trusted Advisor providing business leadership in matters relating to the built and natural environment.

OUR STRATEGY

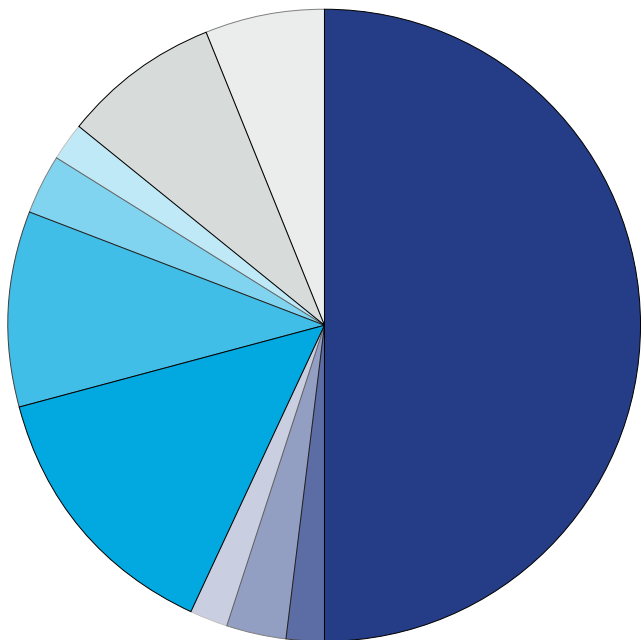


OUR MISSION

To raise the profile and expand the influence of the industry and to assist members improve their business performance and the quality of service.

ACENZ MEMBERS - GET TO KNOW US

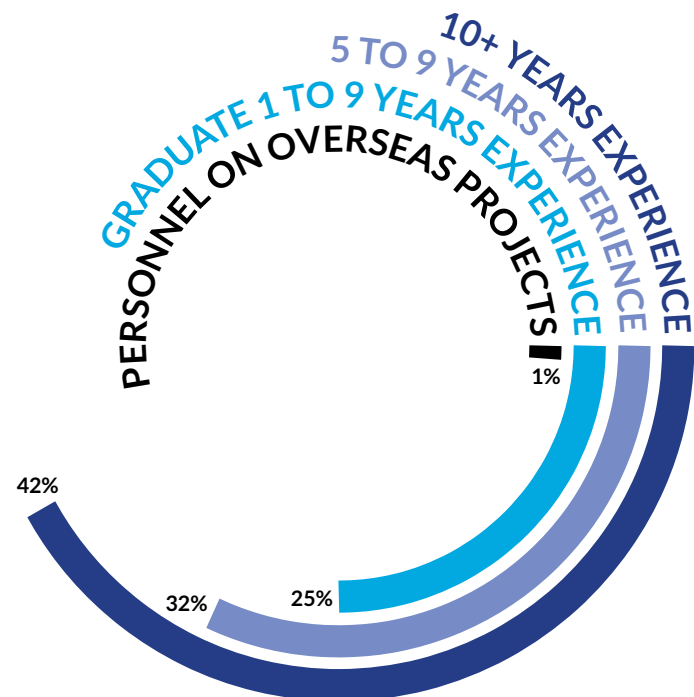
ACENZ is a firm based membership organisation, with member firms' personnel totalling close to 11,000. Member firms practice in an array of engineering disciplines, services, and offer a variety of expertise and experience levels.



53% Engineers, **14%** Management & Corporate Services, **13%** Technicians & Contractors, **8%** CAD/Draftpersons, **3%** Planners, **3%** Scientists, **3%** Surveyors, **2%** Architects, **1%** IT.

TOTAL PERSONNEL BY CATEGORY

ACENZ has a diverse mix of membership including engineers, architects, planners, surveyors, technicians, scientists, administrators, IT professionals, etc. While we remain a strong majority of engineering professionals, the other half includes professionals in a wide array of background and study.



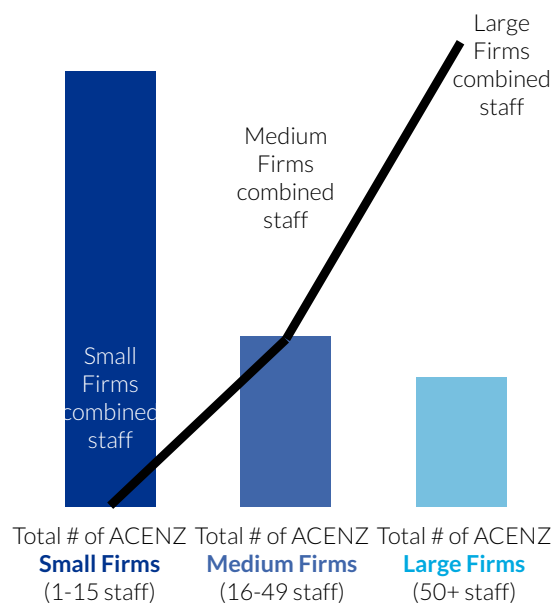
TOTAL PERSONNEL BY EXPERIENCE

Just as different professional categories need different things for their jobs, so do professionals with different levels of experience. ACENZ's diversity in experience ensures a thorough perspective and view on a range of matters, policy, product, and opinions.

ACENZ MEMBERS - GET TO KNOW US

Our members give us the voice of the consulting and engineering industry in New Zealand. ACENZ represents the visible embodiment of our members and our commitment to change and improvement. Our industry flourishes and the public benefit grows through the commitment and dedication of our members.

The sector is vulnerable to the global economic headwinds. The New Zealand economy entered recession in early 2008, before the effects of the global financial crisis set in later in the year. High interest rates and falling house prices drove a rapid decline in residential investment. The end of the global financial crisis (2007-2011) ushered in the golden era in the construction sector in NZ. This brought about upward trend in our business from 2012 onwards. The year 2014-2015 were highlighted by the activities of mergers and acquisition happening around the world that resulted in staff re-shuffling, headquarters relocation and businesses re-consolidation. In year 2017, we saw a few medium sized firms increased significantly over the span of 12 months. There were about 5 medium sized firms increased their staff from 30-40 mark to 50-80 mark, a whopping 30%+ increment.



Small Firms represent 109 of ACENZ's total 184 firms, **Medium Firms** compose 46 firms and **Large Firms** total 29.

Largest 15 Member Firms for years 2008-2017

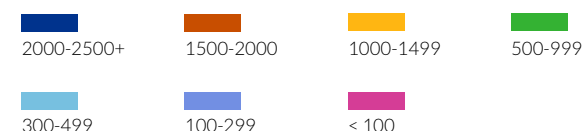
	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
Beca	1	1	1	1	1	2	2	1	2	2
Opus	2	2	2	2	2	1	1	2	1	1
Aurecon	3	4*	4	3	4	5	5	4	4	4
AECOM	4	3	3	5	5	4	4	7	7	9
Tonkin & Taylor	5	5	6	7	6	8	8	10	10	8
Stantec NZ	6	6	5	4	3	3	3	3	3	3
GHD	7	7	7	6	8	6	6	6	6	6
Jacobs	8	8	8	8	7	7	7	8	8	7
Harrison Grierson	9	9	9	10	10	11	11	11	11	10
Holmes Group	10	10	10	11	11	12	12	12	12	13
Calibre	11*	11	11	13	12	10	10	5*	5*	5
Babbage	12*	12*	12	12	14	14	13*	13	13	12
Wood & Partners	13	13	14	x	15	x	x	x	x	x
WSP Parsons Brinckerhoff	14	21	13	14	13	13	15	x	x	x
Mott MacDonald	15*	14	x	NM	NM	NM	NM	NM	NM	NM

* Did not respond to the survey that year

x = not in the largest 15 firms that year

NM = Non-Member that year

	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
TOTAL Staff	10,621	10,513	9,889	10,172	9,645	9,116	8,561	9,021	8,926	9,217
TOTAL Member Firms	184	180	171	175	173	169	169	174	175	166



THE CONSTRUCTION SECTOR

INTRODUCTION

Engineering & design consultancy services are intellectual services aimed at optimising investment projects in the construction and the infrastructure at all stages of a project from the initial phase to its final operations. The client base is predominantly formed by national and local governments, investors and industrial firms. Demand for consulting engineering services is therefore closely linked to the general economic and social environment as well as construction output. It is therefore worthwhile to analyse and understand the sector that ACENZ Members are operating in.

The construction sector is a key driver of economic growth in New Zealand. **It is the sixth largest sector in the New Zealand with a GDP of \$14 billion, contributing to 7% of New Zealand total GDP.** Annual GDP growth in Construction was 3.9% in the year to March 2016, compared to 2.3% for the New Zealand economy over the same period. The construction and construction-related services account for 10% of total employment nationwide, and has an even greater impact when integration with other parts of the economy is considered.

THE CONSTRUCTION SECTOR SNAPSHOT

VALUE OF BUILDING WORK PUT IN PLACE*

(in NZ\$ mil)	2016	2015	2014	2013
Residential	12,638	10,366	9,513	7,580
Non-residential	7,233	6,203	5,811	4,890

*Estimates of the actual dollar value of work put in place on construction jobs.

NUMBER OF CONSENTS ISSUED

Types	2016	2015	2014	2013
Houses	21,252	18,988	18,397	16,733
Townhouses, flats, units, apartments, retirement villages	8,718	8,034	6,302	4,458
TOTAL(dwelling)	29,970	27,022	24,699	21,191

The number of new dwellings consented fell 7.2 percent in December 16, following a 9.6 percent fall in November. The trend reached a 12-year high in July 2016, but has decreased 12 percent since then. Canterbury is the main driver of the decreasing trend. In the year ended December 2016, 29,970 new dwellings were consented – up 10 percent from 2015.

EXPORT OF SERVICES

Services (NZ\$ mil)	2016	2015	2014	2013
Architectural, scientific, and other technical services	32	38	40	58
Engineering Services	164	158	158	165

New Zealand's expertise in consultancy work has evolved from the country's background in research, innovation and reform. Our international successes include:

- assisting countries with earthquake risk assessment and mitigation, and emergency, disaster and risk management.
- advising governments on economic growth and environmental management.
- designing infrastructure solutions for transport and water-related services.

SCORECARD

Measure (year ended Mar)	2016	2015	2014	2013
GDP (NZ\$/bil)	12.8	12.4	11.6	11.0
Employment in Construction Industry*	242,900	232,000	204,500	185,800
Construction Related Occupations**	521,753***	490,114***	unavailable	469,318 (census baseline)

Small firms (1-6 workers) make up 91% of the construction industry.

The GDP for year ended Mar 2017 is not available. It is estimated to be about NZ\$14 billion.

*Employment in construction industry: includes many core construction workers (such as plumbers) but also many occupations, such as accountants, that do not require construction-specific skills. (This is measured by the Household Labour Force Survey).

**Construction-related occupations: includes the main labour supply sources for the construction sector, but many of whom are not working on construction activities. For example, truck drivers might be working directly for construction firms, working on construction activities but for transport firms, or working outside the construction sector (for example milk tanker drivers).

*** Projection based on census 2013 crew mix.

THE CONSTRUCTION SECTOR

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THE 7 UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

1. **Cyclical and Volatile**
2. **Diverse Workforce**
3. **Incredible Multiplier Impact**
4. **Low Labour Productivity**
5. **Lack of Innovation and Delayed Adoption**
6. **Low Investment Information Technology**
7. **High Industry Fragmentation**

1. CYCLICAL AND VOLATILE

Whilst there have been several growth periods followed by slowdowns in the economy as a whole, there were three significant boom periods for the construction industry; the 'Think Big period' from 1977 until 1982, the 'Construction Boom' from 1984 until 1987 and the 'Golden Era' from 2012 onwards.

The Think Big Era: 1977 – 1982

The 'Think Big programme' was initiated by the government of the day, who invested around NZ\$6 billion per year through several industry departments. The investment programmes created thousands of jobs and supported the local production and processing of energy. The boom cycle in the construction industry was short-lived. The external environment, in the form of the international oil situation, had a very strong effect on this cycle. The 'Think Big Era' influenced future policy makers away from too much government involvement in a market-dominated industry. As a result we have a systemic loop set up of history-influencing economic evolution and future decision making, which in turn induces cyclical behaviour that then impacts policy and influences policy makers.

The Construction Boom: 1984 – 1987

In the mid-1980s the government liberalised the economy and deregulated the financial sector. The subsequent growth of the financial sector coupled with government departmental restructuring increased demand for new office buildings. There were far greater returns on investments in sectors such as construction when the real exchange rate rose. This was a signal to the market to invest in the construction sector, though the key factor that caused the boom was the deregulation policy of the government. There then followed a significant downturn in 1987, as stock markets crashed around the world, resulting in rapid retrenchment and over supply of non-residential property in the early 1990s.

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

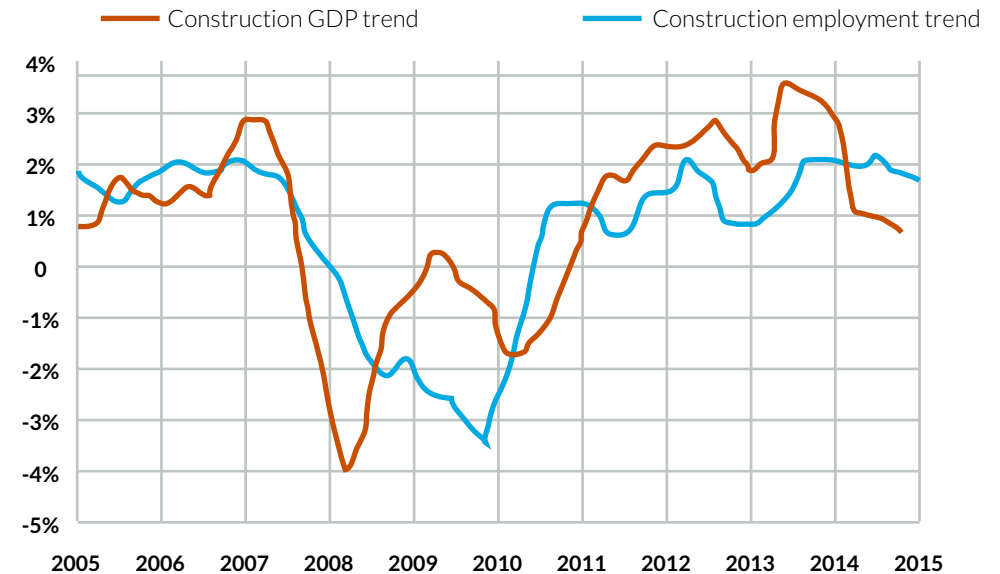
Steady Growth: from 1992 until recession in 2008

In 1992, the New Zealand Institute of Economic Research forecasted that the contraction of the sector following the two boom periods had taken place and the trough of recession had passed. Despite small fluctuations in 1999 and 2001, there has been a steady growth in the construction sector since 1992 supported by overall building output figures. Evidence from the Reserve Bank suggests that construction output closely follows the national GDP cycles, but swings more extremely. In macroeconomics, construction related indices are often used as the economy indicators. Orders for housing, building permits, housing prices and housing stats are all used as key leading indicators of the economy. Also, some indices in the construction industry, such as investment in building, plant construction and orders for engineering output, are key lagging indicators of the economy. In New Zealand at the moment there is a strong correlation between residential construction prices and inflation.

The Golden Era: 2012 onwards

New Zealand is in the midst of the largest construction boom in 40 years. The factors driving the boom include: The \$40b Canterbury rebuild; record net inward migration; new commercial developments (especially in Auckland); the seismic upgrading of earthquake prone building; repairs to leaky buildings in the wake of the weather-tightness crisis; a chronic shortage of housing (particularly in Auckland); among other external reasons including the end of the Global Financial Crisis (2007-2011). The 2016 National Construction Pipeline Report shows building work is expected to peak in 2017 at \$37 billion.

Quarterly employment and real GDP growth to March 2015



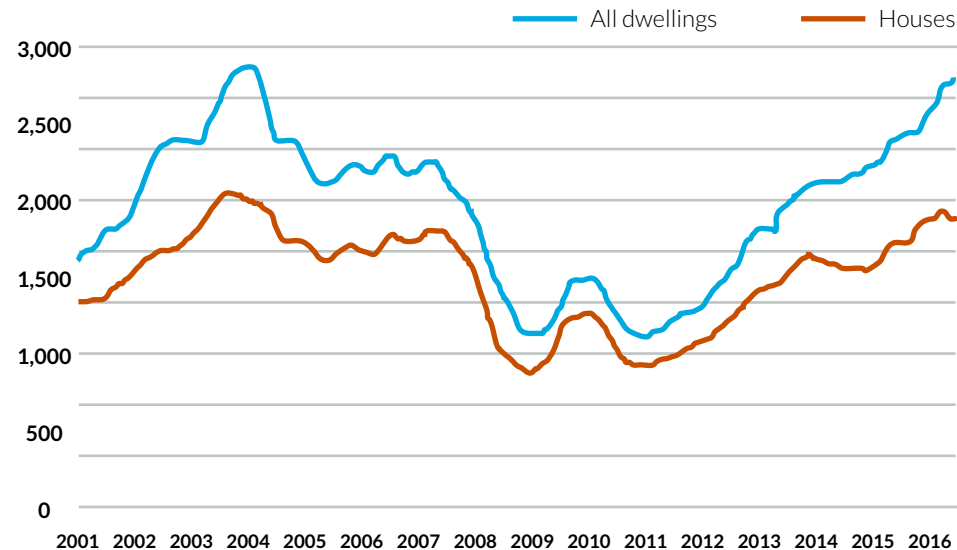
Construction Sector Indicators

The New Zealand economy entered recession in early 2008, before the effects of the global financial crisis set in later in the year. High interest rates and falling house prices drove a rapid decline in residential investment. The outlook for the New Zealand economy deteriorated sharply following the intensification of the global financial crisis in September 2008. Economic activity contracted 0.9% in the December quarter 2008, with production GDP affected by a reduction in manufacturing, construction and wholesale and retail trade.

THE CONSTRUCTION SECTOR

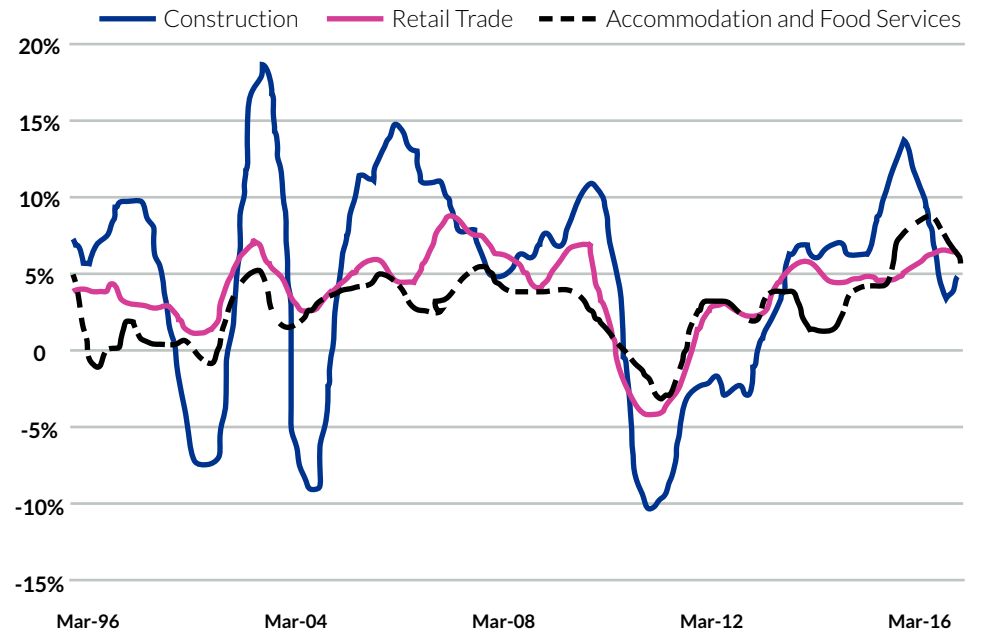
THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

Trend for new dwellings consented (monthly)



The annual number of homes consented has passed 30,000 for the first time in 11 years. Auckland is expected to dominate construction work over the six years to 2021, peaking in 2018. Besides growth in new dwellings, on-going and new projects have also been driving growth around the country such as: Thirty-Year NZ Infrastructure Plan 2015 including Auckland City Rail Link, Auckland Western Ring Route, The Panmure Corridor, The Wellington Transmission Gully; Skycity's international convention centre; luxury hotels for the Wynward Quarter; and many more.

Annual growth in GDP



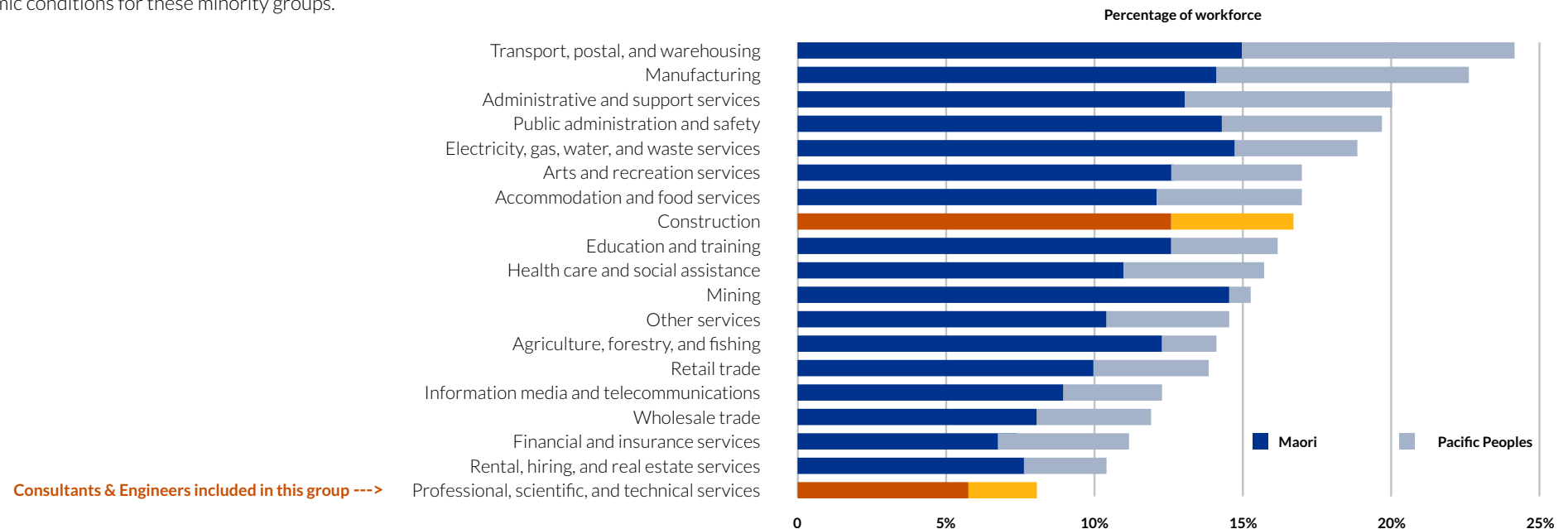
The Construction sector is prone to boom and bust cycles and exhibits greater volatility than other sectors. It's not surprising that it's affected by factors such as the global and national economic outlook, as well as other driving forces like the occurrence of natural disasters and geopolitical influences that may cause population hike and thus drive residential houses demand. It is still interesting to highlight that the volatility exceeds those that are most subjected to the fluctuations of business cycles, for e.g. retail, accommodation and food services. Over the last 20 years, the sector has exhibited double digit annual growth and decline.

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

2. DIVERSE WORKFORCE

Construction employs a high proportion of Maori and Pacific Peoples. The Construction sector offers significant employment opportunities for these ethnic groups, making the consistent provision of work by the Construction sector an important part of improving economic conditions for these minority groups.



About 17% of Construction workers identified as Maori or Pacific peoples, which is eighth highest proportion out of the 19 industries assessed. Consulting engineers (classified under Professional, scientific, and technical services) has the lowest percentage out of the 19 industries. (see chart above). Female employment in the sector has been growing at a faster pace than males, doubled to 17% over the last 15 years.

With New Zealand's current building boom, it makes sense to encourage more women to join the construction industry. The average hourly earnings for women (\$27.96/hr) is higher than that for male (\$26.14/hr) employees. This is largely a result of the different roles which women take in the in the sector (usually higher skilled). Construction sector workers are younger than across the whole economy of NZ.

It is an important sector that offers opportunities to workers at all levels across the skill and experience spectrum. The construction sector has the highest percentage of workers with a post-school qualification (out of 19 industries) as their highest level of qualification, but the lowest percentage of Bachelor degrees. The image that people have of the construction industry as an employer is a relatively poor one, with inadequate gender diversity and little job security, mainly due to the cyclical nature of the business. As a result, E&C companies often struggle to attract talented recruits to their workforce. They also tend to be perceived as less effective in internal people -development initiatives. Management roles have become more diverse with the number of women at this level increasing from 13% to 18%. Source: [2016 Hays Construction & NZIQB Salary Guide](#).

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR



DIVERSE WORKFORCE CASE STUDY

Fulton Hogan & Endometriosis NZ

Fulton Hogan, a large company with 80% of its 3500 Kiwi staff men, became a sponsor of Endometriosis NZ – a small charity devoted to tackling a painful women's health issue. As part of the sponsorship agreement, Fulton Hogan will provide a research grant that will fund the study of endometriosis in adolescents.

This will be conducted by a collaborative team of researchers from the University of Adelaide, University of Melbourne and University of Canberra. Fulton Hogan will also fund Endometriosis New Zealand's educational programme in Auckland and Wellington secondary schools. The 'me' programme (which stands for Menstrual Health and Endometriosis) has been delivered to secondary schools across the country since 1995 and is an important way of raising awareness among younger audiences.

CEO Robert Jones says they identified strong synergies between the two organisations, including mutual values and a common commitment to making a difference. He says the company is on a diversity journey – it has a programme called 'Road to Success' to focus on minority groups in their business, such as women, Maori, Pacific Islanders and Asians, and to develop them to leadership roles.

"We are working hard to attract women into the industry, and our relationship with Endometriosis NZ shows we are serious about addressing issues for women in business. Fulton Hogan wants to remove barriers for women who want to work in engineering or roading, it's a very family-oriented company that cares about communities and the people in them." - Robert Jones, CEO of Fulton Hogan NZ



THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

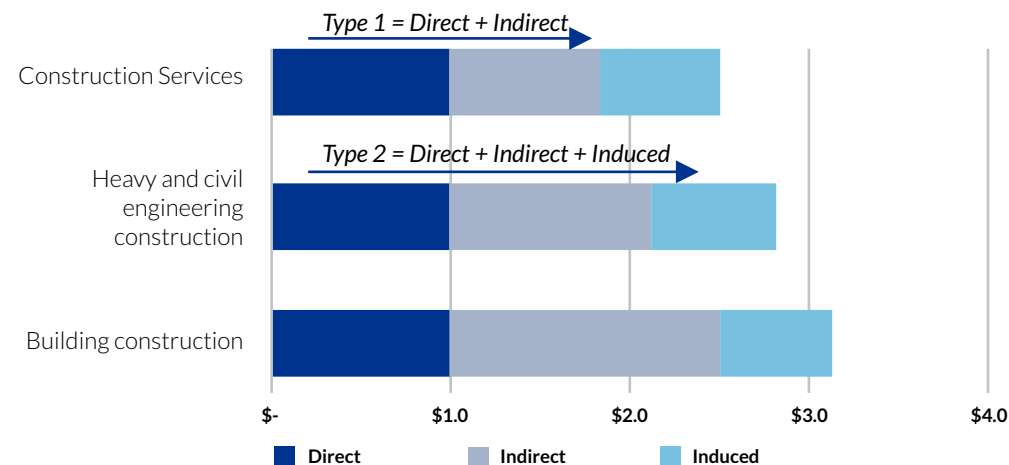
3. INCREDIBLE MULTIPLIER IMPACT

Multipliers measure the extent to which investment in particular sector affects other sectors.

The national input-output tables by Statistics NZ show that **one dollar invested in the Construction sector generates a total of two dollars and eighty cents in economic activity**. The sector has the second highest multiplier impact of any sector in our economy (second only to the dairy product manufacturing). This is because of the major impact construction spending has in stimulating other sectors in its supply chain and through its workers spending their income.

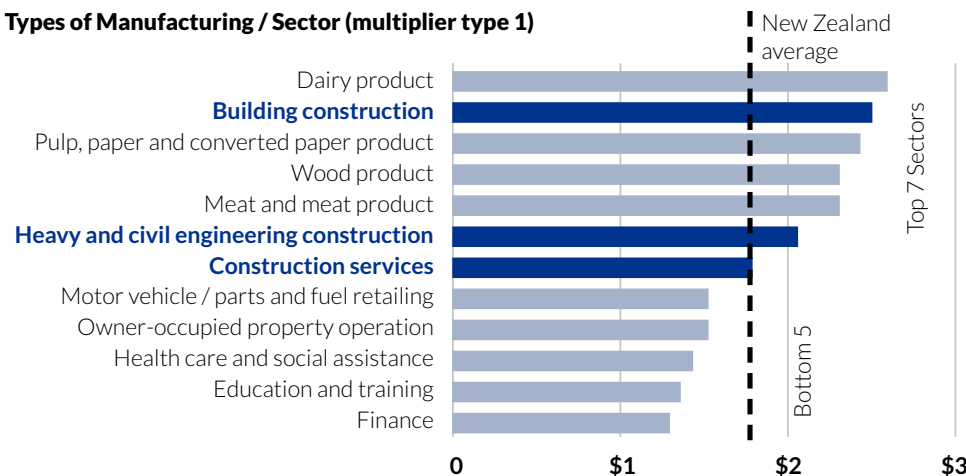
The indirect impacts show the value of the relationship between construction and the broader economy, including the mining; manufacturing; and professional, scientific and technical services sectors (including consulting engineering services) etc.

Direct and Indirect Impacts

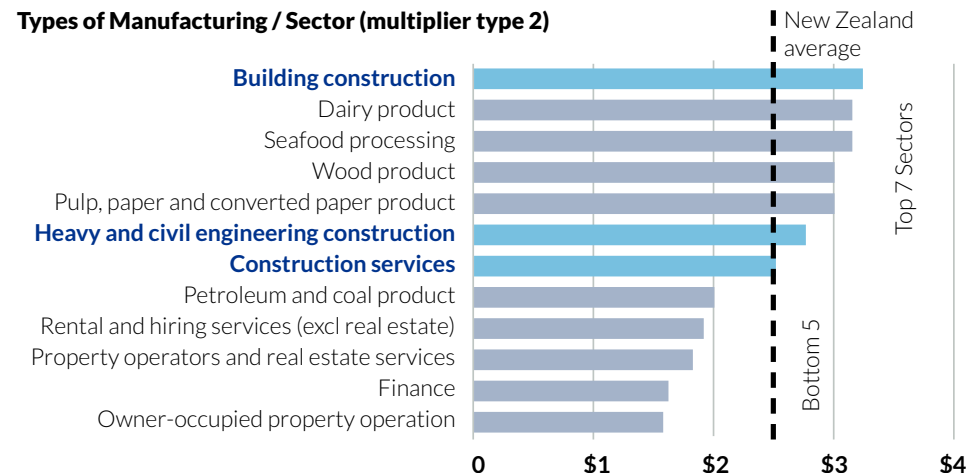


Below: Type 2 multiplier impact includes the induced impact of household expenditure for workers by sector. **The building construction sub-sector has the highest Type 2 multiplier out of 55 sectors.**

Types of Manufacturing / Sector (multiplier type 1)



Types of Manufacturing / Sector (multiplier type 2)



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THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

4. LOW LABOUR PRODUCTIVITY

Labour productivity is determined by dividing the output (GDP\$), by the number of workers. It is also used to measure worker efficiency and becomes useful when it is compared across time periods to determine whether workers are producing more or less than before.

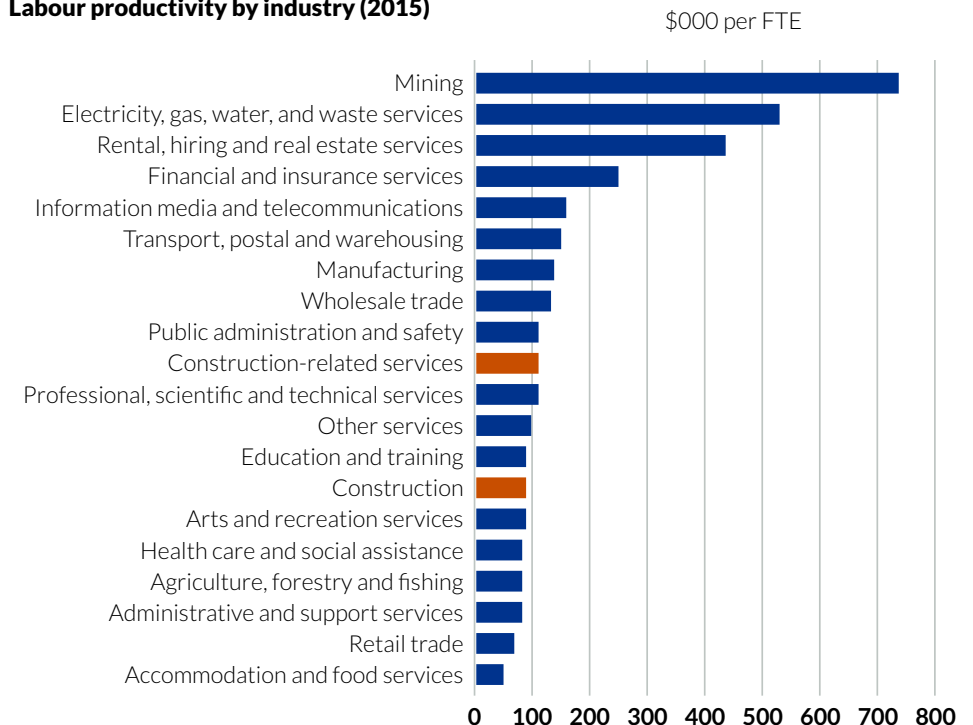
Since 2012, measured labour productivity has increased by only 1%. Every 1% increase in labour productivity for construction yields an increase in GDP of around \$139m, even before multiplier effects are considered. Supporting the sector by smoothing sources of volatility means that gains in underlying productivity are not lost when the sector encounters a bust.

Over the long-term, gains in productivity and multiplier effects would compound to produce even larger benefits. More broadly, improving performance of the sector provides a range of benefits which will be shared by the industry and consumers.

For the industry, this means improved profit margins, better skills development and earning opportunities and a better ability to weather the cyclical nature of the industry. For consumers, this means that high quality construction will cost less, involve fewer project delays and have a wider variety of options to satisfy consumer demand.

The industry could help grow its productivity through investment in skills, training, innovation, promoting better contracting practices and exploring options for improved quality assurance processes. Innovation and investment into technology can also be a key to unlocking greater productivity.

Labour productivity by industry (2015)

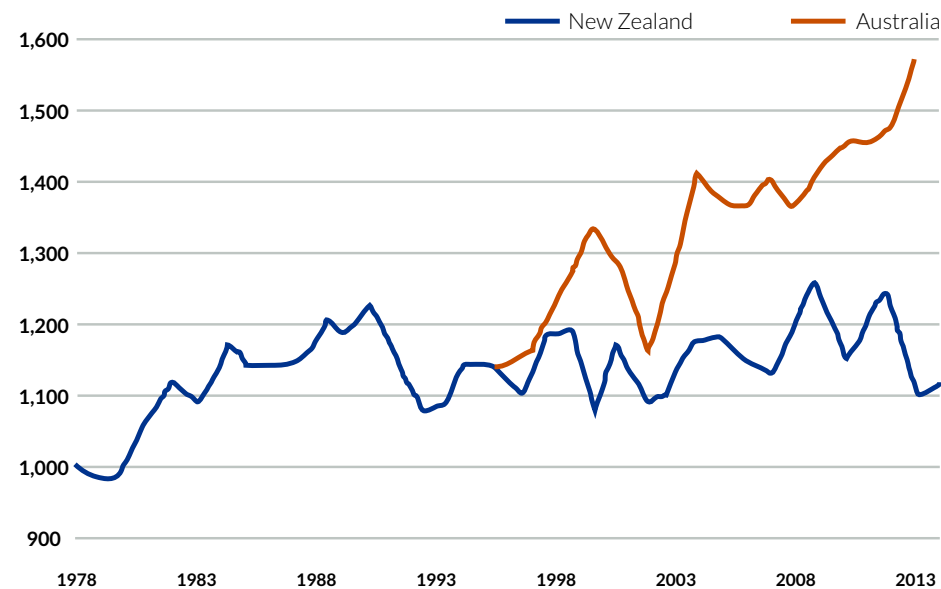


The Construction sector has a relatively low labour productivity, at nearly \$78,000 per FTE. This is due to the fact that, excluding major infrastructure projects, most of the activities performed by this sector are labour intensive. For recommendations on improving labour productivity, please refer to [PwC Value of Construction Sector 2016](#).

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

Research by NZIER showed that **70% of the aggregate gap in productivity between Australia and New Zealand is due to under-performance of New Zealand's industries**, rather than a difference in the industrial structure of the two countries. New Zealand's principal problem is multi-factor productivity – the quality of management, organisational innovation, the production process, and the quality of labour and capital. Their research shows that asphalt plants across the country are operating at levels well below their capacities.



Index, 1989 = 1000. Australia only included from 1995. Source: [Statistics New Zealand, ABS, NZIER estimates for 2012 and 2013](#)

Their analysis points to more systemic causes of performance including:

- procurement systems and policies used by the public sector
- availability of market information on which industry can base investment decisions and government agencies develop procurement strategies
- the regulatory and legal environment in which the sector operates
- public sector rules governing work practices and infrastructure standards
- weak industry management skills and capabilities
- industry structure and transport logistics.

For more details please refer to NZIER: [Construction Industry Study 2013](#) & [Construction Productivity 2013](#).

Internationally, most construction sectors show relatively poor productivity performance but aspects of the New Zealand sector appear to further exacerbate this trend. The dominance of residential construction with a very high number of very small firms means that productivity enhancements of firms exposed to international competition and innovation are slow to spread. In New Zealand, small firms (1-6 workers) make up 91% of the construction industry.

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

5. LACK OF INNOVATION AND DELAYED ADOPTION

“The Engineering and Construction (E&C) sector has been slower to adopt and adapt to new technology than other global sectors. As an industry based on competitive procurement models, E&C has historically taken a conservative approach to product design and delivery, leading to silos in project management and a somewhat fragmented industry.

E&C is the largest consumer of raw materials and other resources, using about 50% of global steel production and more than 3 billion tonnes of raw materials (globally). 1% rise in productivity worldwide could save \$100 billion a year. The industry has vast potential for improving productivity and efficiency, thanks to digitalization, innovative technologies and new construction techniques.

Consider the rapid emergence of augmented reality, drones, 3D scanning and printing, Building Information Modeling (BIM), autonomous equipment and advanced building materials – all of them have now reached market maturity. By adopting and exploiting these innovations, companies will boost productivity, streamline their project management and procedures, and enhance quality and safety.” - Foreward from the World Economic Forum: Shaping the future of construction 2016 by John M. Beck (Aecon Group, Canada)

The [Building and Construction Sector Productivity Partnership](#) was established between 2011 and 2014 to address the issue of low productivity in the sector with an ultimate goal of 20% productivity improvement by 2020. Achieving this alone will add 2% to the country's GDP – around \$3 billion each year.

The relationship between innovation and productivity is not well understood within the construction sector. Innovation can be broadly defined as the intentional introduction and application of new ideas, processes, products or procedures designed to significantly benefit the individual, the group, the organisation or the wider society.

The University of Auckland conducted a research based on the 500 innovations adopted by the construction alliance, the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) and published their analysis report in April 2015 entitled '[Driving Innovative Thinking in the NZ Construction Industry](#)'.

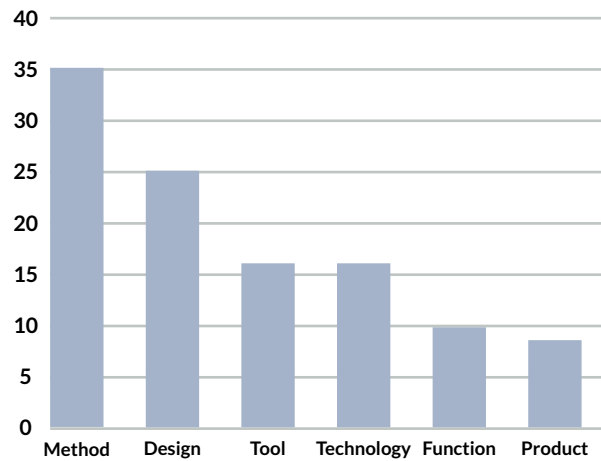
The researchers found that the most commonly accepted innovation classifications have mainly been developed by analysing innovation within the manufacturing and services context. As there are significant differences between construction and other industries, it is therefore necessary to develop an appropriate innovation classification system for the construction industry. According to the article, there are six types of innovation as follows:

- **Product:** Product Innovation involves all new construction materials and products developed in the project or introduced to the project and used within the construction process.
- **Design:** Design Innovation is related to new and innovative plans, designs, sketches or concepts for the final building or infrastructure that is being developed in the project.
- **Tool:** The Tool Innovation involves the development or implementation of novel construction machinery equipment or tools in the construction project.
- **Function:** The Functional Innovation refers to new tasks developed or introduced in the construction project and associated management processes.
- **Technology (Design + Product):** The New Technology refers to the new design that is coupled with a new material or product.
- **Method (Tool + Function):** The method innovation is the combination of the Tool and Function Innovation that involve both a new tool or equipment and new tasks that are usually related to the new tool.

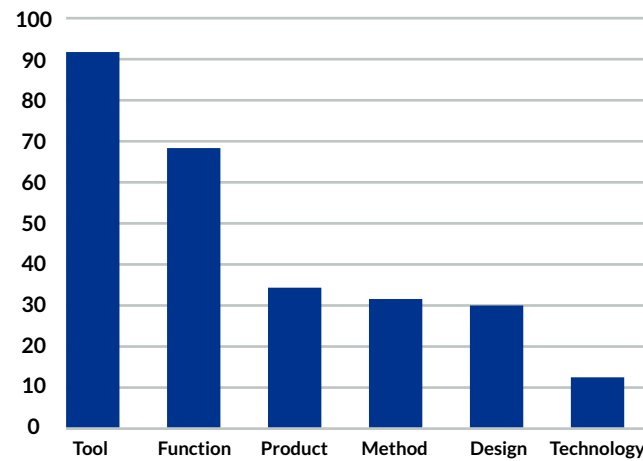
THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

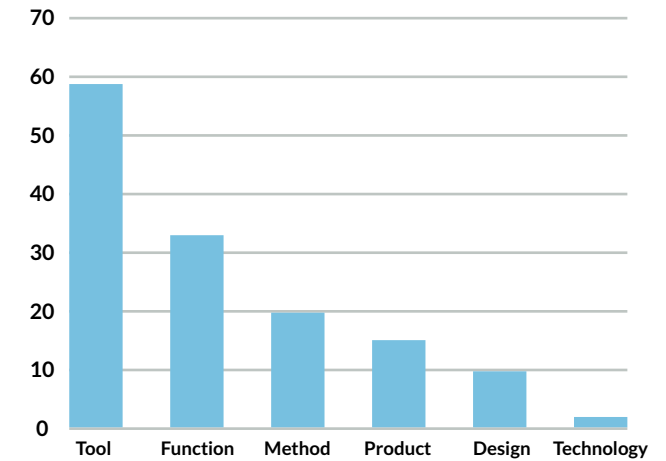
Innovation types that delivered a combination of quality-time-cost benefit



Innovation types that focused on delivering a single benefit



Innovation types that focused on either sustainability, safety or community



The performance indicators used for their research analysis are Cost, Time, Quality, Safety, Environment and Community.

Graph 1 (above) shows the majority of innovations are delivering a combination of direct productivity improvement benefits such as quality, time and cost, were from Design and Method categories. As show on Graph 2 (middle), Functions and Tool categories seem to be more focused on delivering a single benefit. Graph 3 (right) shows that Tools also appear to be the most prevalent type of innovation that deliver either safety, environment or community benefits.

The study shows that different innovations would improve different set of performance indicators, thus having very different impacts on productivity. Such diversity means that the impact of the reported innovation on productivity and performance are of different levels of significance, and it is required to achieve maximised productivity performance.

Also, **when more sophisticated types of innovation such as Technology and Methods were developed, the impact was more widespread and significant**, delivering benefits along multiple dimensions of performance such as quality, time and cost. For more details on the study, please visit this [link](#).

THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

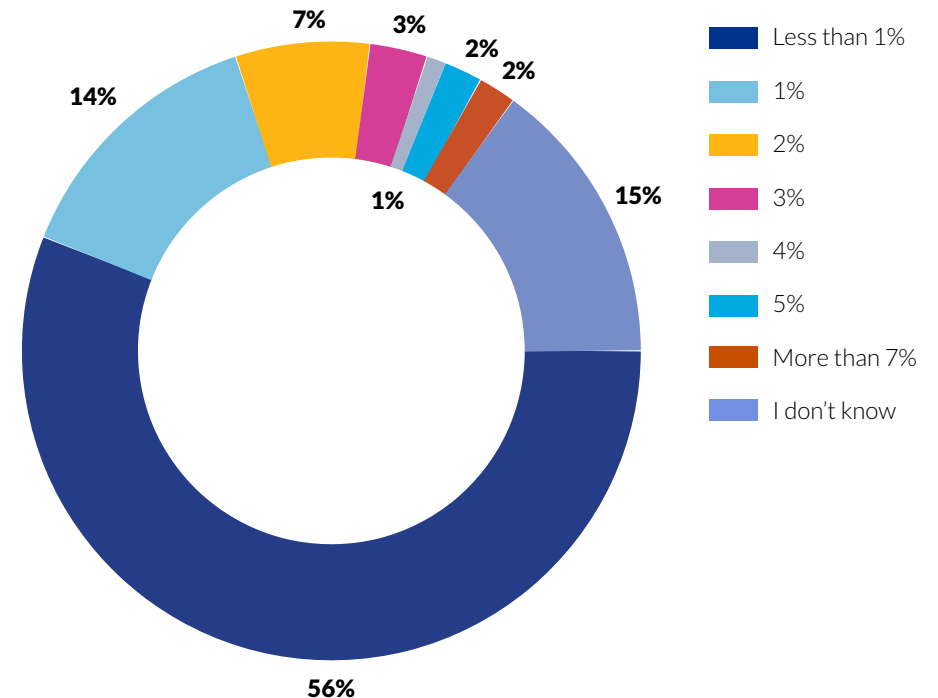
6. LOW INVESTMENT IN INFORMATION TECHNOLOGY (IT)

Of the 1,869 construction companies in the United States who responded to the [2016 Construction Technology survey](#), 56% of them spend less than 1% of corporate revenue (fees the corporation bills to projects as either profit or overhead charges) on IT. The survey found that out of 19 industries, construction allocates the least amount of revenue for technology.

The percentage of companies spending 1% or Less than 1% of annual sales volume on IT continues to grow, from 45% in 2015 to 70% in 2016.

There is a low priority in investing in IT (including cyber security) and businesses need to recognise that the process of digital transformation will affect all major areas. **Organizations that make technologies and cyber security a priority are better prepared to make important decisions that will increase their financial performance.**

Percentage of Annual Sales Volume Spent on IT in 2016



THE CONSTRUCTION SECTOR

THE SEVEN UNIQUE CHARACTERISTICS OF THE CONSTRUCTION SECTOR

7. HIGH INDUSTRY FRAGMENTATION

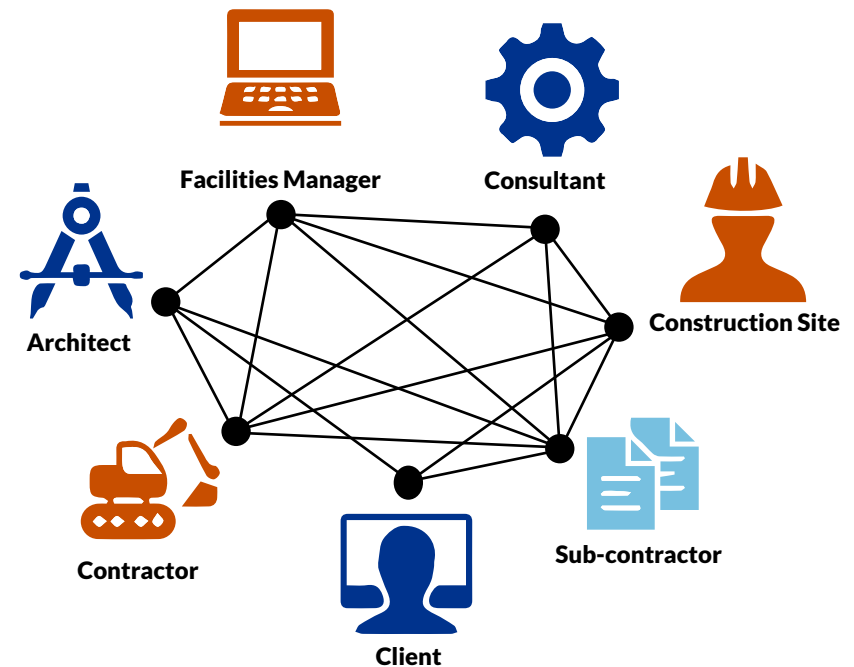
A fragmented industry is an industry in which no single enterprise has large enough share of the market to be able to influence the industry's direction.

Fragmented practices are common in construction industry due to the traditional procurement system and poor adoption of advanced technologies and approaches for construction projects. There are internal and external fragmentations. Internal fragmentation refers to the problem of integration and coordination between different alliances organizations (e.g. client, consultant). External fragmentation refers to the involvement of non-alliance organization (e.g. local authority) at different stages of the design process.

There are various reasons that caused high fragmentation. Fundamentally it is inherent in the traditional contract strategy (procurement) that is characterized by a lack of sense of identity, promoting a confrontational culture and a lack of feedback loops or coordination between the design and construction. Furthermore the design and construction process is conducted in a sequential manner and is constructed of segregated professionals (lack of interaction between contractors and designers) during the design and construction phase. The scenario often acts as an effective barrier to using the skills and knowledge of all project partners effectively in the design and planning of the project. Input from other experts e.g. consulting engineers and facility management expertise etc is extremely beneficial during the early stage of a project.

Process and team integration are key drivers of change necessary for the industry to become more successful, so is mutual consent on standards across the industry. Areas of standardisation include software systems, definition of costs, classification and measurements along the whole life cycle, and in legal arrangements contracts. Source: [Impact of Fragmentation Issue in Construction Industry](#)

"In many cases, industry standards are referred to in regulatory frameworks, either directly or indirectly, and they are sometimes incorporated into national building codes. For this reason, the industry must strive to set optimal standards ahead of regulation, so that it can shape the public agenda." Shaping the Future of Construction, World Economic Form.



Above: Illustrates the relationships between various construction stakeholders. A high level of complexity of the project increases the inefficiency for e.g repeated processes or functions and duplications due to the lack of communication and standardization that causes waste and lead times in the project cycle. This leads to extra cost to the client for non-value added activities.

DEMOGRAPHIC DISRUPTION

1. THE AGING POPULATION

- The global silver tsunami
- The land of the long 'silver' cloud
- Snapshot of our aging population
- The impact on superannuation
- Aging population and the housing market
- An aging workforce
- Employer examples

2. SUPERDIVERSITY

- Implications of superdiversity for business
- Business recommendations



THE AGEING POPULATION

THE GLOBAL SILVER TSUNAMI

The World is Getting Older

Source: [World Economic Forum - How 21st-Century Longevity Can Create Markets and Drive Economic Growth](#).

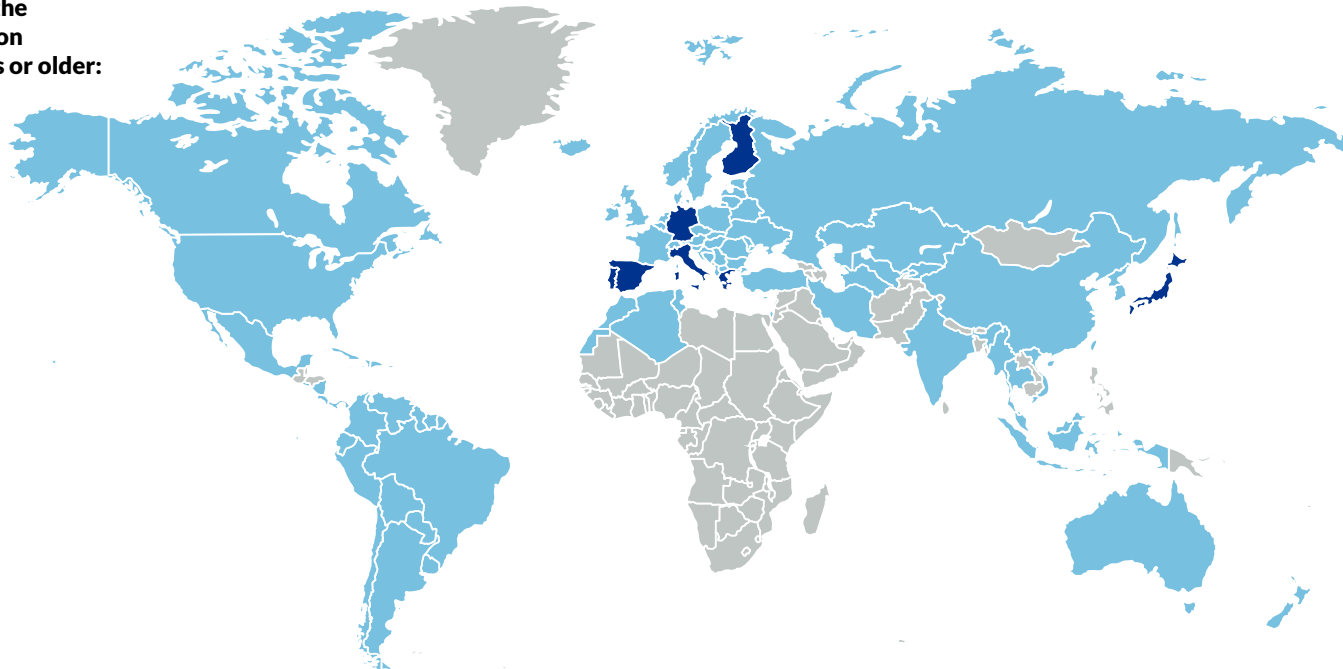
In October 2015, the World Economic Forum reported that the world will soon reach a recently unimaginable milestone in the history of humanity i.e. by mid-century (2050), there will be more people on this planet over 60 than under 15 years of age. Aging is not just a phenomenon in industrialised nations. In fact, currently emerging markets are experiencing the most dramatic impacts of aging. What took a century to unfold in Europe, Japan, and the United States is transpiring in only a few decades in China, Brazil, India, and Turkey.

Many would not have predicted that China would position aging high on the agenda of its 2016 G20 leadership. Japan has the longest life expectancy among the OECD countries, followed by Spain and Switzerland. 26.7% of Japan's population is 65 years or older. It has been proposed that the threshold for 'elderly' status in Japan to change from 65 years old to 75 years old.

Year 2025 projection by the World Health Organisation Percentage aged 60 years or older:



Map image provided
by [Freepik](#).



Redefining 'elders' will keep them who are usually still in great physical health in the workforce and contribute to the labour force and hopefully boost their economy. This proposal seems to sit well with the general population and is most welcomed by the economist, as at the current pace, it's estimated that by year 2040 the proportion will rise to 40%¹. Global experience suggests that as nations grow wealthier, their populations become less fertile. As economies develop, residents are more likely to use birth control, women have more choices, parents are less likely to regard large families as an economic necessity, and families are less likely to view having a large number of children as a hedge against high infant mortality rates.

In a recent research published in The Lancet, scientists believe that average life expectancy will hit 90 by 2030. The study predicts that life expectancy will be the highest for women in South Korea (90.8 years), followed by women in France (88.6 years) and Japan (88.4 years). South Korea's projected gains were thanks to improvements in childhood nutrition and access to healthcare and medical technology, which had been spread more fairly throughout society than in many Western countries².

¹ Business Insider Malaysia Jan 13, 2017 - [Japanese people are living so long that the country's definition of 'elderly' could change](#)

² [The Dominion Post Feb 23, 2017 - Living to 90 will be the new normal](#)

THE AGEING POPULATION

THE LAND OF THE LONG 'SILVER' CLOUD

In New Zealand, the ratio of those under the age of 15 to those over 65 was 8:1 in the year 1901. Those over the age of 65 made up just 4% of the population. We currently have 15% of population over the age of 65 and 20% under the age of 15. It was projected that by year 2050 we will have more than 25% over the age of 65 and 16% under the age of 15.

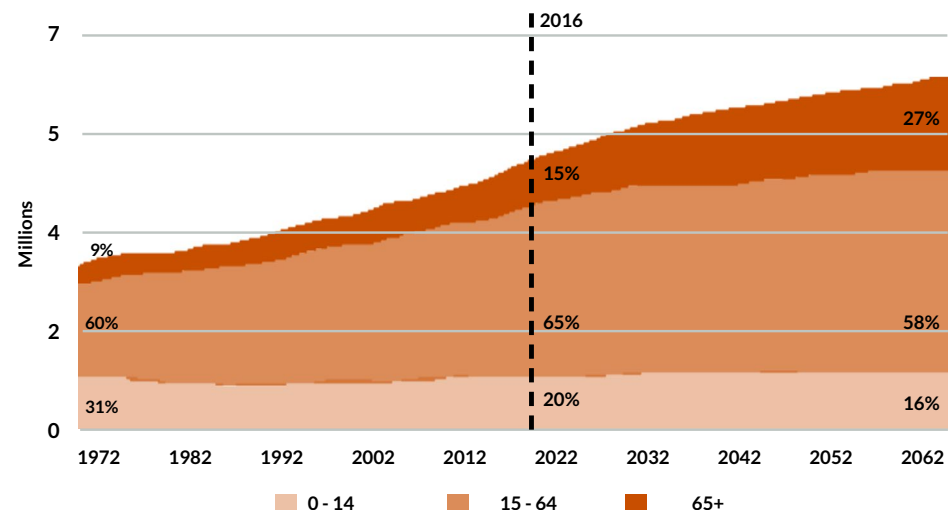
With mass modernisation and urbanisation, new-found breakthroughs in healthcare and sanitation, increase life-expectancy, coupled with plummeting birth rates, depopulation is accelerating. This results in a profound demographic reshuffling of the age structure and "growing old" has become the norm. The trend is unsustainable without significant changes to the assumptions that underpin our behavioural norm, social expectations, public finances, policies and institutions within the context of a nation with more people over 65 than under 15 years of age. Cities and communities must now become instruments to further extend healthy aging into the 80s, 90s and even 100s.

The elderly differ in their socio-demographic make-up from the rest of the population. For instance there are marked differences in sex ratio (women outlive men by 3.6 years), marital status (more widow than widower), employment (currently 22% of those aged 65+ are employed, in 2036 it's estimated the number will rise to 32%), living arrangements (women aged 85+ years are five times as likely to be living without a spouse or a partner, as men of the same age), income, geographical distribution, and spatial mobility.

Many countries are developing national strategies for their aging populations. At the national level, the main concerns are the sustainability of a taxpayer-funded superannuation, and the increased cost of providing health services for older people. At the regional and local levels there are planning implications for health-related issues, for housing and accommodation, and for the provision of aged-care, transport, and community support services³.

We currently have about 6,200 people over the age of 95.

Increasing ratio of older New Zealanders (population by age group)



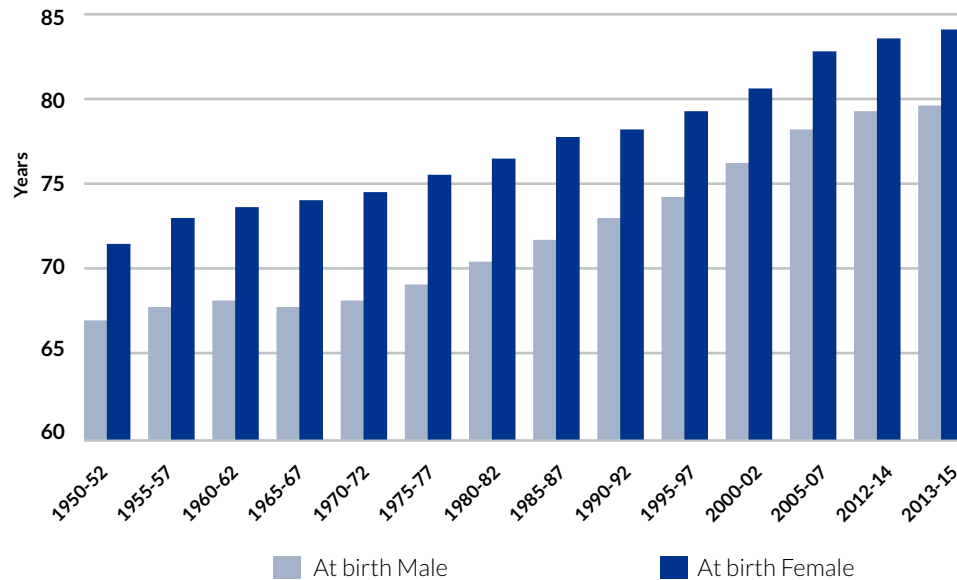
Source: [NZ Treasury He Tirohanga Makapuna: 2016 Statement on the Long-Term Fiscal Position](#)

³ Stats New Zealand - [Population aging in New Zealand](#) (article)

THE AGEING POPULATION - SNAPSHOT

Average life expectancy at birth

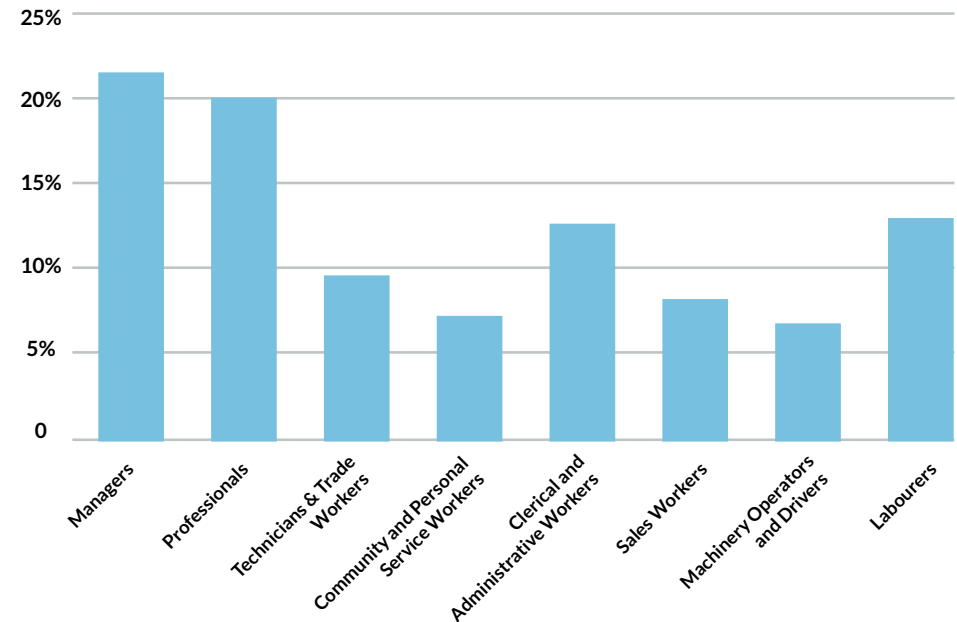
Source: [Statistics New Zealand abridged life tables for 2013-15](#)



In New Zealand, average life expectancy is increasing by about 1.3 years each decade.

Occupations of employed people over the age of 65

Source: [Statistics NZ 2013 Census Quickstats: 65 Plus Tables \(ANZSCO Major Group v.1.1\)](#)



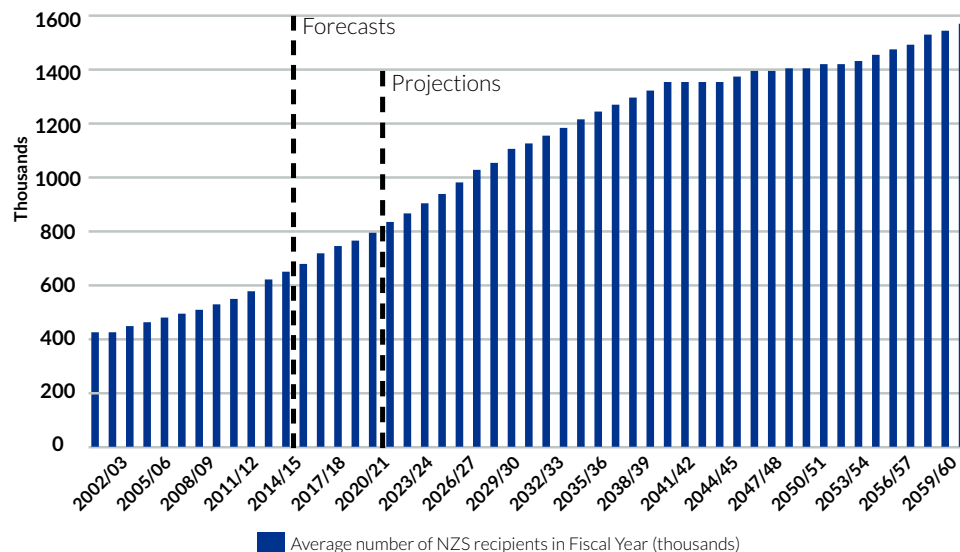
More than 40% of the working people over 65 are managers and professionals.

THE AGEING POPULATION

AND THE IMPACT ON OUR SUPERANNUATION

Annual number of NZ Super recipients

Source: [The Treasury New Zealand Superannuation Fund Contribution Rate Model \(v3.3, 2016\)](#)



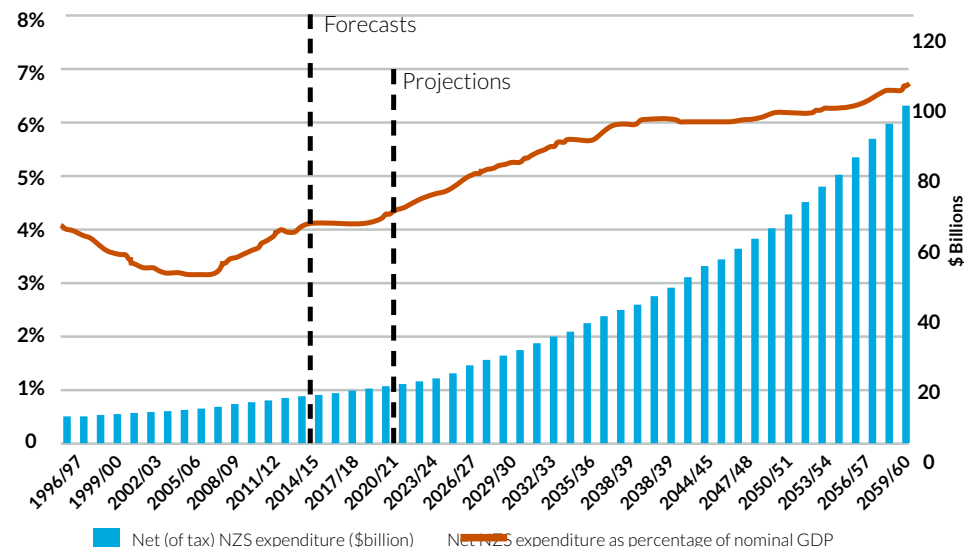
Increasing Number of NZ Super Recipients

In many countries, caring for large numbers of elderly people has and will put severe pressure on government finances. In Mar 2017, New Zealand Prime Minister Bill English has announced the age for state superannuation will rise to 67 in gradual steps starting in 20 years time. The changes will be phased in from July 2037 and will not affect anyone born before June 1972. The age would lift from the current 65 to 67 in 2040. He said the Government had a strong track record of supporting older New Zealanders. Gradually increasing the retirement age from 2037 will more fairly spread the costs and benefits of NZ Super between generations, ensure the scheme remains affordable into the future and give people time to adjust⁴.

"Eighteen OECD countries have raised the age of entitlement for super to 67, 69 and 70. More of us are living longer and there are fewer young people working relative to our retired population. The cost of NZ Super is growing faster than GDP and the time to make decisions about the future is now." Diane Maxwell, Retirement Commissioner⁵

Net NZ Super over time

Source: [The Treasury New Zealand Superannuation Fund Contribution Rate Model \(v3.3, 2016\)](#)



The Growing NZ Super Bill

In 2015, the Government used around \$11 billion (net) of taxpayer money to pay for Super. In 20 years, the number of people over 65 will have doubled and the cost will have tripled. So it will be up to almost \$40 billion (net) to pay out in Super if New Zealand had not increased superannuation age to 67.

⁴ Dominion Post Mar 7, 17 - Super age rising to 67 in steps

⁵ Stuff.co.nz Mar 6, 17 - [Your working life is two years longer](#)

In 20 years, the number of people over 65 will have doubled.

THE AGEING POPULATION

AND THE HOUSING MARKET

Auckland 'design champion' Ludo Campbell-Reid, General Manager of the Auckland Council Design Office, believes that higher density isn't just the way for Auckland, but that it would benefit the entire country. Campbell-Reid argues that New Zealand needs a paradigm shift in the way it lives. The boomers want to live near to their children and vice versa, he says, but there isn't always suitable housing available, which sometimes pushes them out of the area.

He believes **the answer is large-scale medium density housing across the country**, not building retirement housing in the middle of nowhere as has been traditionally done where older people are divorced from the community. They'd rather be in a town centre close to the opera, cinemas, restaurants, transport and other facilities. But it's not going to happen without quality medium-density housing.⁶

Retirement villages have a high capital requirement for entry and this makes retirement living unaffordable for many elderly. There is a growing need for the provision of affordable elderly housing in locations that enable them to age in place while providing access to services, amenities and community. Achieving this outcome will require councils to proactively masterplan new land supplies to ensure a range of housing typologies which enable people to transition fluidly within the same community and between different housing options as they age.⁷

How will New Zealand's aging population affect the property market?

Key trends of the future property market:

- Smaller households
- More homes and closer access to public transport
- More communal dwellings (including retirement homes)
- More homes that cater to older people's needs (see [Lifemark](#) for more information)

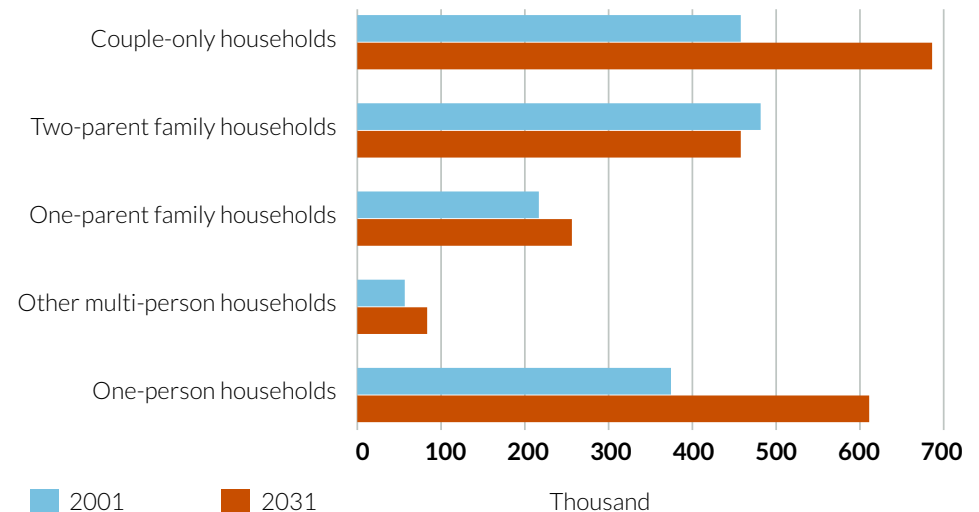
We are seeing a general trend towards fewer people in each household (or smaller average household size). This trend may have slowed in recent years, with children remaining in the family home for longer as housing has become less affordable. But the aging population will drive the future trend. Overall, the average size of households is projected to slowly decline between 2006 and 2031, from 2.6 to 2.4 people per household. The average household size is shrinking due to the increasing proportion of one-person and couple-only households. Most of the couple-only households will be empty nesters – couples reaching ages where their children have left the parental home.

⁶ Property Professional NZ – Winter 2016

⁷ [Building Affordable Elderly Housing](#) – Housing NZ April 2016

Household types 2006-31

Source: [Statistics New Zealand](#)



One-person households are projected to grow particularly fast. Under a mid-range scenario, one-person households will account for 29 percent of all households in 2031, up from 23 percent in 2006. The growth in one-person households will be mainly due to the increasing number of older people, with almost three-quarters of the growth occurring among those aged 55 years and over. Twelve percent of the total population will be living alone in 2031, compared with 9 percent in 2006.

Aging populations are necessitating new infusions of investment in social infrastructure especially in health. Growing urbanisation will boost spending for vital infrastructure sectors such as water, power, telecommunications and transportation. According to Statistics NZ, over 70% of New Zealand's population live in main urban areas, a fairly high level compared to global averages.

THE AGEING POPULATION

AN AGING WORKFORCE

Longevity and improved standards of living is one of New Zealand's greatest achievements. Just as New Zealand's population is aging, so too is our workforce. We are very unlikely to be able to fix this phenomenon by increasing immigration (adult immigrants arriving now and in the near future will themselves contribute to population aging) or by raising the birth rate (current fertility-rate is 1.99 per woman and by 2036 it is estimated to decline to 1.85 per woman), so it is crucial that we improve and develop the human capital we already have by maximising the potential of older employees. Older workers will have a profound effect on the labour market as aging will affect the size, characteristics and possibly the productivity of the New Zealand workforce. **If people in mid-life are unable to contribute to their full economic capacity due to discrimination or other reasons, then this will have serious implication: the economy is losing productivity, business is losing profits, employers are losing talents, society is losing a contribution and older people are losing self-esteem and choice.**

"Although the number working past 65 is increasing, it won't prevent a skill shortfall. In 2015, some 70,000 dropped out of the workforce on or shortly after retirement, and that's where the problem lies. With more people seeming to want to work past retirement age, the first step would be to make it easier for them to stay. Companies should be actively working on solutions to engage, motivate, challenge and retain these people. You can't buy homegrown experience, and the last thing we should be doing is turning away those who offer that." John Milford, Chief Executive of the Wellington Chamber of Commerce⁸

In response to the issues raised by an aging workforce, Wespac CEO (1990-2008) David Morgan stated: '... it is the responsibility of business, assisted by supportive public policy, to realign their workplace structures to coming realities. We should reject early retirement as an acceptable restructuring solution. We should seek more women in our workforces. We should raise participation rates in the upper age groups, and increase opportunities for retirees to work part-time. So given the future awaits us, how many companies are thinking seriously about the composition of their workforce?' ⁹

⁸Dominion Post Feb 24, 2017 – [Age-old myths hindering businesses](#).

⁹[Maximising the potential of older workers](#) – by Judith Davey, NZ Institute for Research on Aging.

¹⁰[2014 Report on the Positive Aging Strategy](#) and [The Business of Aging 2015 Update](#) by the Office for Senior Citizens

The business case for hiring older workers:

- Alleviate skills shortages – by using age to narrow the fields of applicants, organisations restrict and narrow their recruitment potential
- A vibrant and diverse workforce – a diverse workforce will be better placed to respond to the changing environment including the aging of the consumer pool and better reflects the age composition of their customers
- Retention of the experience of the older employees and protection of the corporate memory – older workers can play a vital role in training and mentoring younger workers, creating new role models and providing a stabilising influence on younger workers
- Improved management of staff – reducing staff turnover and the costs of recruitment; avoiding the loss of talented knowledgeable workers to competitors
- Higher staff morale – morale can be improved through policies and processes aimed at showing workers they are valued and that recruitment and promotion are based on performance and credentials
- Improved public image

What can employers do?

In order for older workers to maintain the skills that businesses demand, businesses may need to consider up-skilling their employees to keep pace with the changing nature of work. Employers may consider to introduce career development schemes aimed at attracting/retaining older workers, establish a share scheme for employees as part of their retaining talents effort, incorporate good health insurance as their remuneration package, provide flexible working arrangements including phased retirement, retaining older workers as mentors after they leave, offering retirement seminars, putting in place a comprehensive health & safety framework for all staff (particularly older workers). Employers can also consider to provide services and programmes to connect older and younger people and promote better understanding between age groups. ¹⁰ Employers can also advertise jobs on www.olderworkers.nz, and www.wiseones.co New Zealand's job board connecting older job seekers with age friendly employers.

Did you know?

- Older workers were viewed as overall more productive and better in a crisis, better mentors, stronger work ethics, than their younger counterparts,
- Few organisations had structures in place to reap the rewards of older workers' productivity and diversity
- At an individual level, 40% of older workers had experienced age-related discrimination in the previous 5 years (response from employees at Crown Research Institutes and District Health Boards)
- They were still looking for challenging and rewarding careers

Source: Survey conducted by NZ Office for Senior Citizens (OSC) and the Human Rights Commission in 2014

THE AGEING POPULATION

EXAMPLES OF EMPLOYERS THAT PLANNED FOR THE AGEING WORKFORCE

BMW

In 2007, BMW in Dingolfing, Germany, implemented a pilot project called “Today for Tomorrow” to improve work conditions for older workers on an assembly line and implemented 70 changes. Among the changes were:

- Replacing cement floors with wooden platforms to reduce the impact on knees
- Barbershop chairs were installed to allow workers to sit at workstations
- Orthopaedic footwear to reduce the strain on feet
- Adjustable worktables to reduce physical strain and facilitate personnel rotation during shifts
- Provide an industrial body trainer – a physiotherapist and exercise rooms

In the first year they experienced a 7% increase in productivity that rivaled that of lines staffed by younger workers, they have since reported zero defects and a reduction in absenteeism from 7% to 2%. The presence of physical trainers on the factory floor is one way BMW, the luxury German carmaker, is reinventing the assembly line to accommodate an aging workforce. From special ergonomic chairs to expansive exercise rooms, it is finding new ways to make senior workers comfortable while crafting some of the world’s most coveted cars. Now, BMW has implemented similar ideas on most of its assembly lines in Germany and around the world.

¹¹

Vector Energy New Zealand

Power company Vector Energy began planning for their aging workforce in 2012, after realising a third of their staff in the Taranaki region were older than 50. After some deeper research, it was discovered almost half of all Vector’s staff were older than 45 and the company began to wonder about what was going to happen in 10-20 years’ time. Vector group HR manager Paul McCloskey said advisory groups were set up to considering succession planning and individual meetings were set up with older employees to find out what their plan was. “It was a very sensitive situation but...most of the staff were fairly open about what their future plans were.” Apprentices were now buddied to older employees to not only assist them in more physical aspects of the work, but also to soak up the knowledge senior staff possessed. Efforts had also shifted to figuring out how to ensure older staff stayed with the company, rather than simply see them walk out the door at 65, he said.

¹¹ CS Monitor – [How BMW reinvents the factory for older workers.](#)



When the neck aches, a physiotherapist takes care of BMW mechanic Peter Peisker.
Photographer credit: [Paulus Ponizak](#).

THE AGEING POPULATION

EXAMPLES OF EMPLOYERS THAT PLANNED FOR THE AGEING WORKFORCE

ANZ banking group

The third largest bank in Australia first launched its “Age Diversity Strategy” in 2004. Its purpose was to create a workplace culture where “age is no barrier” by retaining skills and experience; actively recruiting mature age workers; better reflecting the age profile of customers and the wider community; investigating the business and customer benefits of mixed-age teams; emphasizing flexible work practices and marketing them to mature age employees; and creating an inclusive culture where experience is valued. The results within the first few years of the programme included substantial increases in the age of employee retirement and significant decreases in older worker turnover.

Deloitte

Deloitte’s Mass Career Customization (MCC) programme is a tool that enables the organisation to dial up (increase responsibilities) and dial down employees (e.g. reduce their hours of travel). The MCC framework articulates a definite, not infinite, set of options along the four core dimensions of a career – pace, workload, location/schedule and role – as well as the trade-offs associated with choices across the four, highly inter-related dimensions. In collaboration with their managers, employees periodically select options along each dimension based on their career objectives and life circumstances within the context of the needs of the business.

How are we doing?

New Zealand has one of the highest employment rates in the OECD of aged workers, with the latest figures showing 22% of workers are aged over 55. New Zealand ranked 2nd place among 34 OECD countries in how it treats older workers, only behind Iceland.

A new report from the Auckland University of Technology’s Work Research Institute, which surveyed more than 1200 workers older than 55, suggests baby boomers are a happy bunch at work. Money is not the driver, with the aging workforce more concerned about being respected and having flexible working arrangements later in life. Those surveyed reported relatively high levels of wellbeing and low levels of age discrimination, but one in four did not believe older workers were valued in their organisation and cited biases held by managers as a problem.

Equal Employment Opportunities Trust NZ chief executive Bev Cassidy-Mackenzie said Vector was in the minority, with many employers lacking plans about what would happen in the future as people got older. **Older workers were often more stable employees, committed to their employer and had huge institutional knowledge.** But they were often not utilised, especially at a management level, as younger staff saw them as a threat. These guys are not a threat, their careers are finished...they’re quite happy to pass on that knowledge but a lot of companies won’t use them because they see them as a threat, she said.¹²

¹² Sunday Star Times 20 Sep 15: [How to keep a baby boomer happy in the workplace.](#)

THE AGEING POPULATION

AS DRIVERS OF ECONOMY

The aging population as the drivers of economy

Older people are key contributors to our economy and our communities. They are skilled workers, volunteers, caregivers, mentors and leaders. They continue to make a large economic contribution as business leaders, taxpayers and consumers. With better economic futures, older adults have become conspicuous consumers and active savers. An Australian study has found almost one-fifth of Baby Boomers were traveling using their kids' inheritance. Now, a number of New Zealand baby boomers say they have similar attitudes¹³.

Notwithstanding the enormous disparities both within and between regions, the majority of the world's wealth today is concentrated in the burgeoning 60+ segment of the population. According to the US Government Consumer Expenditure Survey, baby boomers outspend other generations by approximately US\$400 billion each year on consumer goods and services. A similar overspend applies in other developed countries where large percentages of disposable income are held by the 60 and over¹⁴. It is important to ensure that there are a range of choices and opportunities to meet the diverse needs of older people in New Zealand.

¹³ Dominion Post 14 Feb 17: [Boomers spend the lot](#)

¹⁴ World Economic Forum – Aging (white paper)

SUMMARY

The concept of what it means to be aged, elderly, or old continues to evolve as we experienced improved health, well-being, and survival into increasingly older ages. An historical shift is turning global aging into a positive development on the basis of longevity, driving consumer demand for new markets and our ability to capture and retain the experienced worker. Our burgeoning older population will affect many aspects of our country and communities. This presents immense opportunities, as well as challenges. New Zealand government is paving the way by reshaping its retirement strategies to better reflect the aging of our societies.

Many companies are well on their way to showing the rest through example how to prosper and not perish. Changes will continue, whether we are ready or not. Changes in technology and care environments will doubtless have a positive impact on the care industry. The promise of strength, sustainability and prosperity is evident when we shift our perspectives and realign business strategies. Those who are ready will take advantage of the obvious trends presented and reap more than just financial rewards.

SUPERDIVERSITY

According to Statistics New Zealand's latest census from 2013, there are 213 ethnic groups represented in New Zealand.

New Zealand's defining issue through the coming decades will be, not diversity, but super-diversity. This is especially evident in Auckland, where almost 50% of the population is Maori, Asian and Pacific peoples; where 44% were not born in New Zealand; and where there are over 200 ethnicities, and 160 languages spoken.

By 2038, on Statistics NZ projections, 51% of New Zealanders will be Asian, Maori and Pasifika, although 66% will still identify as European due to New Zealanders with multiple ethnicities. New Zealand's super-diversity has reached a critical mass; never before has New Zealand had living here such a large number of people who were not born here.

Aucklandy city is the fourth most diverse city in the world, behind Dubai, Brussels, and Toronto.

Source: [Examining Super-diversity on a global scale by Massey University](#)
Icons provided by [Icons8](#)

Diversity and demographic changes in New Zealand



The number of people aged over 65 will double by 2031 to reach 120,000.



Immigration levels are at an all time high with the two largest groups coming from China and India.



Nearly a quarter of those living in Auckland are Asian.



Over a quarter of New Zealanders were born in another country.



By 2020 the Asian population will overtake the Maori population in size.



Over the next 20 years New Zealand's population is estimated to reach 5 million, with 2 million of those people living in Auckland.



The average household income is 15.7% higher in Auckland compared with regions like the Hawke's Bay and Taranaki.



With an increase in aging, and a decrease in fertility, 2025 will have a ratio of 64 dependents for every 100 people in work.



Children born in 2014 have a life expectancy of 94 for females and 91 for males.



21% of over 65's work well into their 70s.

SUPERDIVERSITY

2013 CENSUS TO 2038 (PROJECTION)

2013 Census —————> 2038 (Projection)

New Zealand

- European 74% —————> 66%
- Maori 15% —————> 20%
- Pacific 7% —————> 11%
- Asian 12% —————> 21%
- Other 3%

Auckland

- European 59% —————> 47%
- Maori 11% —————> 13%
- Pacific 15% —————> 18%
- Asian 23% —————> 34%
- Other 3%

New Zealand: Median Age

- European: 41 years old —————> 44 years old
- Maori: 24 years old —————> 28 years old
- Pacific: 22 years old —————> 26 years old
- Asian: 31 years old —————> 37 years old
- Total: 38 years old —————> 42 years old

The projections also indicate:

- The Maori, Asian, and Pacific populations will continue to grow faster than New Zealand's population overall, so will increase their share of the total population.
- The number of people identifying with Asian ethnicities is likely to exceed the number identifying with the Maori ethnicity from the mid-2020s.
- All four ethnic populations will age, with increasing numbers and proportions of their populations at the older ages.
- Auckland is projected to be home to almost 40% of the country's total population in 2038 compared with 34% in 2013.
- Hamilton will be one of the most diverse cities by 2038, with 28% Maori, 23% Asian and 10% Pacific population.
- Wellington will see the Asian population rise from 9% in 1996 to 24% in 2038.
- Porirua city is projected to have the highest proportion of Pacific population in 2038 at 31% amongst territorial authorities.
- Maori and Pacific population growth will be mainly driven by their high rates of birth and natural increase (births minus deaths). During 2012–14, their total fertility rates were 2.5 and 2.7 births per woman, respectively. By comparison, the 'European or Other' and Asian rates were 1.9 and 1.7 births per woman, respectively.

All ethnic populations are aging.

- The projections indicate with relative certainty that all four ethnic populations will gradually age over the coming decades.
- However, the Maori and Pacific populations will continue to have a much younger age structure than the total New Zealand population because of their higher birth rates.
- The Asian population will also continue to have a younger age structure than the overall New Zealand population, mainly due to immigration (which is concentrated in ages 14–29 years).
- The 'European or Other' population will age further, with the median age rising from 41 years in 2013 to 44 years in 2038.

SUPERDIVERSITY

IMPLICATIONS OF SUPERDIVERSITY FOR BUSINESS

An extract from [Superdiversity Stocktake](#) [Summary of Findings] by Mai Chen.

Superdiversity means that there is no “business as usual” for organisations if they want to keep winning great customers and staff.

Business needs government to keep social capital high so that it can sustain high financial capital. International students, tourists, and skilled and business investor migrants will not be attracted to New Zealand if there is significant discrimination and hostility towards foreigners.

Businesses are conscious of diversity, but their focus is limited to gender. The available data indicates that there is poor ethnic representation in senior management and on boards, and few companies have an ethnic diversity policy or initiatives in place.

New Zealand benefits from greater access to foreign capital, foreign markets, international students and high tourist numbers. However, in order to capitalise on the diversity dividend, businesses need first to address challenges such as discrimination in recruitment and in the course of employment.

We need to increase the business interface between Maori and ethnic minorities and migrants. Maori businesses have already benefited from increased trade with Asia, but there remains huge potential for growth. Deeper business relations between Asians and Maori will contribute to improved social capital between these two groups, and to the socio-economic position of Maori in New Zealand, which will benefit New Zealand as a whole.

Super-diversity is a New Zealand-wide phenomenon, especially with the Government’s recently announced immigration policies, which allocate extra bonus points to migrants who work or settle outside Auckland and allow foreign rural workers to gain permanent residence.

The diversity dividend. Diverse employees can bring benefits to businesses, including:

- i. Access to a wider, diverse customer base*
- ii. Innovation*
- iii. Greater export potential*
- iv. Migrant employees can be loyal, hardworking and willing to do jobs that New Zealanders will not do.*

SUPERDIVERSITY

RECOMMENDATIONS FOR BUSINESS

List of Recommendations for Business

[excerpt from [Superdiversity Stocktake](#) by Mai Chen]

1. Businesses should consider adopting the following measures to develop sufficient internal capability to adapt to an increasingly diverse workforce:
 - Regular collection and monitoring of ethno-specific data on the composition of the workforce and the business's client or customer base
 - Workplace policies and practices should be informed by and developed in accordance with this data.
 - A diversity strategy should be developed (in addition to an anti-discrimination policy), where appropriate, to promote ethnic equality, diversity and inclusion in the work-place, in consultation with relevant internal and external stakeholders.
2. To communicate with, and access, ethnic markets, businesses should consider implementing the following measures:
 - Recruiting for cultural intelligence and language ability. Ethnic customers may feel more comfortable dealing with people similar to them, who speak the same language;
 - Providing cultural intelligence training for employees;
 - Translating print and online material into other languages and/or basic English; and
 - Making use of ethnic media outlets, and companies with expertise in diverse communications.
3. More assistance and education need to be provided to Kiwis doing business with migrants to help them recognise the cultural differences in business practice, communication and values. In turn, migrants to New Zealand should receive more information on New Zealand's business culture.
4. More people from diverse backgrounds should be encouraged to train as mediators, and all mediators would benefit from training in cultural intelligence given the likely increase in disputes exacerbated by cultural misunderstanding with New Zealand's growing super-diversity.
5. Organisations such as Te Puni Kokiri, the Office of Ethnic Communities, New Zealand Trade and Enterprise and the Ministry of Business, Innovation and Employment need to encourage Maori and Asian companies to do business together and to help reduce any cultural gulf which may impede or undermine business deals.
6. Government agencies such as the Office of Ethnic Communities within the Department of Internal Affairs and the Ministry of Business, Innovation and Employment should publish information about the value of diversity for business, and should increase initiatives such as conferences and knowledge workshops to encourage interface between ethnic and mainstream businesses as New Zealand's super-diversity grows.

SUMMARY

The depth of cultural understanding needs to improve to unlock this dividend for New Zealand companies. Local businesses shouldn't forget about the significant human capital, spend and incremental revenue that the local NZ non-European community offers. Organisations serious about growth need to recognise the importance of cultural diversity, acknowledge that goods and services (including home design) can be significantly different for different ethnicities. The impact of cultural diversity on business communication has widespread implications--from corporate boardrooms to employee break-rooms--and business owners can benefit from gaining an understanding of the eccentricities of all cultures to which they are exposed.

Managers today must take the time to study the cultural eccentricities of their business counterparts before attempting to make contact with people in other countries or from other subcultures. Verbal communication and body language are more important than ever in international business dealings because innocent hand gestures, mannerisms or even posture can cause a rift between culturally diverse business partners. Reciprocity in business relationships is highly valued. Understanding the subtle nuances of different cultures could go a long way in forging rewarding business relationships.

INNOVATIVE DISRUPTION

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1. FROM RESISTANCE TO ADAPTATION

- ## 1. FROM RESISTANCE TO ADAPTATION

2. CONSULTANTS AND ENGINEERS IN THE FOURTH INDUSTRIAL REVOLUTION

- ## 2. CONSULTANTS AND ENGINEERS IN THE FOURTH INDUSTRIAL REVOLUTION

INNOVATIVE DISRUPTION

RESISTANCE TO INNOVATION IS LITTERED THROUGHOUT HISTORY

Disruption happens when a new invention not only creates a new market for itself, but that market takes over (and destroys) earlier, existing markets for similar technologies.

A review of human history reveals that innovative disruption happens since the beginning of humankind. For thousands of years, beginning around 10,000 BC in the Middle East, humankind embarked upon its first disruptive revolution. Until that point, humans had roamed the earth in hunter-gatherer societies, foraging for food. When ancient humans discovered farming, and began settling permanently, in one place, advancements in agricultural technology led to a surplus food supply, which in turn, led to surplus time. The result was unprecedented innovation, and explosive technological, economic and social development — hallmarks of recorded history.

Example: Flexible Glass – the Romans

Around 20 AD a craftsman brought a drinking bowl made of flexible glass before Roman Emperor Tiberius Caesar who threw it to the floor, whereupon the material dented, rather than shattering. The inventor then repaired the bowl easily with a small hammer. After the inventor swore to the Emperor that he alone knew the technique of manufacture, Tiberius had the man beheaded, fearing such material could undermine the value of gold and silver and collapse the economy. “Flexible glass” or “vitrum flexile” was lost for almost 2,000 years, appearing sometime in the last one hundred years. Thus, a single power holder, fearful for his immediate wealth, single-handedly suppressed an innovation for millennia.

Example: Stockings knitting machine – the English

In the late 16th century, an English clergyman named William Lee invented a machine for knitting stockings – a wonderful advance, he believe, because it would liberate hand knitters from their drudgery. When he demonstrated it to Queen Elizabeth I in 1590 or so and asked for a patent, she reportedly replied, “Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring them to ruin by depriving them of employment, thus making them beggars.” After the royal slap down, the queen denied his patent, the hosiers’ guild campaigned against him, and he was forced to move to France, where he died of poverty.¹⁵

¹⁵Humans are underrated – Geoff Colvin

Example: FM Radio – the American

FM radio, technically superior to its AM counterpart, was originally developed in the US by Edward Armstrong in 1936, who worked closely with David Sarnoff, the CEO of the Radio Corporation of America (RCA). When Armstrong proposed that the RCA adopt FM radio, Sarnoff scoffed, which led Armstrong to start his own business geared at selling FM radios. Sarnoff, personally invested in the continued dominance of AM, lobbied the Federal Communications Commission to change the frequency on which FM was broadcast, after Armstrong had successfully sold 500,000 units.

This move was ostensibly to free up room on the spectrum for new FM stations. Although they could be retroactively fitted with new adapters, most FM radios became obsolete, as the cost of replacement was too high for the fledgling FM industry. Consequently, the development of FM radio was set back for at least three decades. When Armstrong took Sarnoff to court over the matter, Sarnoff unleashed the substantial legal power at his disposal, leaving Armstrong destitute.

After years of fighting and losing, Armstrong committed suicide. Although FM eventually entered into the American mainstream, enjoying a considerable golden age in the 1970s, its advancement was considerably delayed by Sarnoff’s resistance. By the end of the 1970s, 50.1% of radio listeners were tuned to FM, ending AM’s historical prevalence. By 1982, FM commanded 70% of the global audience and 84% among the 12- to 24-year-old demographic.

Source: [Disruptive Competition Project](#).



Photo L to R: The first [stocking frame machine](#) invented by William Lee in 1589. Armstrong and his new wife Esther in Palm Beach in 1923. The radio is a portable superheterodyne that Armstrong built as a present for her.

INNOVATIVE DISRUPTION - RESISTANCE

RESISTANCE TO INNOVATION IS LITTERED THROUGHOUT HISTORY

Example: The suppression of Cotton – the English and French

In the 18th century, England was famous for its woollen and worsted cloth. That industry, centred in the east and south in towns such as Norwich, jealously protected their product. Cotton processing was tiny with very little cotton imported into England. This was due to commercial legislation to protect the woollen industry. Cheap calico prints, imported by the East India Company from India, had become popular.

In 1700 an Act of Parliament passed to prevent the importation of dyed or printed calicoes from India, China or Persia. However Lancashire businessmen produced undyed and unprinted calico cloth with cotton weft. Hence in 1720, the cottonwool import recovered and the woollen manufacturers, in true protectionist fashion, claimed that the imports were taking jobs away from workers in Coventry. A new law passed, enacting fines against anyone caught wearing printed calico muslins.

The French government, in their suppression of Calico cloth, went further still. This new cloth changed the economic landscape in France, as eager consumers demanded the new cloth, importing it in droves. However, the artisan weavers grew concerned over their new competition, and, rather than innovating themselves, asked the government to clamp down on printed cloth, claiming it would “destroy the French economy.” The government complied, banning printed-cloth for decades, and executing dissenters. The struggle to rid France of Calico cloth, 16,000 people were killed between executions and armed revolt.

A paper commissioned by the London School of Economics asserts that the French had possessed the potential to become global leaders in the textile industry, but the ban on printed cloth severely inhibited that industry’s development. Thus, by complying with the demands of incumbent cloth weavers, France not only hampered consumers, but set back their economic development.

Did You Know? How long did it take to reach 50 million users?

Telephone	75 years	Facebook	2 years
Radio	38 years	Twitter	9 months
TV	13 years	Angry Birds	35 days
Internet	4 years	Pokemon	19 days

Example: Charlie Chaplin

Chaplin agonised over his future in a new world of film sound. Cinema’s new era took its toll on his confidence. Astonishingly, he even contemplated giving it all up to become a British MP. He recalled, “I was obsessed by a depressing fear of being old-fashioned.” He resisted talkies for almost a decade, but he slowly adapted his style to accommodate vocals. It was only in 1940 that he made his first talkie, *The Great Dictator*, his masterpiece satirising Hitler. The film’s climax features a speech, delivered by Chaplin dressed as Hitler, now dubbed one of the greatest in film history. Chaplin not only adapted to talkies; he mastered them.

*“The aeroplane and the radio have brought us closer together. The very nature of these inventions cries out for the goodness in men - cries out for universal brotherhood - for the unity of us all. Even now my voice is reaching millions throughout the world - millions of despairing men, women, and little children - victims of a system that makes men torture and imprison innocent people. To those who can hear me, I say - do not despair.” Extract from *The Great Dictator* speech.*¹⁶

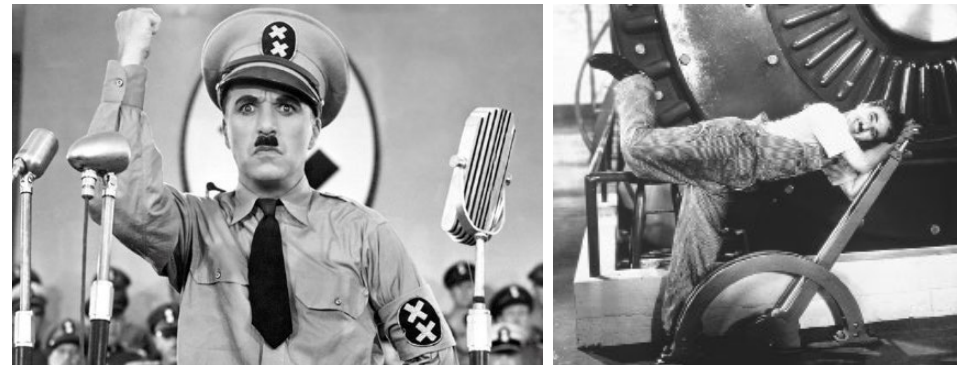


Photo credit: IMDB - Charlie Chaplin in [The Great Dictator](#) and [Modern Times](#).¹⁶ [Please visit here for a full transcript of this speech.](#)

INNOVATIVE DISRUPTION - ADAPTATION

Patents are usually the most preferred IP rights in relation to technological innovations. Patents are also used as a measure of output of innovation and can give us a reasonable guide to the pace and direction of technological advance in industry.

Patents for capital goods in Britain, 1750-99						
Type of invention	1750-9	1760-9	1770-9	1780-9	1790-9	Total
Power sources	10	21	17	47	74	169
Textile machinery	5	6	19	23	53	106
Subtotal	15	27	36	70	127	275
Agricultural equipment	1	3	5	22	27	58
Brewing equipment	0	1	2	4	17	24
Machine tools	1	4	1	2	3	11
Salt making equipment	2	3	2	1	2	10
Sugar making equipment	0	1	7	1	1	10
General chemical equipment	0	3	2	9	9	23
Building tools and machinery	1	2	4	2	5	14
Mining machinery	1	5	3	7	5	21
Metallurgical equipment	6	9	11	18	19	63
Shipbuilding	4	14	7	17	37	79
Canal and road building	2	1	1	2	24	30
Other industrial	1	5	11	13	18	48
Total	34	78	92	168	294	666
% of all patents	37.0	38.0	31.3	35.2	45.2	38.3

Source: Derived from MacLeod 1988; 148.

The table shows the number of patents for capital goods being patented in Britain over a span of six decades. The fastest growing categories were power sources, pumps (including James Watt's steam engine being patented in 1775) and textile machinery. A sustained rise in patenting from 1750 is visible, and the rise is especially strong in the last decade of the 18th century. In the same time path, strong growth can be seen in other sector including patent of agricultural equipment, brewing equipment, shipbuilding, canals, building equipment and metallurgical equipment, all suggesting not just technological advancement, but the adaptation to it.

Source: [The Cambridge Economic History of Modern Britain](#) published by Cambridge University Press 2004.

Did You Know? The 'disruptors' are also adapting...

Founded in 1999, Alibaba runs the world's largest online and mobile marketplaces in retail and wholesale trade. Its US\$25-billion initial public offering in New York in 2014 was the biggest stock market flotation in history.

E-commerce has cannibalised brick-and-mortar sales in several retail categories, jeopardising many chain stores' sales growth. But this doesn't mean mall development is slowing in the short term. Rather, shopping centres are adapting what they offer to accommodate the rise of e-commerce. The shopping centres of the future will contain the things you can't get online: food & beverage, entertainment, and concept and experience stores. Alibaba wants to serve 2 billion consumers and create 100 million jobs over next 20 years, says Jack Ma, the executive chairman at Alibaba. In January 2017, Ma made a statement after meeting with US President Trump, "Alibaba will create 1 million U.S. jobs by enabling 1 million American small businesses and farmers to sell American goods to China and Asian consumers on the Alibaba platform". In fact, Ma pointed out that pure e-commerce players will soon face tremendous challenge. "This is why we are adapting.

Over the next 30 years, with computing power as the new 'technology breakthrough' and data as the new 'natural resource', the landscape of retail, financial services, manufacturing and entertainment will be transformed."

INNOVATIVE DISRUPTION

SUMMARY

Historically, the trend is clear. Incumbents take advantage of regulatory structures to keep out potentially disruptive rivals. New inventions, when they do emerge, are cheaper, more-consumer friendly and often springboard other innovations. In that light, regulators ought to recognise the advantages disruptive technologies confer on the economy, and adapt accordingly. While the rate of technological expansion sometimes raises challenges, the opportunities for economic expansion and furthering the public interest are immense.

Innovation will come, whether or not the industry is ready for it. With strategy, research, agility, and appropriate business models, New Zealand can meet the challenges of disruptive innovation with confidence. New Zealand needs the construction industry to build high quality, sustainable buildings to house and sustain people and businesses reducing social costs. To do that, the industry needs to be open and agile – able to predict and quickly respond to change.¹⁷

¹⁷ [“When did disruption become a good thing?”](#) - Branz

INNOVATIVE DISRUPTION

ENGINEERING CONSULTANCY IN THE FOURTH INDUSTRIAL REVOLUTION

While industrial revolutions catalysed by steam-powered mechanisation, mass production, and then computing have caused social and economic disruption, in time and overall they have generated growth and jobs. Now, the 'fourth industrial revolution' may be different in a way that has profound implications for all workers including professionals like consultants and engineers. "Is my job at risk?" It's a question many people are asking, not just low-skilled workers but also professionals, young and old.

Risks to consultants and engineers in the built and natural environment

Undoubtedly, advances in technology will create exciting opportunities. But analysis reveals a web of interconnected risks including, for example:

- commoditisation of services through automation of rule-based activities like detailed design;
- loss of clients through outsourcings of whole sections of the value chain;
- failure to secure essential talent in key service areas; and
- failure to manage the leadership challenge of understanding and navigating the complex transitional landscape.

Source: Innervise.com.au: [Fourth industrial revolution challenges engineering executives](#).

Maintaining competitive advantage

For the executives and directors of consulting engineering firms this presents a real, immediate and significant strategic challenge. Not only must they face questions about mix of clients and capabilities, but increasingly who their clients and competitors are, and what this means for viable business models. Current investments in service and capability innovation need to be carefully reviewed in this light.

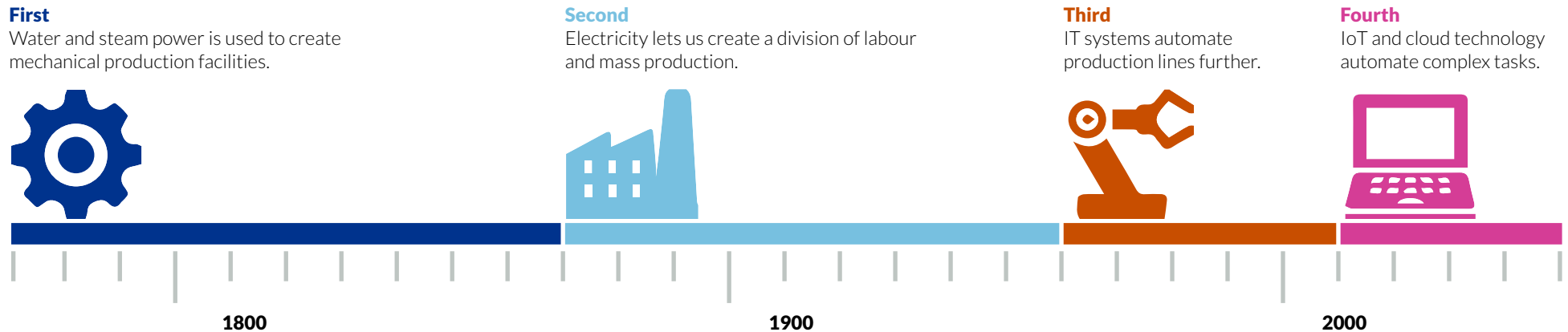
What actions should consulting engineers take to survive and thrive? Clearly the actions must differ, tailored to the particular circumstances of each firm. Yet a common thread is likely to include:

1. Up-skilling of leaders in the C-suite and boardroom to ensure they are equipped to lead and navigate change.
2. Modernising sector-specific client strategies recognising that the traditional strategy playbook doesn't fit so neatly any more.
3. De-cluttering businesses to improve efficiency and ensure human and financial capital is focused externally on clients, networks and capability in a risk-adjusted portfolio.
4. Establishing a customer-focused innovation portfolio with a strong focus on practical application of ideas.

As consultants and engineers in the built and natural environment, we may be on the cusp of one of the most exciting times. Those with an appetite to engage with risk will revel; others will want to flee. It's an environment in which boards of directors must engage more closely and constructively with executives to chart and sustain a robust course. Early movers are likely to gain a distinct advantage.

INNOVATIVE DISRUPTION

THE INDUSTRIAL REVOLUTION TIMELINE



Industrial Revolution	1st	2nd	3rd	4th
Period	1760-1850	1850-1914 (Start of WWI)	1990-2013	Today
Important Inventions	Watt steam engine, textiles, iron making.	Telegraph, railroads, large-scale steel and iron production, assembly line.	Internet, WiFi, smart phones, 3D printing.	Artificial intelligence (Ai), virtual reality (VR), augmented reality (AR), internet of things (IoT), bitcoin, blockchain.
Who gets hurt?	The rise of industrial technology devalued the skills of artisans, who handcrafted their products from beginning to end. However less skilled workers were in demand. They could easily learn to use the new machines – the workers and machines were complements – and so the workers could earn far more than before.	Widely available electricity enabled the building of far more sophisticated factories, requiring better educated, more highly skilled workers to operate the more complicated machines; companies also grew much larger, requiring larger corps of educated managers. Now the unskilled were jeopardized, and educated workers were in demand – but that was okay, because unskilled could get educated. As long as workers could keep up with the increasing demands of technology, the two remained complements. The result was an economic miracle of fast-rising living standards.	Information technology had developed to a point where it could take over many medium-skilled jobs – bookkeeping, back office jobs, repetitive factory work. The number of jobs in those categories diminished, and wages stagnated for the shrinking group of workers who still did them. At both ends of the skill spectrum, people in high-skill jobs and low-skill service jobs did much better. The number of jobs in those categories increased, and pay went up. Economists called it the polarization of the labour market.	Infotech is taking over tasks at the high-skill end of the job spectrum – lawyers, doctors, managers, professors etc. These jobs are highly cognitive, and that’s just what computers do best; they needed only time to accumulate the required computing power. Not only that, infotech is also penetrating the low-skill end of the job spectrum – where the work is less cognitive and more physical.

Icons provided by [Icons 8](#)

INNOVATIVE DISRUPTION

ENGINEERING CONSULTANCY IN THE FOURTH INDUSTRIAL REVOLUTION

We're now at the beginning of the fourth industrial revolution.

We're starting to see robots powered by AI taking over highly cognitive and less cognitive jobs. For example, autonomous cars are threatening the livelihood of truck and taxi drivers (not surprising as 40% of fatalities are due to drink driving). A robot can pack and unpack boxes, take items to or from a conveyor belt, fold a T-shirt, carry things around, count them, inspect them, buzzing through hospital hallways delivering medicines, hauling laundry, picking up infectious waste, go into wreckage of Japan's ruined Fukushima Daiichi nuclear power plant, dispose bombs in dangerous places and many more.

In Japan, robots are quickly evolving to perform the functions of butlers, home health-care aides, and companions. Combining robotic hardware known as WAM (whole arm manipulator), robotic arms can help people in and out of their jackets, shirts and pajamas. Robovie-R3 (right) launched in 2010 and Robovie II (far right) launched in 2009, shuffle alongside mall shoppers at speeds up to 1.5 miles per hour, take the hand of elderly users as they navigate through crowds, and tote shopping baskets – all without demanding to stop for coffee.

“Chief financial officers (CFOs) should be very worried. What’s to come over the next 10 to 15 years is extremely different. We were in the last three or so years of the 20-year structured era, but the unstructured era would significantly accelerate automation over the next 20 years. Put simply, many of the roles of the CFO would be automated: all their knowledge, processes, would be captured by cognitive systems. There is nothing in the role of the CFO that will not be captured by cognitive systems or that cannot be automated.” Marie Johnson, Chief Digital Officer of the Centre for Digital Business¹⁸.

¹⁸Sunday Star Times Feb 26, 2017 – CFOs should be worried



Photo credit left to right: [Hiroshi Ota and Minako Inoue with Momoko, a Robovie R3 robot, in Oriza Hirata's "I, Worker."](#)
[Photo by Julie Lemberger and Robovie II.](#)

INNOVATIVE DISRUPTION

DID YOU KNOW?

The Luddites - The Luddites were a group of English (UK) textile workers and self-employed weavers in the 19th century that used the destruction of machinery as a form of protest. The Luddite movement emerged during the harsh economic climate of the Napoleonic Wars, which saw a rise of difficult working conditions in the new textile factories. The movement is said to be named after [Ned Ludd](#), a young apprentice who allegedly smashed two stocking frames in 1779. Before an attack, they'd send a letter to manufacturers, warning them to stop using their "obnoxious frames" or face destruction. In 1882, factory owners and parliament began to fight back and winning. Picture (RIGHT) shows an 1812 handbill sought information about the armed men who destroyed five machines (The National Archives, UK). **Maybe the Luddites aren't wrong anymore?**

Desk Set - In Desk Set (1957), Ms Watson (Katherine Hepburn) is in charge of its reference library, which is responsible for researching facts and answering questions on all manners of topics. To help the employees cope with the extra workload, the network has ordered two computers invented by Sumner (Spencer Tracy). Sumner explained, "The purpose of this machine, is to free the worker from the routine and repetitive tasks and liberate him time for more important work". When the employees find out the computers are coming, they jump to the conclusion that they are being replaced. "I hear thousands of people are losing their jobs to these electronic brains," one of them says. Their fears seem to be confirmed when everyone on the staff receives a pink slip printed out by the new payroll computer. Fortunately it turns out to be a mistake; the machine fired everybody in the company, including the president. Ms Watson is exactly the human predecessor of today's Watson cognitive computing system. Watson is an IBM supercomputer that combines artificial intelligence and sophisticated analytical software for optimal performance. It is named after IBM's founder Thomas J. Watson. IBM was also the sponsor of the movie Desk Set. **Are the names a coincidence?** Even in 1957 the idea was clear; the technology just wasn't ready.

The Imitation Game - The Imitation Game is based on the biography of Alan Turing. Turing is widely considered to be the father of theoretical computer science and artificial intelligence. In 1950, he proposed an experiment that became known as the Turing test, an attempt to define a standard for a machine to be called "intelligent". The idea was that a computer could be said to "think" if a human interrogator could not tell it apart from a human being, through conversation. He suggested that rather than building a program to simulate the adult mind, it would be better rather to produce a simpler one to simulate a child's mind and then to subject it to a course of education. His Turing test was a significant, characteristically provocative and lasting contribution to the debate regarding artificial intelligence, which continues after more than half a century. On 8 June 1954, Turing's housekeeper found him dead with an apple lay half-eaten beside his bed. The logo of Apple Inc. is often erroneously referred to as a tribute to Alan Turing, with the bite mark a reference to his death. However both the logo designer and the company deny any homage to Turing.

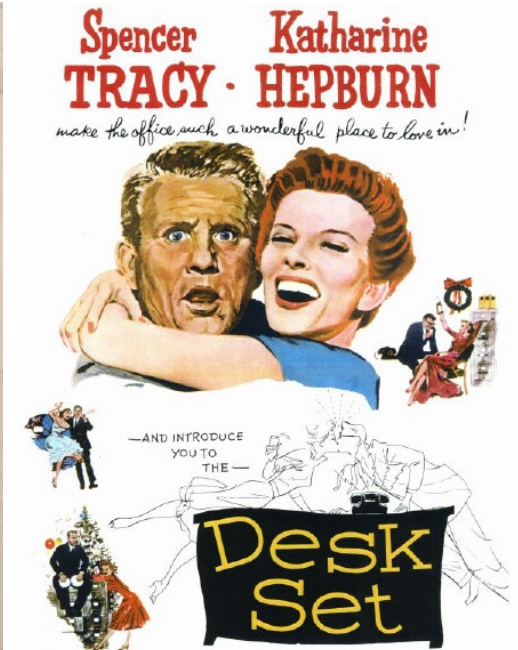
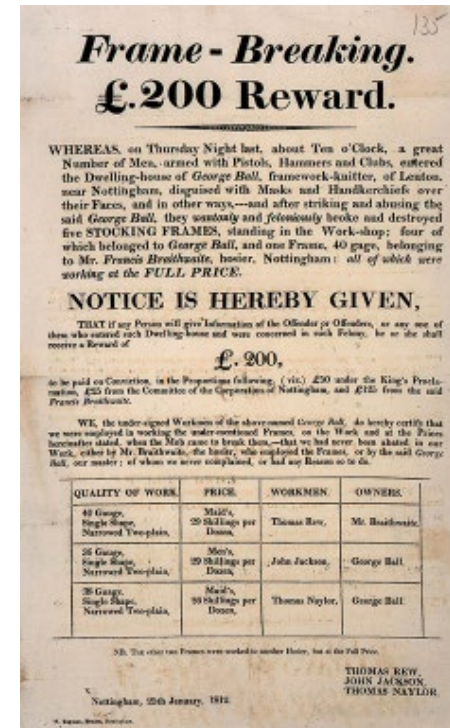


Photo credit: [An 1812 handbill sought information about the armed men who destroyed five Luddite machines](#), [Desk Set movie poster](#), and [Alan Turing](#).

INNOVATIVE DISRUPTION

COMPUTERS ARE IMPROVING FASTER THAN WE ARE - GLOBAL EXAMPLES

Example: Lawyers

At the top end, what's happening to lawyers is a model for any occupation involving analysis, subtle interpretation, strategising, and persuasion. In cases around the world computers are reading millions of documents and sorting them for relevance without ever getting tired or distracted. Law firm Baker & Hostetler has hired Ross, the world's first artificial intelligent (AI) attorney built on IBM's Watson. The cost savings are extraordinary. It was predicted that one AI lawyer can do the work of 500 or more lawyers. In addition, software can detect patterns in millions of documents that no human could spot – unusual editing of a document, for example, or spikes in communication, or even changes in e-mail style that may signal hidden motives. None of this means lawyers will disappear, but it suggests that the world will need fewer of them.



Example: Financial Advisors

Hedgeable, an U.S. based financial services company has started using Katana, an AI financial adviser, serving their high-net-worth clients. Katana focuses on client accounts with a minimum of \$1 million to analyse their securities, aggregate all of their financial data, create tax efficient transfers, apply automated downside protection on any current holdings, and perform tax efficient trading and tax-loss harvesting. Below, is Katana...Hedgeable's tax samurai.



Example: Insurance Workers

In Jan 2017, 34 insurance workers at a Japanese insurance company are being laid off and replaced with an artificial intelligence (AI) system. Fukoku Mutual Life Insurance, seeking greater efficiency in calculating their payouts to policyholders, will soon replace many of its office workers with an AI system based on IBM's Watson Explorer. Fukoku Mutual Life Insurance stated that they expect an increase in productivity by 30%.

Example: Surgeons

Medicine is also an excellent field for such technology. Autonomous surgical robots will perform surgical procedures all by themselves. They have eyes far sharper than any human's eyes, brains that can hold far more of the latest research than any human brain could absorb, and "hands" that are steadier, surer, more precise than any human's hands. The Smart Tissue Autonomous Robot (STAR) successfully stitched up a pig's small intestines using its own vision, tools and intelligence to carry out the procedure and did a better job than human surgeons who were given the same task. Robots now assist surgeons in 80% of prostatectomies in the US. These surgeries are minimally invasive, requiring much less cutting and shorter recovery times.

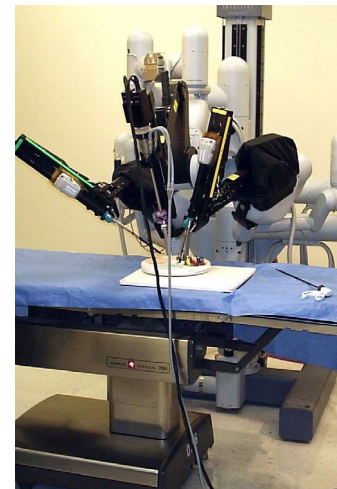


Photo credit: Laparoscopic robot by [Nimur at the English language Wikipedia, CC BY-SA 3.0](#). The Smart Tissue Autonomous Robot (STAR) can [autonomously perform 60 percent of bowel anastomosis on pig intestines](#). Photo by Children's National Medical Center

INNOVATIVE DISRUPTION

COMPUTERS ARE IMPROVING FASTER THAN WE ARE - KIWI EXAMPLES

Example: Alliance Group

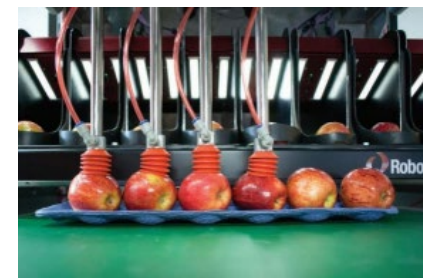
Leading meat processor and exporter Alliance Group is to invest \$10.6 million in advanced technology at its Dannevirke plant as the company focuses on exploring innovations in the way it processes livestock. The 100 per cent New Zealand farmer-owned co-operative will install new robotic primal/middle cutting machinery and reconfigure the boning room of the plant in Taranua. The custom-built primal/middle cutting technology features an x-ray unit which analyses each carcass and instructs the two cutting machines where to cut. No job losses were expected as a result of the introduction of the changes. The technology will reduce the amount of labour required, but this will be accommodated by natural attrition so they're not anticipating redundancies.

Example: Production worker Baxter

Baxter is now available in New Zealand at about NZ\$30K. Baxter is an interactive production robot based on the premise that a robot should work among human workers safely and be flexible enough to adapt to a changing environment. At 6ft tall from the top of the 360-degree sonar and front camera that sit on its head to the bottom of the four roller coasters on which it moves around, the humanoid robot weighs about 80kg and has two arms that each has vision capability; a reach of 261cm; seven degrees of movement; and end effectors that can be changed in five minutes to suit its application.

Example: Orchard Robots

The 'Multipurpose Orchard Robotics' project is a collaboration between Robotics Plus Ltd, University of Auckland, University of Waikato and Plant and Food Research aiming to automate the harvesting and pollination of kiwifruit and apples. The central system is developing an Autonomous Mobile Modular Platform (AMMP) that task performing systems attach to. The AMMP will be capable of driving around an orchard by itself, stopping at the appropriate spots for tasks to be performed. The modularity aspect of the platform allows for other systems to be attached to it. These other systems, like sensing systems, custom arms or spraying systems, perform the necessary tasks without needing to build vehicles for every seasonal task.



Photos counter clockwise from top: [The primal cutter at Alliance's Dannevirke plant](#), Baxter, the automated production worker by [Rethink Robotics](#), Placement of apples by the robotic apple picker ensures all the apples are pointed the same way.

INNOVATIVE DISRUPTION

COMPUTERS ARE IMPROVING FASTER THAN WE ARE - KIWI EXAMPLES

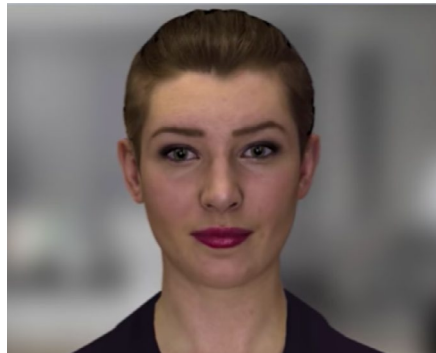
Example: Autonomous shuttle at Christchurch Airport

The smart shuttle, made by French company Navya, can carry up to 10 seated and five standing passengers and is fully electric. It has no steering wheel and is set up so there is no clear front or back. It follows pre-programmed routes which are easily reconfigured. The shuttle's positioning system is able to detect where it is to within 20mm. A top speed of 50kmh is possible but it will mostly run below 25 kmh. A fully-charged battery can last up to 10 hours, but is more likely to last five or six on flat land with air conditioning going. The trial carried out in Jan 2017 is a collaboration between the airport and HMI Technologies, with support from the Christchurch City Council, the University of Canterbury, the NZ Transport Agency and the Ministry of Transport.

Example: Nadia the digital avatar

Soul Machines is an Auckland-based company that develops intelligent, emotionally responsive avatars that improve the user experience on artificial intelligence platforms. Nadia can speak, write and chat online. She was created to help disabled people that traditionally struggled with technology interfaces to have better accessibility to the company's services.

"The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom." Isaac Asimov, American writer and professor of biochemistry at the University of Boston



Photos left to right: [Christchurch Airport held a demonstration of its fully autonomous electric vehicle, the first to be trialled in New Zealand](#) (photo by David Walker of Fairfax Media), [Nadia the digital avatar](#).

SUMMARY

Technology can be used to destroy or create jobs. The bigger opportunity is to use technology to enhance performance and augment human activity. There is no economic law that everyone is going to benefit equally. We are seeing technological shifts and changes on a scale we have never seen on this planet. These require severe and extreme leadership that understand how we want to shape these technologies.

Robots may be common in modern factories and automations that learn are becoming more sophisticated. While algorithms and hardware capability are improving rapidly, AI has not taken over our lives. An understanding of the skill sets required by future employers will help us to navigate the future better.

[illegible]

- Introduction
- The future of jobs
- Recommended actions

SKILLS DISRUPTION

INTRODUCTION

The very nature of work is changing. The skills that the economy values are changing. We've been through these historic shifts a few times before, most famously in the Industrial Revolution. Each time, those who didn't recognize the shift, or refused to accept it, got left behind. While we've seen the general phenomena before, the way that work changes is different every time, and this time the changes are greater than ever. The skills that will prove most valuable are no longer the technical, classroom-taught, left-brain skills that economic advances have demanded from workers over the past 300 years. Those skills will remain vitally important, but important isn't the same as valuable. The new high-value skills are instead part of our deepest nature, the abilities that literally define us as humans: sensing the thoughts and feelings of others, working productively in groups, building relationships, solving problems together, expressing ourselves with greater power than logic can ever achieve. We shouldn't focus on beating the computers at what they do. We'll lose that contest. Nor should we even follow the inviting path of trying to divine what computers inherently cannot do – because they can do more every day.

“General cognitive skills are becoming commoditized and thus a diminishing source of competitive advantage”

By one popular estimate, 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist. Current technological trends are bringing about an unprecedented rate of change in the core curriculum content of many academic fields. Nearly 50% of subject knowledge acquired during the first year of a four-year technical degree outdated by the time students' graduate, according to one popular estimate. In such a rapidly evolving employment landscape, the ability to **anticipate** and **prepare** for future skills requirements, job content and the aggregate effect on employment is increasingly critical for businesses, governments and individuals in order to fully seize the opportunities presented by these trends—and to mitigate undesirable outcomes.

“It is predicted that knowledge won't be the source of their greatest value. The most valuable people are increasingly relationship workers.”

Excerpt: Humans Are Underrated by Geoff Colvin 2016

Smart lawyers can still do great. The key to differentiation lies in the most deeply human realms of social interaction: understanding an irrational client, forming the emotional bonds needed to persuade that client to act rationally, rendering the sensing, feeling judgments that clients insist on getting from a human being. As infotect continues its advance into higher skills, value will continue to move elsewhere.

“Engineers will stay in demand, but tomorrow's most valuable engineers will not be geniuses in cubicles; rather, they'll be those who can build relationships, brainstorm, collaborate, and lead.”

SKILLS DISRUPTION

THE FUTURE OF JOBS SURVEY BY THE WORLD ECONOMIC FORUM

In 2015, the World Economic Forum conducted a job survey and presented their findings in “The Future of Jobs – Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution” 2016 report. The dataset that forms the basis of this report is the result of an extensive survey of Chief Human Resources Officers (CHROs) and other senior talent and strategy executives of leading global employers, representing more than 13 million employees across 9 broad industry sectors in 15 major developed and emerging economies and regional economic areas.

The respondents expect strong employment growth across the Architecture and Engineering and Computer and Mathematical job families. 3D printing, resource-efficient sustainable production and robotics are all seen as strong drivers of employment growth in the Architecture and Engineering job family, in light of a continued and fast-growing need for skilled technicians and specialists to create and manage advanced and automated production systems. This is expected to lead to a transformation of manufacturing into a highly sophisticated sector where high-skilled engineers are in strong demand to make the industrial Internet of Things a reality. The largest amount of skills disruption is expected to occur in the Financial Services & Investors industry.

Impact of disruptive change on existing skill sets

A focus on the state of the talent pipeline for traditional formal qualifications and ‘hard skills’ therefore risks dramatically understating the scale of impending skill set disruption if a large part of the existing subject knowledge of the current workforce will be outdated in just a few years. At an industry level, the highest expected level of skills stability over the 2015–2020 period is found in the Media, Entertainment and Information sector, already profoundly transformed in recent years, while the largest amount of skills disruption is expected to occur in the Financial Services & Investors industry. In the face of rapidly rising computing power, an ability to work with data and make data-based decisions will become an increasingly vital skill across many job families as employers scramble to build a workforce with solid skills in data analysis and presentation (e.g. through visualization) and the amount of potentially useful digital information generated and stored keeps increasing exponentially.

With regard to the overall scale of demand for various skills in 2020, more than one third (36%) of all jobs across all industries are expected by our respondents to require complex problem-solving as one of their core skills. It is anticipated that complex problem solving skills will become somewhat less important in industries that are heavily technical today—such as Basic and Infrastructure and Energy—in which technology may automate and take on a bigger part of these complex tasks going forward, and will ascend in those industries, such as Professional Services and Information and Communication Technology, that are expected to become more complex and analytical due to these trends.

Overall, social skills—such as persuasion, emotional intelligence and teaching others—will be in higher demand across industries than narrow technical skills, such as programming or equipment operation and control. Content skills (which include ICT literacy and active learning), cognitive abilities (such as creativity and mathematical reasoning) and process skills (such as active listening and critical thinking) will be a growing part of the core skills requirements for many industries.

Many formerly purely technical occupations are expected to show a new demand for creative and interpersonal skills. Similarly, Sales and Related jobs may see an increased demand for creative skills and ideas for promoting a memorable shopping experience, as brick-and-mortar retail has to reposition itself in relation to e-commerce and online competition. Overall, our respondents anticipate that a wide range of occupations will require a higher degree of cognitive abilities—such as creativity, logical reasoning and problem sensitivity—as part of their core skill set.

New and emerging jobs expect to become critically important by 2020

Two job types stand out due to the frequency and consistency with which they were mentioned across practically all industries and geographies. The first are **data analysts**, which companies expect will help them make sense and derive insights from the torrent of data generated by the technological disruptions. The second are **specialized sales representatives**, as practically every industry will need to become skilled in commercializing and explaining their offerings to business or government clients and consumers, whether due to the innovative technical nature of the products themselves, due to their being targeted at new client types with which the company is not yet familiar, or both. Other new specialties frequently mentioned include new types of human resources and organizational development specialists, engineering specialties such as materials, bio-chemicals, nanotech and robotics, regulatory and government relations specialists, geospatial information systems experts and commercial and industrial designers.

SKILLS DISRUPTION

CASE STUDY

Cadbury Dunedin

In Feb 2017, Mondelez International, the owner of Cadbury, announced that more than 350 jobs set to go as factory closes its door by early 2018. The proposed closure of Cadbury plant in Dunedin is a high-profile example of a long-standing trend. Manufacturing jobs have been disappearing from New Zealand for decades due to technological improvements and globalisation. The economy as a whole, is creating more jobs than the job losses in sectors like manufacturing. But they are in different sectors (usually in services), and often in different regions (usually in large urban centres). This means that when a rural or small town manufacturing job is lost, there is no immediate comparable replacement.

“We need to ensure workers of tomorrow are acquiring the right kind of skills to operate in a very different world of work.” Shamubeel Eaqub, economist and commentator.

He quoted that Cadbury’s proposed closure is sad news for Dunedin but a continuation of a trend. Reversal is not possible, but a host of tired but trusty old policy ideas keep turning up: a better welfare safety net, a local approach to redeploying workers, making education fit for a changing economy, and tackling housing. He cited two policy issues that New Zealand should look into.

The first being our welfare system, it needs to be generous enough to look after people losing jobs to give them a safety net to recover and look for new employment. Many provinces are facing significant labour shortages. By working closely with neighbouring regions and businesses, there have been successful examples recently of creating a win-win for workers and businesses. This collaboration is often best led by local businesses and political leaders.

For young people growing up in rural New Zealand, there is no guarantee there will be enough jobs for them in their hometown nor will they be able to afford to move to places like Auckland where jobs are plentiful. This frames the second policy issues: how best to educate our young people and how to ensure mobility for our people across regions.

The obvious is to focus on education and admit that we do not know what skills will be needed in the future. A focus on critical thinking and creativity seem obvious. That means **expanding beyond the current myopia of STEM in tertiary education right now. They are important, but social sciences are important too.** And we really need to tackle the housing crisis in Auckland, because young people should have the choice to live where they like in New Zealand.¹⁹

¹⁹ Sunday Star Times Feb 26, 2017 – “Manufacturing jobs disappear”

From Disruption to Reinvention

What’s New? Reinvention from Manufacturing to Tourism

Mondelez International has unveiled its concepts for the \$3 million redevelopment of Cadbury World. While the factory will close early 2018, the tourist attraction will expand into the factory’s old dairy building, a site five times as big as the present Cadbury World.²⁰

²⁰ Otago Daily News Apr 24, 2017 – “\$3m Cadbury World boost”



Photos: [Crunchie Mountain](#) and a [Chocolate fall](#) at Dunedin’s Cadbury World

SKILLS DISRUPTION

THE WORLD ECONOMIC FORUM RECOMMENDED ACTIONS

Reinventing the HR Function:

As business leaders begin to consider proactive adaptation to a new talent landscape, they need to manage skills disruption as an urgent concern. They must understand that talent is no longer a long-term issue that can be solved with tried and tested approaches that were successful in the past or by instantly replacing existing workers. Instead, as the rate of skills change accelerates across both old and new roles in all industries, proactive and innovative skill-building and talent management is an urgent issue. **What this requires is an HR function that is rapidly becoming more strategic** and has a seat at the table—one that employs new kinds of analytical tools to spot talent trends and skills gaps, and provides insights that can help organizations align their business, innovation and talent management strategies to maximize available opportunities to capitalize on transformational trends.

Making Use of Data Analytics:

Businesses will need to build a new approach to workforce planning and talent management, where better forecasting data and planning metrics will need to be central. Earlier mapping of emerging job categories, anticipated redundancies and changing skills requirements in response to the changing environment will allow businesses to form effective talent re-purposing strategies within their company, their own industry and across industries. **HR has the opportunity to add significant strategic value in predicting the skills that will be needed, and plan for changes in demand and supply.** To support such efforts, the Forum's Future of Jobs project provides in-depth analysis on industries, countries, occupations and skills.

Talent diversity — no more excuses:

As study after study demonstrates the business benefits of workforce diversity and companies expect finding talent for many key specialist roles to become much more difficult by 2020, it is time for a fundamental change in how talent diversity issues—whether in the realm of gender, age, ethnicity or sexual orientation—are perceived and well-known barriers tackled. In this area, too, **technology and data analytics may become a useful tool for advancing workforce parity**, whether by facilitating objective assessment, understanding typical careers paths and cliffs, identifying unconscious biases in job ads and recruitment processes or even by using wearable technologies to understand workplace behaviours and encourage systemic change.

Leveraging flexible working arrangements and online talent platforms:

As physical and organizational boundaries are becoming increasingly blurred, organizations are going to have to become significantly more agile in the way they think about managing people's work and about the workforce as a whole. **Work is what people do and not where they do it.** Businesses will increasingly connect and collaborate remotely with freelancers and independent professionals through digital talent platforms. Modern forms of association such as digital freelancers' unions and updated labour market regulations will increasingly begin to emerge to complement these new organizational models. For policymakers, an important set of regulations concerns the portability of safeguards and benefits between jobs and the equivalent treatment in law of different forms of labour and employment types.

An ability to understand the current skills base in near-real time and to accurately forecast, anticipate and prepare for future job contents and skills requirements will be increasingly critical for businesses, labour market policymakers, workers' organizations and individuals to succeed. Drivers of change to job markets such as Big Data analytics may themselves become useful tools in managing this process.

Please read [The Future of Jobs](https://reports.weforum.org/future-of-jobs-2016/skills-stability/) for more details of their research study.
<https://reports.weforum.org/future-of-jobs-2016/skills-stability/>
<http://www.filmsforaction.org/articles/deep-learning-is-going-to-teach-us-all-the-lesson-of-our-lives-jobs-are-for-machines/>

SKILLS DISRUPTION

WATCH THIS SPACE

LookSee Wellington

[LookSee Wellington](#) is a campaign to attract tech talent resulting in candidate registrations. It is a collaborative initiative between WREDA and Workhere New Zealand, supported by Immigration New Zealand and NZTech. WREDA, which combines the economic development activities of Wellington City Council and Greater Wellington Regional Council, is funded by Wellington ratepayers. The online platform went live in Feb 2017 and has already received more than 5000 registrations of interest from senior staff of Facebook, Google, Amazon etc. The candidates, who have their flights and accommodation paid for, will attend a series of pre-arranged job interviews with employers who have roles that match their skills. More than 25 employers have signed up including Xero, Trade Me and Weta Digital. If an employer goes on to hire one of the candidates – or hires an unsuccessful candidate who applied through the LookSee Wellington website – they must pay upwards of \$9000 (known as the employer fee, or marketing success fee).²¹

FILTR

[FILTR](#) is a free website that allows students to upload video, portfolio content, a CV, and a list of skills directly, and employers would come to them, reversing traditional job seeking process.

Beamery

[Beamery](#) is a London-based start-up software company that helps recruiters or employers identify, get connected to and nurture relationships with prospective hires, long before they apply for a job. It uses machine learning algorithms to determine which prospects are most interested in working for a given employer, and in what capacity.

Expert360

[Expert360](#) is a Sydney-based web platform that connects top-level consultants to mid-size clients around the world. The Expert360 platform takes care of all the billing, expenses and contracts. Unlike traditional consulting, consultants will receive ratings and reviews that will enable other clients to see their performance.

²¹ Stuff.co.nz Feb 21, 2017 – [Thousands of IT professionals, including Silicon Valley figures, show interest in Wellington](#)

The interaction between future employers and public-sector institutions needs to intensify, to make sure all parties can spot and address imbalances early.

New Zealand government has been proactive in looking for ways to respond to labour market needs. In May 2016, Careers New Zealand became part of Tertiary Education Commission (TEC) in a reform which will result in better and more consistent careers information for school students. In March 2017, Ministry of Business, Innovation and Employment (MBIE) rolled out the 'Occupation Outlook' app and the 'Regional Economic Activity' app. The apps feature comprehensive job profiles with information on salaries, hours required, qualifications and job prospects. Young people can view this information at the regional levels.

SUMMARY

The changes in the labour market are among the most difficult to manage for both corporate leaders and individuals. Most adults were brought up to believe that their schooling would provide them with the credentials and skills needed to get started and advance in the workplace. But that's no longer true. The scale of technological change, the disruption in the way we work, and the mismatches between skills and jobs are all daunting challenges in the new global labour market. But they're not insurmountable. Every time a new technology revolution has unleashed its powerful forces, humans have figured out a way to adapt, find new endeavour, and prosper.²²

²² "No ordinary disruption" – McKinsey Global Institute

Think out of the box to catch those outside the box!

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1. Advanced building and finishing materials
2. Cross company collaboration
3. 3D printing
4. Standardised, modularised, or prefabricated components
5. Smart and (semi) automated equipment
6. Better quality buildings
7. The use of big data and analytics
8. The use of advanced technologies
9. Drones and embedded sensors
10. The use of digital tools (BIM)
11. Adopting closed-loop circular design principles
12. Reinventing business models
13. Adopting standardisations
14. Increasing cybersecurity
15. Real time communication
16. Online networking with the wider industry
17. Forging more intergovernmental relations

OUR BUSINESS 2017 AND BEYOND

ENGINEER A DIGITAL FUTURE

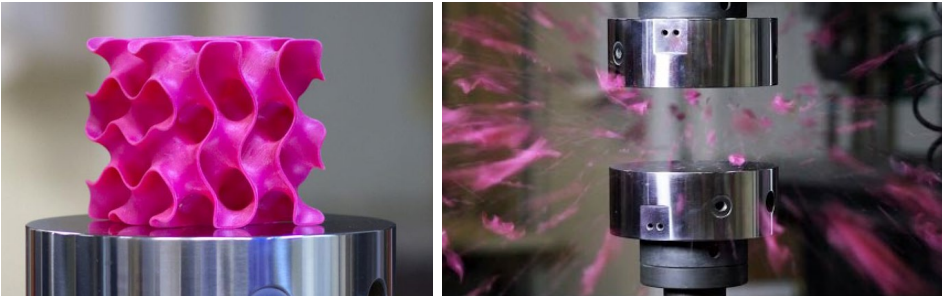
The fourth industrial revolution is a game-changer. It blends physical and information systems, making use of the huge quantities of data we all generate. Ever-increasing computational power is enabling us to make sense of this data, creating rich opportunities for innovation and making this an exciting time to be an engineer. Here we list a few examples of new technologies and new approaches in our business that may help us to engineer a digital future.

1. Advanced building and finishing materials

Materials constitute an extremely powerful lever for innovation. With approximately one-third of construction cost attributed to building materials, the scope for applying advanced building materials (ABMs) is considerable. Despite their price premium, have an improved total-cost-of-ownership (TCO) performance relative to traditional materials. Hence the industry can win risk-averse clients who would normally favour the lower-price options.

Watch this space: Porous, 3D Graphene

MIT researchers have developed one of the strongest lightweight materials known to man. They created the new material by compressing and fusing flakes of graphene, a 2D form of carbon. The new material has a sponge-like configuration with a density of only 5%, and is likely to have strength 10 times that of steel.



Photos: [3D-printed gyroid models such as this one were used to test the strength and mechanical properties of a new lightweight material](#) (photo right by Melanie Gonick/MIT).

A few examples of advanced building and finishing materials.

Incremental innovation		Radical innovation
Advances on traditional materials and existing characteristics	New material combinations and multi-functional characteristics	Innovative materials with entirely new functionality
<i>iQ Natural</i> , an advanced vinyl flooring, is 100% recyclable, using a bio-based plasticizer. The product has TVOC (total volatile organic compound) values 100 times below the strictest European standards.	<i>Lixil's</i> super-lightweight ceramic sidings combine fast-hardening cement with organic fibre to meet the required performance at half the weight	Rain-absorbing roof-mats, imitating the process of perspiration, considerably reduce air-conditioning costs.
 	 	 
<i>Neopor</i> is an enhanced styropor, offering up to 20% efficiency improvement in insulation.	Self-healing concrete, generated through the addition of bacterial spores, is estimated to reduce lifetime costs by up to 50%.	<i>Micronal</i> , a micro-encapsulated phase-change material incorporated into building materials, enables intelligent temperature management.
 		 
<i>ArcelorMittal</i> has launched organically coated steel that achieves 30-year guaranteed durability and does not contain genotoxic, hexavalent chromium.	Concrete admixed with special construction chemicals achieves 50% faster curing times.	Slippery liquid-infused porous surfaces constitute super-repellent surfaces inspired by the carnivorous nepenthes pitcher plant.
 		 
 Higher recyclability / re-usability	 Reduced material costs	 Higher energy efficiency
 Reduced life-cycle costs	 Faster construction process	 Improved health / well-being
		 Early development / pilot phase
		 Market-ready

Icons provided by [Icons8](#)

OUR BUSINESS 2017 AND BEYOND

ENGINEER A DIGITAL FUTURE

2. Cross-Company Collaboration

E&C companies cannot realize their full potential on their own. The industry is one of the most fragmented in the world and relies on a seamless interplay of all participants along the value chain and throughout a project's life cycle. Companies need to jointly define standards and agree on common goals. They should promote itself as an attractive employer and engage local communities by means of participatory planning and ongoing community-involvement initiatives.

Example: Engineering Week

Leaders from a number of engineering firms (Beca, Opus, IPENZ, MWH and AECOM) have joined forces to develop the Engineering Week that was held in Wellington, New Zealand in August 2016. Their aim was to promote engineering in our community and as an exciting and rewarding career for young graduates entering the workforce. It was linked to a public awareness campaign launched by the Engineering, Education to Employment programme, which was set up in 2014 by Tertiary Education Commission to help achieve a government goal to boost engineer numbers.

Example: Health & Safety Collaboration

In April 2017, Arrow International, Cassidy Construction, Dominion Constructors, Fletcher Construction, Hawkins Construction, Leighs Construction, Naylor Love and NZ Strong signed an agreement committing to standardise their approach to on-site health and safety. The companies supporting this agreement, and Site Safe, know that working together to standardise and improve health and safety practice will achieve far greater benefits and enable subcontractors and their workers to have better consistency about what is required of them.

Example: BASF

(German chemical company) and ARUP have jointly developed an app for architects, engineers and project owners to calculate the energy savings achievable from the latent-heat storage system 'Micronal'.

Example: Autodesk and Siemens

Interoperability is one of the industry's constant thorny issues. Proprietary CAD formats, create a virtual Babel and generate barriers to understanding engineering information. In March 2016, Autodesk and Siemens declared a strategic agreement that will allow their CAD and PLM solutions to work together toward sharing data. A pact at a high level between companies means that their people can now work in a cooperative spirit with their counterparts. Software toolkits will be shared among development teams. Companies will be able to buy each other's software with the intent of making them work together.



Photo above: Engineering week, offered as a cross-industry collaborative event to encourage students to consider a career in engineering and science related professions. [Photo courtesy of Fairfax Media \(photographer: Monique Ford\).](#)

OUR BUSINESS 2017 AND BEYOND

ENGINEER A DIGITAL FUTURE

3. 3D Printing

3D printing, an invention from the 80s, is poised to have a dramatic impact upon architecture, building design and manufacturing, with entire houses already produced in China with giant 3D printers. 3D printing allows building designers to experiment with shapes and geometries in design that may not be financially viable with existing building techniques. It promises productivity gains of up to 80% for some applications, together with an important reduction in waste. Construction time for some buildings could shrink from weeks to hours, and customized components could be provided at much lower cost.

Example: 3D printed bridge

[MX3D](#), a Dutch start-up working with partners such as ArcelorMittal, ABB and Autodesk, has developed an external 6-axis 3D printing robot capable of printing lines in mid-air. This new technology has been recently implemented to create a canal bridge for pedestrian traffic in the ever crowded city of Amsterdam. It showcases how engineering advancement could be used in the future to print on-site small scale infrastructure.

Recently, Casey Hemingway, a student from the University Auckland has been awarded a coveted paid internship to join MX3D in Amsterdam. Hemingway joined the team at MX3D in March 2017 to begin building a pedestrian bridge. We hope that the technology will be available in New Zealand in the near future.

Example: 3D printed housing components

WinSun (China) claimed that they have been building 10 houses a day by using 3D-printed building components.

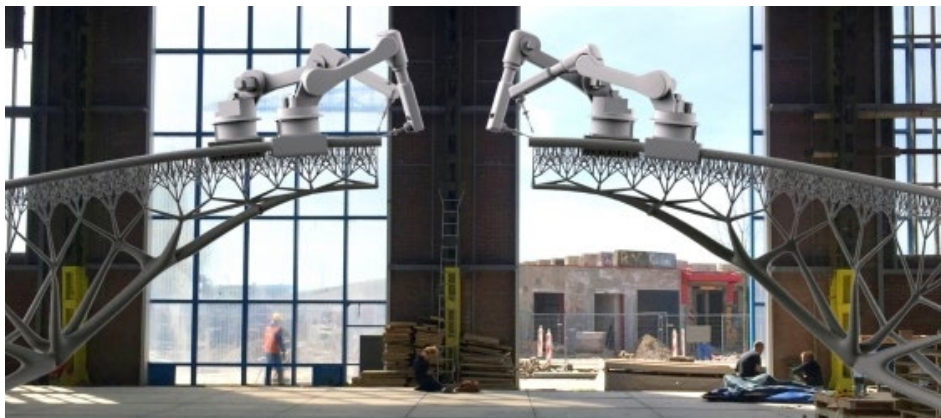


Photo render above: [MX3D's project to use 3D printing robots](#) to construct a bridge across an Amsterdam canalway. Due to high pedestrian traffic, the bridge has to be constructed off-site and will be installed once the project has been completed.

4. Standardised, Modularised, or Prefabricated Components

The standardization of components brings many benefits, including a reduction in construction costs, fewer interface and tolerance problems, greater certainty over outcomes, reduced maintenance costs for end-users, and more scope for recycling. Modularization adds to the advantages of standardization, by increasing the possibilities for customization and flexibility, and helping to realize the potential of prefabrication in a factory-like environment. Prefabrication would increase construction efficiency, enable better sequencing in the construction process and reduce weather-related holdups; by such means, it becomes possible to reduce a project's delivery times and construction costs relative to traditional construction methods, and also to create safer working environments. Prefabrication can be applied in a wide variety of project types, ranging from residential housing to large-scale industrial plants. The various systems can be distinguished by their degree of prefabrication: at a simpler end are the mostly two-dimensional building components, such as walls, ceilings or truss elements; then there are modular structures, comprising larger volumetric elements like entire rooms or storeys; and finally, there are entirely prefabricated assets. The degrees of prefabrication is based not just on these physical dimensions, but on a further factor as well: the integration and complexity of mechanical, electrical and plumbing systems.

Example: Broad Group China

In cooperation with ArcelorMittal, is using a system of modular building components that enables very speedy construction: a 57-storey building was built in only 19 days by moving 90% of the construction work to the factory.

Example: Skanska

Has developed a new construction concept known as "Flying Factories", which are temporary factories set up close to construction sites; they apply "lean" manufacturing techniques and employ local semi-skilled labour. The advantages include a reduction in construction time of up to 65%, a halving of labour costs and a 44% improvement in productivity relative to on-site assembly, while still upholding the construction industry's importance as a local employer.

OUR BUSINESS 2017 AND BEYOND

ENGINEER A DIGITAL FUTURE

5. Smart and (Semi) Automated Equipment

Owners of smart building are gaining benefits such as reduced operating costs and increased operational efficiency with the adoption of connected devices. This development affects all sectors. In the Energy sector, smart meters and demand response are emerging. In Transportation, smart technology enables smart transport, street lights & traffic lights monitoring and car parking. As technological advances – in robotics, for instance – open up enormous new possibilities. (Semi-) automated excavators, bulldozers, conveyers, pumps and mobile cranes offer great potential and reduced construction costs by shorter delivery time, increased productivity, higher quality (due to higher accuracy and fewer workmanship errors), improved safety and so on.

Example: Komatsu

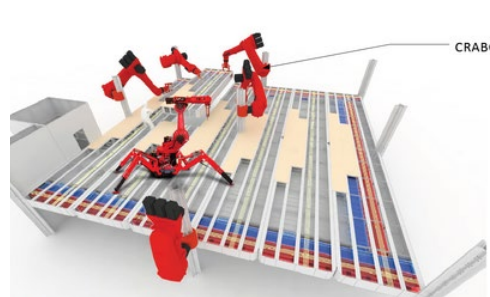
a Japanese manufacturer of construction equipment, is developing automated bulldozers incorporating various digital systems. Drones, 3D scanners and stereo cameras gather terrain data, which is then transmitted to the bulldozers; these are equipped with intelligent machine-control systems that enable them to carry out their work autonomously and thereby speed up the pre-foundation work on construction sites, while human operators monitor the process.

Example: Crabots

An army of robot-crane hybrids (called “crabots”) will be assembled to build Google’s new headquarters in California. They will lift prefabricated components such as walls and heavy furniture into place beneath vast glass canopies.

Example: Eolgreen hybrid street lighting

The Eolgreen hybrid streetlight is a combined wind and solar lighting system that ensures entirely autonomous operation. By relying on wind to continue operation, the hybrid can generate power with wind strength at just 1.7 metres per second. Surplus energy created by the streetlight is stored for ongoing consumption of the light, or pushed back into the grid. The street lighting does not require network connection with zero CO2 emission and zero energy costs. It can be seen in a Mount Roskill, Auckland car park. The Eolgreen is available at [Hiway Group](#).



Photos clockwise from top left: [PC210LCi-10](#) is the world's first intelligent machine control excavator incorporates a fully factory integrated 3D iMC and guidance system based on Komatsu's unique sensor package. [HiWays smart street light](#). Google's "Crabots" which are part robot, part crane. The [D61i-23](#) was the first Komatsu machine released with Intelligent Machine Control. It is also the world's first dozer with fully auto-blade control.

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6. Better Quality Buildings

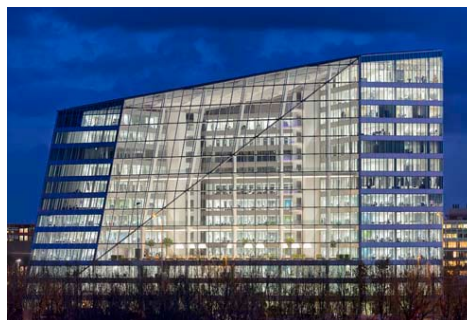
A more recent addition to the environmental measurement tools administered by the New Zealand Green Building Council ([NZGBC](#)) is the National Australian-Built Rating System New Zealand ([NABERSNZ](#)). NABERSNZ is being used to measure and reduce energy use year on year. Meters are installed to gauge energy output across a range of core services and spaces. Building with a five-star NABERS rating attracted a rent premium of between 4% and 21% and have a better occupancy rates and tend to have longer lease terms. There's a perception that green buildings are more expensive but that's no longer true as they reduce waste and increase operational efficiencies. The benchmarks for building performance will continue to rise and those who are not planning to meet them risk losing market edge.

Example: Deloitte's The Edge, Amsterdam

Deloitte's new Amsterdam head office, the Edge, shows how smart building design can provide flexibility and comfort for its occupants while also reducing energy demands. Producing more energy than it consumes, the Edge is widely regarded as the most sustainable office building in the world. The multi-storey, north-facing glass atrium admits lots of daylight while concrete walls on the south facade absorb heat from sunlight, and solar panels convert that sunlight into energy. A single network controls every technical system in the building, including a network of tens of thousands of sensors placed around the building. The lift, the lighting and cooling systems, coffee machines and towel dispensers, even the robot security guard which cruises around the building at night, can all be controlled and adjusted centrally.

Example: IAG Building Christchurch (part of the Showplace Office Park)

IAG and Goodman are the first to achieve a 5 star NABERSNZ whole building rating for their Christchurch office at 14 Show Place, Addington. Key sustainable features include a Variable Refrigerant Flow (VRF) HVAC system with heat recovery, CO2 sensors, LED lighting, daylight harvesting and occupancy sensors. They have retrofitted LED lighting with up to 20 percent savings in lighting energy and sought specialist advice on engineers to ensure the correct equipment was installed for best energy efficiency. They are seeing a 40 percent reduction in energy consumption in the building despite an increase in the tenant.



7. The Use of Big Data and Analytics

The use of Big Data analytics could transform the way civil infrastructure systems are operated and maintained so as to optimize decision making, improve safety, and reduce cost. Data from sensors can be stored and data mining can be used to predict the infrastructure health from the available data. Data sensing, analysis and mining can also be used to facilitate decision making and intelligent transportation systems, as well as fire and disaster management, early flood detection and many such use cases.

Example: LENS

Je Dunn partnered with Autodesk and developed a customised visualization technology known as LENS. LENS linked 2D and 3D data, financial data, corporate data, documents, schedule elements, weather etc in a complex web. Every element in the design is tied to their cost estimate and the owner can see the concept model and the dollars tied to it. This massively speeds up the design process and already, even at the early stage, contributes to waste saving. Whereas before, minor changes to the design could mean several weeks or months of backwards and forward communications between architects, engineers and owners, insights into the effects of changes are now visible almost instantaneously. The variance of the final costs to the initial napkin sketch estimated costs was less than 5%.

Below left to right: Deloitte's [The Edge Building](#) (photo by Ronald Tilleman), and the [IAG Building](#) (part of the [Showplace Office Park](#)) in Christchurch. Sketch of the [Kauffman Centre for the Performing Arts](#), and the finished product (aerial photo by Tim Hursley).



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8. The Use of Advanced Technologies

New methods of simulation and virtual reality (VR) help to identify interdependencies and clashes during the design and engineering stages, and enable a virtual experience of the building even in the early design phase. By exploiting mobile connectivity and augmented reality (AR), companies can engage in real-time communication and provide workers with additional on-site information.

Example: Atkins 'Optioneering'

Atkins has implemented advanced parametric design techniques for detailed design "optioneering" in the water infrastructure industry. That has made it possible to provide 22 design options in one day, a 95% improvement on traditional design methods for similar results.

Example: VR Labs

[Context Architects](#) (Auckland-based) is using a custom-built VR lab in its offices, consisting of an HTC Vive VR kit with headsets, motion sensors and hand controls and a custom-built computer system. The VR lab helps get clients involved in the design process and show them the possibilities of what a project can look like in 3D form, instead of just on a screen or on paper.²³

Example: 3D Environments

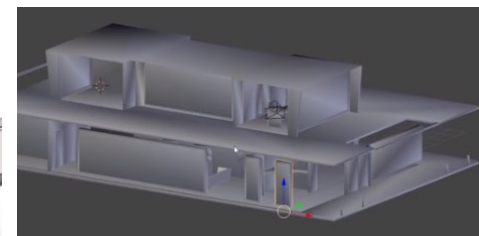
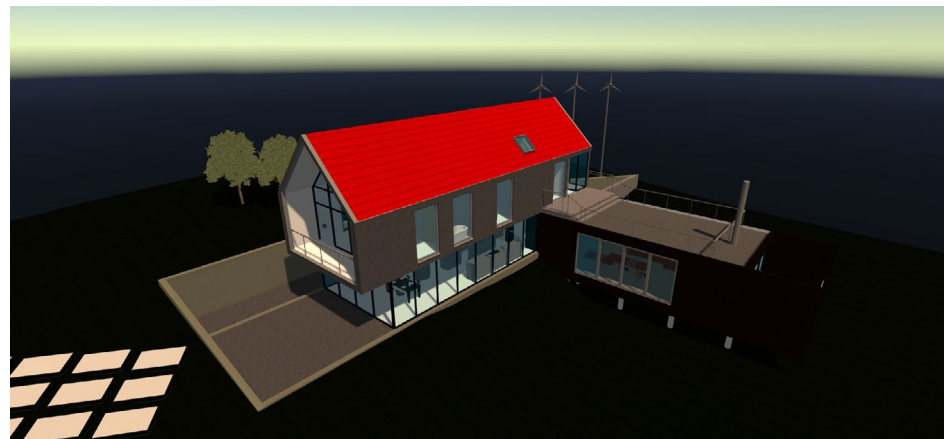
[Unity for Autodesk® Revit® 3.0](#) supports export of 3D model geometry and create 3D environment for users. Translating CAD or BIM models into virtual reality experiences used to take considerable time and programming know how. With the advent of the Unity gaming engine, bringing Revit/3D models into a virtual reality space becomes much easier.

Example: Unreal Engine 4

[Unreal Engine 4](#) is free for the architecture industry and is frequently used to visualize spaces and render architectural models in immersive environments. This tool enables engineers and architects to design and build in a virtual reality environment by means of a powerful editor toolset and the interaction models that have been specifically designed for VR world building. The outcome is a believable immersive experience built upon natural motions and interactions.

Example: Augview

[Augview](#) is a New Zealand-based company, who were the first in the world to create an augmented reality asset management application for utility workers. The Augview app uses asset data and augmented reality to show what gas, power and water mains are underground, who owns them and where exactly they are - all before workers dig into the ground. Augmented reality technology is used to display a 3D model of asset on top of the video feed allowing the users to 'see' objects on the device that may be obscured in the real world. This increases the field workers understanding of their environment without any prior experience.



Above, counter clockwise from top: Creating a VR Experience by bringing a [Revit model into Unity](#). This powerful, intuitive and flexible tool ensures rapid iteration and fluid workflow, thus allowing engineers and architects to create stunning, interactive walkthroughs and provide clients with a realistic sense of how it would feel like to actually live in the simulated environment. Bottom left then right: By exporting a model from Revit to Unreal Engine 4, architects and engineers are able to design and build in a VR environment. [Visit this link](#) for more on the use of VR in the architecture and engineering industry.

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9. Drones and Embedded Sensors

Companies can refine their monitoring of projects by using drones and embedded sensors to enable real-time communication and to track people, machines, components and the construction process itself. This is especially useful in natural disaster rescue process. The uses of drones are many, including surveying, analysing the data, showing clients the progress, monitoring jobs sites, inspecting structures, better safety records and keeping projects on-track.

Example: Cushnie Construction

In Hawaii, [Cushnie Construction](#) employed a drone to document the irrigation site of the hydropower plants before, during and after construction. Without drone technology, the project team would have been hard pressed to overcome the unique site conditions and satisfy tight deadline, and it would start impacting their client's crops such as corn, taro and mixed vegetables.

Example: DANSY

The [Dormitory Authority of the State of New York](#) (DANSY) contracted Greenman-Pedersen (GPI) to assess the exterior buildings before repair work can be carried out. GPI flew a drone near the facade to capture high-resolution images. The firm stitched together the overlapping photos to form a complete orthomosaic and integrated it with the LiDAR point cloud and 2D CAD documents to produce an accurate pictorial representation that depicted the scope of work. The use of drones on this project ultimately minimized campus disruption, reduced costs, saved time and improved safety.²⁴

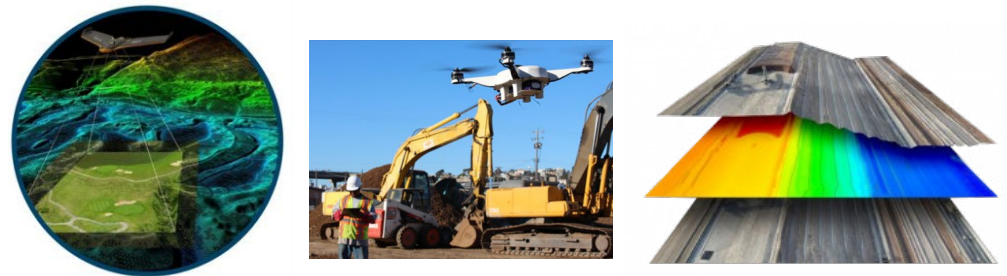
²⁴ Engineering Inc Jan_Feb 2017; ACEC

Example: Aeronavics

Raglan-based company, [Aeronavics](#) was the first company in the world to sell drones for professional use. With the adoption of a tailored surveying multirotor, job times can be reduced drastically for surveyors with simple and accurate recording of data. For earthworks, quarries, roading companies, engineering firms and mines, the use of aerial robotics technology can offer a unique opportunity to source accurate data and information on a much more regular basis and a lot quicker than with traditional methods.

Example: Komatsu

[Komatsu](#)'s SMARTCONSTRUCTION concept uses Skycatch highly reliable, autonomous drones for data collection. Skycatch UAVs scan job sites to capture imagery and automatically generate highly accurate 3D site data. This data is then compared with 3D drawings of the site to automatically calculate the area and volume of earth to be moved. The results are transmitted as instructions to Komatsu iMC machines for fully autonomous work on the site.



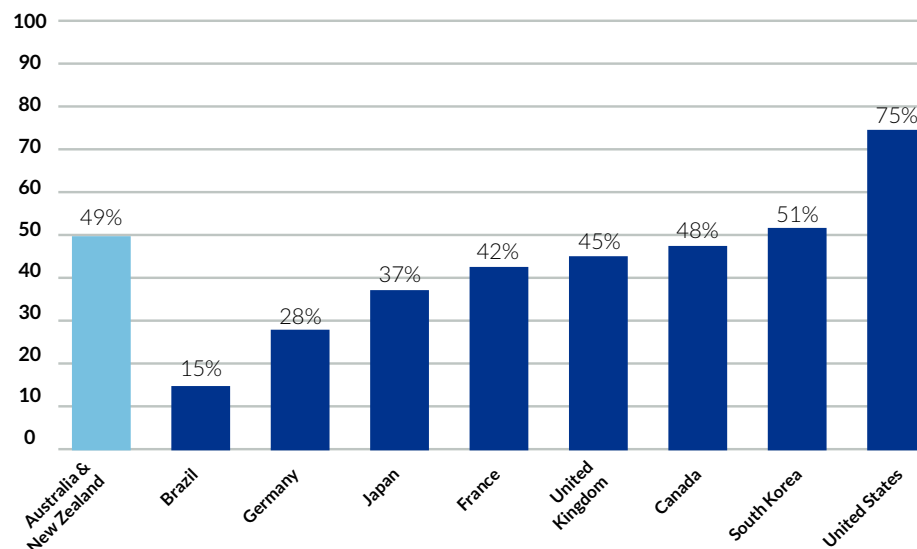
Photos left to right: these small crafts are easily piloted by remote, and can transmit quickly the data they are gleaning to a live feed ([depicted above](#)). Example of a [Komatsu drone](#) used to capture 3D data. For work on structures such as dikes and dirt containment, drones can be used to visualize the progress.

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Percentage of BIM Users with more than three years' experience (Australia and New Zealand compared to other major markets)

Source: McGraw Hill Construction – [The Business Value of BIM in Australia and New Zealand](#)



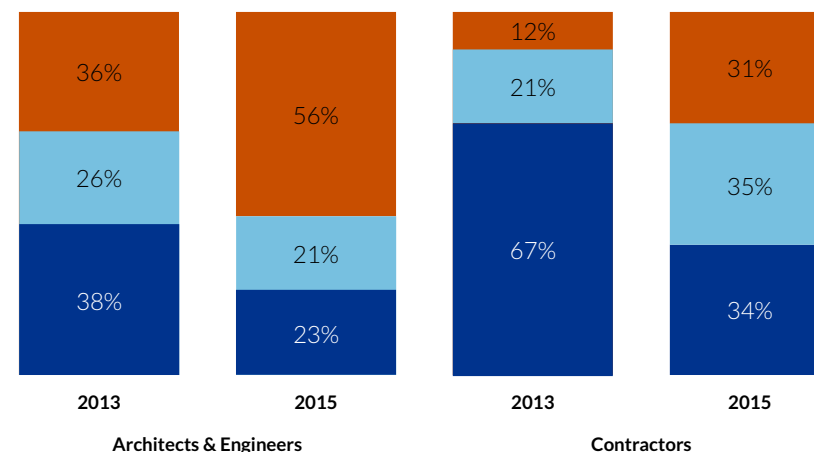
10. The Use of Digital Tools, Building Information Modeling (BIM)

BIM provides all stakeholders with a digital representation of a building characteristics – not just in the design phase but throughout its life cycle. The uptake and sophistication of BIM vary considerably from country to country, and from company to company. The use of BIM is spreading through the global design and construction industry, and architects, engineers, contractors and owners in Australia and New Zealand are no exception.

Current and future BIM implementation levels for A/E and contractor users

Source: McGraw Hill Construction, – [The Business Value of BIM in Australia and New Zealand](#)

- Very heavy implementation (over 60% of projects)
- Heavy implementation (31%-60% of projects)
- Light or moderate implementation (less than 30% of projects)



In the recent survey conducted by ACENZ, 38% of ACENZ members who responded are using BIM as business as usual. What the industry needs is “big and open” BIM, which integrates the entire value chain and is characterized by full interoperability of software and open access to it. The technical challenges are likely to be overcome in the near future. Changing existing processes and increasing collaboration (including data sharing) are some of the challenges that need to be overcome.

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The World Economic Forum's Suggested Steps:

Large Companies	Technology Suppliers
Build up the digital expertise and spread it across the company. Companies should set up a central innovation department and/or a BIM department to institutionalize digital endeavours and to expand the digital knowledge base more quickly. Appoint a chief technology officer, making sure that all regionally dispersed divisions and teams are part of the transformation.	Strengthen the core and seek to overcome interoperability issues and improve interface definitions. Strengthen the product offering for the traditional target group of designers and engineers, by adding functionalities and modeling dimensions, improving usability and simplifying reuse of the vast amount of data from past projects. Agree on standards to improve the interoperability of different BIM systems and integrate all disciplines. Eventually, get the 3D models connected to the Enterprise Resource Planning systems also, in order to create a single source of authoritative data across all relevant systems.
Establish the technological foundation and complement digital capabilities through third parties where needed. Identify and prioritise the most relevant digital technologies according to their maturity level as well as business and market needs. Invest in the requisite software and hardware tools and IT infrastructure.	Educate project owners on the advantages of using BIM, and encourage them to use it early in the planning process. Launch initiatives, such as value proofs, join pilots and digital-skills training courses for clients, to speed up the adoption of new digital technologies.
Take on pioneering roles and share expertise to encourage the adoption of BIM among smaller companies though without overstraining them or expecting equivalent commitment from them.	Expand into construction and underserved markets by adapting to the specific needs of construction companies. Address new links in the value chain and/or new market segments. Offer operators a clearer value proposition for their use of the BIM model after handover.

Example: The Panama Canal

The Panama Canal expansion project by MWH Global, now part of Stantec partnered with Autodesk was one of the largest and most ambitious construction projects in the world. With a project of this scale and urgency, work needed to proceed on several fronts at once. Excavation had to start before the designs were even completed. And the locks had to meet rigorous design standards and seismic requirements. To manage this extraordinary level of complexity, the Panama Canal expansion became one of the first large-scale civil works projects to use building information modeling (BIM). MWH Global, a pioneer in the use of BIM software and processes, used intelligent 3D models to enable a diverse team of engineers, in five design offices around the world, to collaborate efficiently across disciplines. The MWH Global team mapped sites and resolved design conflicts prior to construction (clash detection) to save thousands of rework hours and millions of dollars.²⁵

Example: NKS Hospital

The New Karolinska Solna (NKS) University Hospital in Stockholm is considered to be the world's largest public-private partnership project. The NKS contract required the use of Building Information Modeling (BIM), which provided a single system for designers, contractors and facilities managers to collaborate on. All information relating to the hospital's design, construction and inventory is stored digitally. Ultimately, BIM data will enable the hospital facilities to be managed comprehensively and serve as a map for 29 automated, guided vehicles which will deliver medical supplies, laundry and other items around the site.

²⁵ Autodesk website: [Customer Stories](#)

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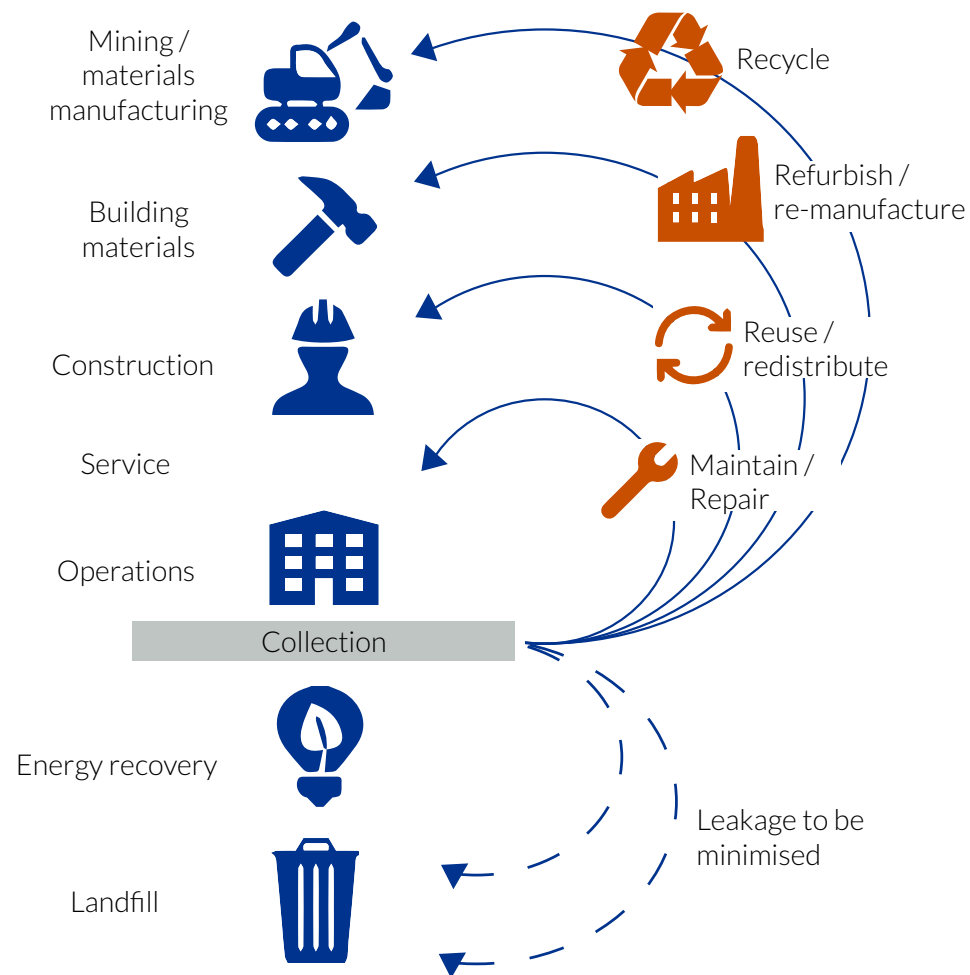
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11. Adopting Closed Loop Circular Design Principles

The foundations of this approach include choosing “good” materials that can be recycled; minimizing the environmental footprint during production (by such means as a closed water cycle, or the use of biomass to produce energy); creating products containing minimum levels of total volatile organic compounds; and changing from an end-of-life to an end-of-use mindset for products. Two examples of materials that broadly satisfy the initial outline description of a closed-loop circular material are **timber and steel**. Both materials can be made into building elements that can be reprocessed when their useful life in a building has come to an end. Steel can be recycled over and over to make new steel, and timber can be recovered through natural processes such as biodegradation.

Circular economy principles in the construction value chain

Source: Ellen MacArthur Foundation; World Economic Forum; the Boston Consulting Group



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12. Reinventing Business Models

In this country, innovation in the construction industry has tended to be at the product level, rather than by changing methods of funding and costing. We are not alone in this-the construction industry internationally is limited in the same way. The construction sector is constantly changing, and so are all of the fields within it.

The following are the common business models used in the construction industry.

- Builders offering a service (not fixed price)
- Architects working for a percentage of the total build cost, plus time and materials. This provides an incentive to create more expensive buildings.
- Developers sell either land, or land plus house.
- Component-makers sell their products.
- Architects and builders as developers-a new and growing trend.
- Self-builders – people who buy their own land and build on it

Emerging business models – the big trends

There appear to be seven new business models we see emerging globally in the sector. They are not mutually exclusive.

1. Mass Customisation
2. Products Becoming Services
3. Services Becoming Products
4. Separation of Ownership and Use
5. The Sharing Economy
6. Agile Design & Construction
7. Agile Planning

For elaboration of the above emerging business models and how to prepare your companies for disruption, please read the [full report here](#).

Some of the new business models we need are starting to emerge. But business models that disrupt the status quo are often seen as threatening by everyone involved in the industry – by their very nature, they are different. That requires people to work and behave in different ways – and the familiar is almost always easier. Sophisticated technology is just emerging in New Zealand. The growth of Computer Numerical Control (CNC) factories, Cross Laminated Timber (CLT) technology, smart software and the increase in computing power that drives BIM are all good examples. ²⁶

²⁶ [“When did disruption become a good thing?”](#) - Branz

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13. Adopting Standardisations

Adopting standardisations - in software systems, definition of costs, classification & measurements, and in legal arrangement contracts. Adherence to standards helps to ensure that products are safe, interoperable and good for the environment. Harmonizing technical specifications of products and services can make industries more efficient, and can break down barriers to trade.

Example: International Property Measurement Standard (IPMS)

IPMS is a high level and overarching building measurement standard. Dubai became the first government to adopt IPMS and the committee is actively engaging with many other key market stakeholders. The Property Council of NZ (PCNZ) is a founding trustee, while the Property Institute of NZ (PINZ) has been involved since the start. PINZ believes that with globalisation we have to adapt to worldwide trends. As a profession PINZ needs to show leadership in the property industry. Change is already happening in New Zealand with Auckland Council Property Limited (now known as Panuku) and Housing New Zealand becoming IPMS 'partners'. To date, PINZ and PCNZ have not formally adopted IPMS, but instead are recommending a transitional period where users can use the guides as required by their clients. It is expected that, over time, the IPMS will overtake the New Zealand guide.

²⁷

²⁷ [NZ Property Professional Magazine](#) – Spring 2016

Example: Conditions of Contract for Consultancy Services (CCCS)

In the late 1990's ACENZ initiated a working party to develop standard conditions for the engagement of consulting services (CCCS). In evolving the content for this contract form various client groups were consulted for input. Later in 2001 the CCCS was further enhanced through a review and update in consultation with the Auckland Regional Contracts Group - representing relevant local authorities (ARCG), the local government asset management group (ALGENZ), Transit NZ (now NZTA) and IPENZ/NZIA.

The CCCS document that emerged from that (unique for the time) client/provider collaboration has grown to be the first contract of recourse for engagement of professional services in the public and private sectors. Regular updates have kept the conditions current with legislation, statutes and client/industry expectations/adjustments. Nearly all clients of ACENZ member firms use CCCS or the concise version - Short-Form Agreement.

Currently the CCCS is undergoing an in depth review involving industry representative organisations, including contractors and architects, and over twenty client stakeholders including local authorities and government ministries, departments and agencies. It is expected that this amended document will be endorsed by all relevant parties before being released as an industry standard model contract later this year.

Example: [New Zealand's building code](#)

The New Zealand's building code is exclusively performance-based. For example, it prescribes that in the event of fire, the evacuation time must allow occupants of a building to move to a place of safety without being exposed to a fractional effective dose of carbon monoxide greater than 0.3. This code was also quoted as an example in the World Economic Forum: "[Shaping the Future of Construction](#)" May 2016 paper.

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14. Increasing Cyber security

As more and more of our data is now stored digitally, we are left more and more vulnerable. The top security threats are infiltration into companies with hacking techniques or malware techniques in order to gain information that can be sold for financial gain either directly or indirectly. With the Internet of Things coming into play, we now have more entrant points into the network than ever before. Corporate leaders will have to step up and improve their companies' cyber security as global payment systems, private customer data, critical control systems, core intellectual property are all at risk today.

Between June 2015 and June 2016, there was a 25% increase in the number of data loss incidents in New Zealand. Total losses were estimated to be between \$300 million and \$400 million a year. **Although it was rated the biggest external risk by New Zealand businesses, ahead of natural catastrophes, a third did not have an effective framework to manage that risk.** Boards need to focus on that exposure and get an understanding, work out what's available to protect the companies. It was worrying that some boards were ill-prepared. It is not mandatory to report cyber breaches in New Zealand and that meant there was less awareness of the potential for what could occur.²⁸

²⁸ "[New Zealand directors worried by everyday risks](#)" – Stuff.co.nz Feb 19, 2017

²⁹ The changing face of ICT security by Paul Johnson published on BusinessPlus – EMA, issue 114 February 2017

In every organisation, context is key. There is no silver bullet, no single solution from a vendor that can provide absolute assurance your organisation is fully protected. In order to invest effectively, organisations have to take a personalised approach to their cyber security, one that is specific to their business needs, their existing digital ecosystem and their relationships with business partners. Here we outline a few security services that are available²⁹:

- **Enhanced Tiered Perimeter Security:** These systems are the first line of defence and ensure the only data allowed through are of a specific type and received in specific formats. These systems also leverage global databases of known attack methods to screen out a large proportion of potential attacks.
- **Vulnerability Assessment (VA):** This is the real-time scanning of internal and external infrastructure. This process identifies devices and/or systems which can be exploited through known vulnerabilities and makes recommendations for remedial action, such as updating code or patching servers. VA is often the resources required to address issues.
- **Behavioural Monitoring:** This is intelligent identification of suspicious activity within an organisation, which may indicate an active threat or even criminal activity.
- **Security Information and Event Management (SIEM):** This is an integrated suite of tools used to capture security-related data, correlate the data into meaningful information, and present as a dashboard. The dashboard provides security experts with sufficient data to identify threats and respond to them appropriately.

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15. Real-time communications

Construction is understood as a process with the following key players: client, contractor, sub-contractor, designer, construction technical supervisor, engineers, architects etc. The construction industry provides a typical example of an environment in which communication plays a significant role and is considered to be an invaluable requirement in order for businesses and professionals to function properly. Main reason being the industry is dependent upon large amounts of information being transmitted, at a rate of intensity and efficiency to meet the demands that many construction businesses require in a highly competitive market.

Example: Apps

In a recent study conducted by Auburn University, Alabama, it was found that there was more than 13,000 apps related to design and construction available on Apple's iPad. Research revealed that most of the apps are to be used during the construction phase and there is a lack of mobile apps for facility management in the market. The most used apps are sharing of large files between construction teams in the field. The second most popular type of app are weather apps. These apps are being used to schedule and coordinate weather sensitive construction activities. Some of the popular apps include 'Tradies's App' (site diaries, invoicing, tender requests app), 'Procure for iPhone' (construction project management app), 'Onsite Punchlist' (project punch lists organiser) etc of which most are directly related to quality control activities. There are a number of calculator based apps available on the market but it was found that these types of apps are of little use to construction managers.³⁰

³⁰ [Construction Apps – Auburn University, Alabama](#)

Example: Real-time Locating System (RTSL)

RTSL is developed by integrating a real-time locating system for tracking workers' location, a location monitoring system for mapping the workers location on a computerized building model, and alarm technology for sending early warnings. The developed system has been applied to an apartment project and an RTLS technology test centre in Korea, and proved to be effective in tracking and monitoring workers in real-time and preventing construction accidents.

Example: Wireless headsets and other tools

Improving job site productivity is essential to taking advantage of a booming construction industry. Modern construction wireless communication solutions help workers to gain more control on the job site, experience fewer work stoppages, keep both hands working at all times and improve work zone safety. Some of the modern products include wireless headsets and two-way radios.

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16. Online networking with the wider industry

In the commercial construction industry, being able to effectively network is a vital skill that could land your company on the path to the next big project. Besides taking advantage of your membership at ACENZ that allows you to network in vast events with like-minded individuals in your fields, you can also tap onto the power of digital networking.

Example: LinkedIn

Social networking sites like LinkedIn enables you to find new people you'd like to network with and having a shared connection introduce you to that person. LinkedIn groups like 'A/E/C Industry Networking Group', 'AEC Industry Online Social Media' are just a few examples where we can tap into the power of online networking. Although it should not replace face-to-face networking, it is still a valuable tool that shouldn't be overlooked. ACENZ offers both a company page and a Young Professionals page...so join us!

Example: ACENZ interactive website

ACENZ will launch its new website by end of 2017 that will facilitate an array of new social media integration. Using cross platform login features and social tools, users can comment, exchange ideas, and engage more easily using today's popular programmes (such as Facebook and Twitter). Watch our space for new features and online tools.

17. Forging more intergovernmental relations

Market openness to foreign firms stimulates trade as well as the movement of capital, technology and skills across the global E&C sector. Impediments like tariffs and duties, strict capital requirements for foreign firms etc. need to be gradually be eliminated by national governments.

Example: The Australia – New Zealand Science, Research and Innovation Cooperation Agreement

A ground breaking bilateral international science agreement was signed between New Zealand and Australia at the Leaders' meetings in Queenstown in Feb 2017. The Australia – New Zealand Science, Research and Innovation Cooperation Agreement is a commitment to valuable collaboration across the innovation and science systems, and between researchers and innovative companies, on both sides of the Tasman. This Agreement sets out a clear work programme that will provide a vital focus-point for our cooperation going forward which is fundamental to both Australia and New Zealand economic growth.

Example: Construction Sector Transparency Initiative (CoST)

CoST works with governments, industry and local communities around the world to get better value from public infrastructure investment by increasing transparency and accountability. CoST is a multi-stakeholder initiative with 15 participating countries spanning four continents and aims to promote transparency by disclosing data from public infrastructure investment.

Example: Construction 2020

In 2013 the European Commission launched the "Construction 2020 Action Plan". The aim was to identify and implement concrete measures that help the European countries foster sustainable competitiveness in the construction sector. It plans to take action in three main areas to enhance international competition: a more open trade in building materials; a more straightforward recognition of the qualifications of foreign architects; and support services for EU-wide operations of small and medium-sized construction companies.

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CONCLUSION

It will be evident from the information presented in this document that the Construction Industry is made up of a broad spectrum of skills and resources and shows encouraging growth in the diversity of people, ideas and processes. There are optimistic signs for positive ongoing economic development within the industry through providing works and services to an active market of clients. Key considerations for maintaining continued stability in the industry are focused around good communication, collaborative client/provider relationships, and managing the available workload to avoid the historic cycles of 'boom-bust' scenarios.

The engineering and associated construction industry sectors are very much affected by political decisions and changing legislation, standards and regulations. In recognising the inevitability of regular change, ACENZ seeks to further develop and optimise its relationships, interactions and communications with the public sector. Thereby the Association can both participate in the formulation of relevant policy, and provide political guidance in matters that are pertinent to the industry.

ACENZ in undertaking its duties as a representative body for professional services bears a brand of being the 'Trusted Advisor'. That label incurs an expectation for leading, informing and educating our members, in addition to us also creating an environment for networking and dialogue that promotes positive changes to take place.

To further develop our industry New Zealand private and public sector leaders should continually be strategic and innovative in considering ways to stimulate the industry transformation and inspire innovations that would greatly benefit society and the environment. Promotion of tradeshow and conferences that showcase the latest ideas and technologies, together with regular engagement with fellow peers in the industry, are seen to be highly beneficial.

Looking forward, digital technologies will advance exponentially and can only realise their full potential if they are widely adopted as standard practice in industry. It is crucial to create a fertile environment for digitalisation within pertinent sectors of the industry. That task should be encouraged and assisted by government and its agencies in their roles as both a regulator and an incubator. The industry also must be aware of the growing threats relating to cybersecurity - early engagement with insurance providers for coverage against cyber threats is highly recommended.

In the emerging future marketplace, innovation will be a differentiator between the companies that will be recognised as market leaders and those that will simply be 'part of the pack'. Other industries, such as the automotive industry, have already undergone radical and disruptive changes, and their digital transformation is now well under way. Our ACENZ Engineering and Consulting companies need to act quickly and decisively in evaluating their culture and commercial objectives. Professional recognition and lucrative rewards await cohesive, nimble and innovative companies.

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The Association representing consulting and engineering professionals in New Zealand.
Level 11, 79 Boulcott Street, PO Box 10247, Wellington 6143
(04) 472 1202 or service@acenz.org.nz
www.acenz.org.nz