Economic impact of engineering – update

Engineering NZ

August 2021

pwc

Strictly private and confidential

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12 August 2021

Update to economic contribution of engineering report

Dear Jodi

As requested, we enclose our final update to our original report (dated February 2020) on the economic contribution of engineering. This supplement to the original report includes an explanation of how we have updated the figures and the data sources we have used.

Please note that this report is provided in accordance with the terms of our engagement as set out in our contract dated 23 June 2021 and is subject to the restrictions set out in Appendix 1.

Engineering continues to be an important part of the New Zealand economy. The period since the original report has been a challenging one due to the global pandemic and the value of engineering has maintained its value.

Thank you for the opportunity to work with you on this update.

Yours sincerely
for PricewaterhouseCoopers Consulting (New Zealand) LP

Chris Gould
Director

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Introduction

Background

In February 2020, PwC delivered a report on the economic impact of engineering. The report was commissioned by Engineering NZ to quantify engineering's contribution to the New Zealand economy.

Engineering is an important activity that cuts across many industries and occupations and is not identified separately in official economic statistics. An economic impact analysis was undertaken to estimate the value of engineering.

This report focused on what proportion of New Zealand's Gross Domestic Product (GDP) that can be apportioned to engineering activity. GDP is a measure of the goods and services produced within a given time frame – usually three months or a year.

Approach to original report

In the original report, two different approaches were taken to estimate the economic impact of engineering. The first approach was based on the estimated economic contribution by industry; the second approach was based on engineering occupations and their associated total income.

Key to the whole process was information gathered in a workshop of senior engineering experts organised by Engineering NZ and facilitated by PwC. The workshop resulted in estimates for the number of engineers in each industry, and the proportion of engineering and estimated salaries in engineering-related occupations.

For more detail on the approach, read the full report published in February 2020.
https://www.engineeringnz.org/public-tools/big-deal/

Purpose and scope of update

Engineering NZ commissioned an update to the figures from the original report so that current figures can be used to help promote the importance of engineering.

This update builds on the original work done to estimate the economic contribution of engineering and is intended to supplement the previous report.

The original work included a workshop to understand the contribution of engineering to industries and occupations. We did not run another workshop to re-test these assumptions which are unlikely to have changed since the time of that report.

This update uses the latest available official data to update both the industry and occupation approaches to measuring economic impact.

Limitations

The original report explained the approaches taken and highlighted the limitations of constructing an economic impact analysis. Those limitations still hold and can be found in detail in the original report.

Two of these limitations are worth noting again. They are:

- GDP is a measure of activity that has occurred and does not account for, or consider, the long lifespan of assets that are typically created through engineering activity.

- Economic activity will often have flow on impacts to other areas of the economy (the multiplier effect). Estimating the size of this impact is outside the scope of both the original report and the update.

Updating the original report involves choices about what data to use and why. These choices result in implicit assumptions. The choices are usually related to the availability of data. For example, if recent industry data is not available then an implicit assumption might be that all industries grow at the same rate, for periods where that detail is not available. We do not make any judgement about whether these implicit assumptions are correct or not. Further detail regarding these assumptions and limitations is highlighted in the relevant sections below.

Updated data in the report

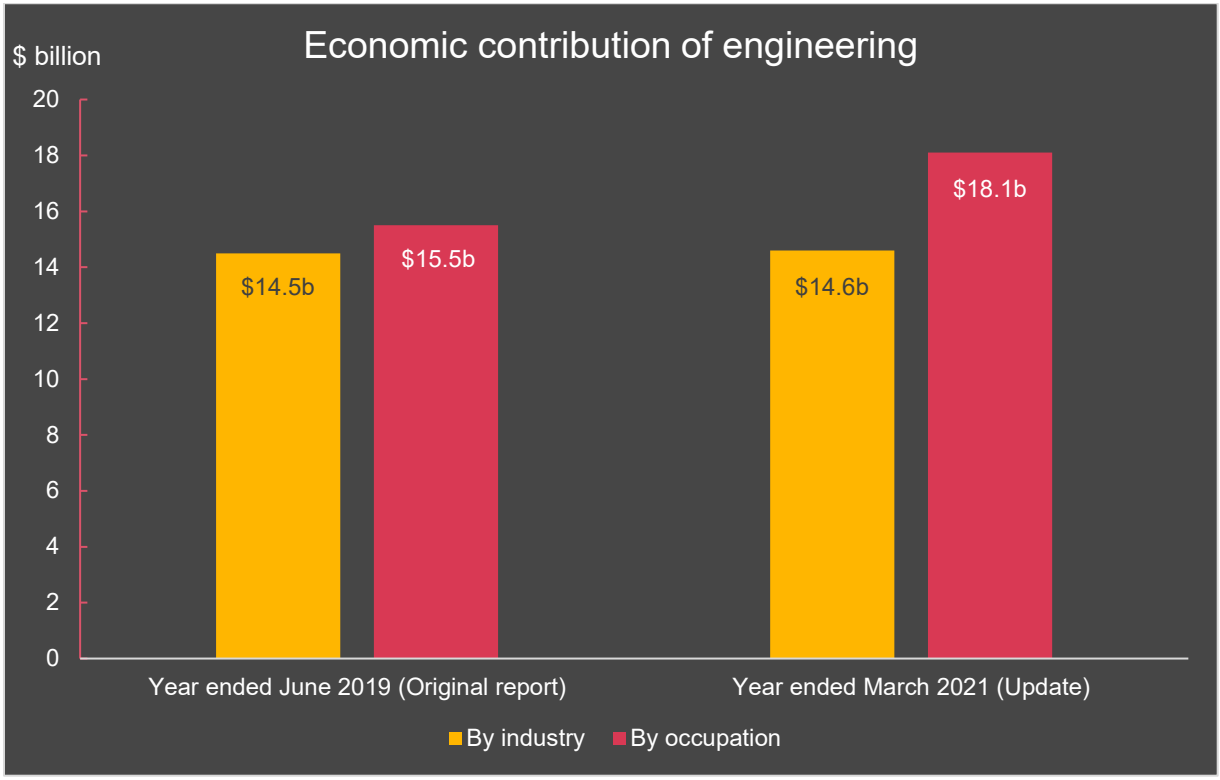
New estimates of the contribution of engineering to the New Zealand economy

In this latest update, the contribution of engineering is estimated to be between $14.6 billion and $18.1 billion (4.5 to 5.6 percent of GDP) for the year ended March 2021.

In the original report, the estimated contribution of engineering to the New Zealand economy was between $14.5 and $15.5 billion for the year ended June 2019.

Table 1 New estimates of engineering contribution

Measure	Original report	Update
Total GDP ($ million)	300,032[1]	325,085
Engineering – industry approach ($ million)	14,493	14,569
Proportion of GDP (percent)	4.8	4.5
Engineering – occupation approach ($ million)	15,476	18,095
Proportion of GDP (percent)	5.2	5.6



The period between the original report and this update includes the impacts of the COVID-19 pandemic. In addition to lives lost to the virus, economies around the world, including New Zealand's, were affected as some industries were unable to operate at usual levels.

[1] This number has since been revised by Stats NZ

While the latest available official data is used throughout, it needs to be acknowledged that there has been a relatively short period of time since the original report, with not a lot of new data points. For example, detailed GDP data is updated annually, with only one additional release since the original report was delivered.

New Zealand's GDP grew 4.7 percent between the year ended June 2019 (the reference point for the original report) and March 2021 (the reference point for this update).

According to the new estimates, **engineering contributes between 4.5 and 5.6 percent of New Zealand's GDP.**

Engineering does not fit neatly into one of the standard industries, so the contribution of engineering is across all industries. To put the scale of the estimate into perspective, traditional industries with similar contributions to GDP include:

- Agriculture (5.6 percent of GDP) – this industry includes horticulture and fruit growing; sheep, beef cattle and grain farming; dairy cattle farming; and poultry, deer and other livestock farming.
- Transport, postal and warehousing (4.4 percent of GDP).
- Financial and insurance services (5.6 percent of GDP).

The following sections provide more detail into how the numbers were updated.

1. Updating the industry measure

The updated estimate of the economic contribution of engineering using the industry approach is between $14.6 billion and $15.4 billion. This represents 4.5 to 4.7 percent of GDP for the year ended March 2021.

Workshop data and original approach

The original report used information gathered at a workshop of engineering experts to estimate the number of engineers by industry.

An average contribution to GDP per employee was calculated for each industry. This average contribution per person was multiplied by the estimated number of engineers in that industry to get an engineering contribution by industry. The sum of engineering by industry calculations became the total contribution of engineering to the entire economy.

Updating the estimated number of engineers in each industry

The number of engineers for each industry (as estimated in the original workshop) was updated by growth in full-time equivalent employees (FTEs) by industry using data from Statistics New Zealand's Quarterly Employment Survey[2] (QES) from June 2016 to March 2021.

The QES does not include the agriculture industry as part of its survey coverage. The number of estimated engineers in the agriculture, forestry and fishing industry was updated by the change in Employee Count (EC) from February 2016 to February 2020 using the latest available Business Demography Statistics[3]. The estimated number of engineers in the agriculture industry is about 10 percent of the total number of engineers across all industries.

Updating estimates of GDP by industry

In the original report, the latest available total GDP number was used (year ended June 2019), and the overall growth rate in total GDP (from 2016 to 2019) was applied to the latest available industry figures.

[2] https://www.stats.govt.nz/information-releases/labour-market-statistics-march-2021-quarter

[3] https://www.stats.govt.nz/information-releases/new-zealand-business-demography-statistics-at-february-2020

At the time of updating this report, the latest available estimate for total GDP (the expenditure measure) in current prices was for the year ended March 2021[4]. The latest available GDP by industry data, in current prices, is for the year ended March 2019[5].

Consistent with the approach in the original report, the total GDP growth rate from 2019 to 2021 was applied to 2019 industry level data to derive industry estimates for 2021.

This approach implicitly assumes that all industries grew at the same rate over that period.

Updating the GDP per employee ratio

To calculate the average GDP per employee, we used two different approaches and present them both here.

The different approaches relate to how the number of engineers is defined. There are two major measures used in labour market statistics: employee count (EC) and full time equivalent (FTEs). Employee counts include all employees regardless of how many hours they work, and FTEs creates a standardised unit to account for part-time employees. To illustrate the difference in the measures, if there are two people working for a business and each works 20 hours a week, the employee count for the business would be 2, and the FTE count would be 1 (0.5 + 0.5).

The first estimate uses the employee count by industry from Business Demography Statistics. The latest available figures at the time of updating the report are as at February 2020.

Year ended March 2021 GDP industry estimates were divided by the industry employee counts as at February 2020.[6] This gives a ratio of economic contribution per employee, by industry.

This ratio is then multiplied by the estimated number of engineers in each industry as determined in the original workshop. Summing up those industry estimates gives a total of $14.6 billion.

The alternative calculation approach is to use industry FTEs (full time equivalent employees) instead of employee counts.

The choice of method of calculation of the number of engineers (Employee Count vs FTEs) makes a difference.

Using the ratio of FTEs contribution to GDP by industry results in an estimated contribution of engineering of $15.4 billion. This is somewhat higher than the approach using employee counts.

Implicit assumptions

It is important to note that the choices made to update the data result in the following implicit assumptions:

- The growth in number of engineers in each industry is the same as overall growth in FTE numbers for each industry. That is, the ratio of engineers to overall FTEs per industry has remained constant from 2016 to 2021.
- The growth by industry in current prices from the year ended March 2019 to the year ended March 2021 is the same as the growth in expenditure on GDP in current prices.
- The contribution of engineers to the value added of each industry is the same as any other employee in each industry. This assumption was also made in the first report and is likely to understate the contribution of engineers.

It is not possible to comment on the degree to which these implicit assumptions accurately reflect reality.

[4] https://www.stats.govt.nz/information-releases/gross-domestic-product-march-2021-quarter

[5] https://www.stats.govt.nz/information-releases/national-accounts-industry-production-and-investment-year-ended-march-2019

[6] We did test rating forward the February 2020 estimates by the movement in FTEs to March 2021, but it made miniomal difference to the total.

2. Updating the occupation approach

The updated economic contribution of engineering as measured by the occupation approach was $18.1 billion for the year ended March 2021. This compares with the estimate in the original report of $15.5 billion for the year ended June 2019.

Workshop data and original approach

There are three different approaches to measuring GDP, and one of these is the income approach. In the national accounts framework, the total income in an economy from different sources is equal to the total value added by all industries and to the total expenditure in an economy.

The approach in the original workshop was to estimate the total income of engineers. The equivalent concept for the whole economy is referred to as compensation of employees (CoE).

The original report calculated the ratio of CoE as a proportion of total GDP by dividing one by the other. Applying the overall economy ratio of CoE to GDP to the estimated income of engineers from the workshop provides another estimate of the contribution of engineering to the New Zealand economy.

Updating the compensation of employees to GDP ratio

The biggest driver of change between the occupation estimate in the original report and this update is the ratio of CoE to total GDP.

In the original report, the CoE to GDP ratio was based on figures from the 2013 Input-Output tables. The latest update uses data from the Income and Expenditure accounts for the year ended March 2020[7]. We used the Income and Expenditure accounts for the latest update because the data is published annually and is more up to date with the latest revisions to data. In contrast, the Input-Output tables are only updated every 7-10 years. The national accounts are subject to revision as more data becomes available.

Table 2 CoE to GDP ratio

	Original Report*	Update**
Compensation of Employees ($ million)	94,901	138,142
Gross Domestic Product ($ million)	196,014	323,142
Ratio of CoE to GDP	0.484	0.427

*National Accounts input-output tables: Year ended March 2013

**National Accounts (income and expenditure): Year ended March 2020

The change in the ratio from 0.484 to 0.427 alone added $2.1 billion to the original estimate. The CoE to GDP ratio for the year ended March 2019 is 0.425, using this ratio instead of the 2013 Input-Output tables gives an estimated contribution $17.6 billion, $2.1 billion higher than the estimate in the original report. The rest of the $2.6 billion change from the original calculation to this update is accounted for by growth in wage rates and the estimated number of engineers from September 2019 to March 2021.

[7] https://www.stats.govt.nz/information-releases/national-accounts-income-and-expenditure-year-ended-march-2020

Updating the engineering salary estimates
In the original report, the salaries of engineering occupations were estimated based on the knowledge of experts who attended the engineering workshop.

To update the original salary estimates, PwC used movements in the Labour Cost Index (LCI)[8] produced by Stats NZ to update the original salary estimates. The LCI measures how average salaries have moved over time and is reported at a relatively broad (high) level of occupation.

The period used to update the workshop data was from September 2019 (when the workshop took place) to March 2021 (latest available data). The relevant high-level occupation categories are Managers, Professionals, Technicians and Trade Workers, Machinery Operators and Drivers, and Labourers. Labour costs for these occupations rose by between 2.1 percent and 3.7 percent over the period.

Updating the number of engineers by occupation
High level occupation data is available from the HLFS on a quarterly basis. This data was used to update the original workshop estimates of how many engineers there are by occupation.

The period used to update the workshop data was from September 2019 (when the workshop took place) to March 2021 (latest available data).

During this period, the number of managers increased by over 10 percent, while the other relevant occupations (professionals, technicians and trade workers, machinery operators and drivers, and labourers) remained relatively constant.

Implicit assumptions
The choices made to update the occupation-related data result in the following implicit assumptions:

- The ratio of salaries and wages (compensation of employees) to GDP is the same for engineers as the overall average for the economy.
- Wage growth is the same for engineers and non-engineers within the same industry.
- The number of engineers by occupation has grown at the same rate as the relevant overall occupation category.

It is not possible to comment on the degree to which these implicit assumptions accurately reflect reality.

[8] https://www.stats.govt.nz/information-releases/labour-market-statistics-march-2021-quarter

3. Summary estimates

The summary estimates are the midpoints taken between the two methods (industry and occupation approaches) described above. For the year ended March 2021, the midpoint estimate for the engineering contribution to GDP was **$16.3 billion (5.0 percent of GDP).**

Both the lower and upper methods for calculating the estimated number of engineers were updated for this report. The midpoint for these two measures is an estimate of **77,600 engineers**. Using the midpoint of the industry and occupation measures, the average estimated contribution to the economy per engineer is $228,000.

Table 3 Summary estimates (including midpoints)

	Estimate by industry	Estimate by occupation	Midpoint	Total economy
Contribution to GDP ($million)	14,602	18,095	**16,349**	325,085
Proportion of GDP (percent)	4.5	5.6	**5.0**	…
Number of engineers	95,800	59,500	**77,600**	2,758,000*
Average contribution per engineer	$152,000	$304,000	**$228,000**	$118,000**

Note: totals may not add due to rounding.

*Total number of persons employed as at 31 March 2021, as estimated by the Household Labour Force Survey.

**Total GDP divided by number of persons employed as at 31 March 2021.

4. Engineers needed

In the original report, it was estimated that 1,500 additional engineers would need to be added to the workforce every year. This estimate was based on the assumptions that engineering grows at the same rate as the rest of the economy, and that the economy grows at a rate of 2 percent per year. This estimate did not include replacement for people leaving the profession via retirement, change in occupation, or other reasons.

While none of the underlying data has changed since the original report, current Treasury forecasts are for annual average GDP growth between 2.9 and 4.4 percent over the next few years.[9] Based on this, an assumed growth rate of GDP of around 3 percent a year is not unreasonable. Keeping the rest of the original assumptions as given, and using the updated number of engineers, this equates to at least 2,300 additional engineers needed per year.

Infrastructure pipeline

An alternative way to understand how many engineers might be needed is to look at future demand.

In line with this, you have asked us to comment on the level of government investment in engineering projects right now (infrastructure in particular) and how demand for engineers may be impacted. This information is not, as far as we are aware, published in any readily accessible form.

[9] https://www.treasury.govt.nz/publications/budgets/budget-2021

We note however that Te Waihanga, the New Zealand Infrastructure Commission, publishes a **pipeline of major infrastructure projects**[10] that have been announced across organisations (mainly central and local government, but there are some private sector projects).

The pipeline gives an indication of the value of infrastructure projects and the timing of different phases. This could be a useful starting point to help estimate how many additional engineers are needed in coming years. It is likely that most of these infrastructure projects will have an engineering component, boosting demand for engineering skills.

New infrastructure is also not the only source of demand for engineers, as demand for engineering services extends beyond the infrastructure sector. The impact of COVID-19, including current limits to migration, will impact on the supply side, further exacerbating the need for engineering skills. All these factors combined signal that the need for new engineers is likely to remain strong.

[10] https://infracom.govt.nz/projects/pipeline/

Appendix 1: Restrictions

This report has been prepared solely for the purposes stated herein and should not be relied upon for any other purpose. We accept no liability to any party should it be used for any purpose other than that for which it was prepared.

This report is strictly confidential and (save to the extent required by applicable law and/or regulation) must not be released to any third party without our express written consent which is at our sole discretion.

To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this Report and/or any related information or explanation (together, the “Information”). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us and have not conducted any form of audit in respect of the organisation for which work is completed. Accordingly, we express no opinion on the reliability, accuracy, or completeness of the information provided to us and upon which we have relied.

The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this report are based on information available as at the date of the report.

We reserve the right, but will be under no obligation, to review or amend our report, if any additional information, which was in existence on the date of this report, was not brought to our attention, or subsequently comes to light.

This report is issued pursuant to the terms and conditions set out in our contract dated 23 June 2021.

Appendix 2: Glossary of acronyms

ANZSCO	Australia and New Zealand Standard Classification of Occupations
ANZSIC	Australia and New Zealand Standard Industrial Classification
CoE	Compensation of Employees
Constant prices	GDP expressed in real terms, adjusted for price affects, also referred to as the volume measure.
Current prices	GDP expressed in dollars, unadjusted for price change
EC	Employee Count
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GDP(E)	Expenditure measure of GDP
GDP (P)	Production measure of GDP
HLFS	Household Labour Force Survey
LCI	Labour Cost Index
QES	Quarterly Employment Survey
VA	Value added

Appendix 3: Calculations

By Industry

The industry approach uses a similar method to the original report, with updated data.

The latest GDP by industry data in current prices is available for the year ended March 2019. Total current price GDP (expenditure measure) is available for the year ended March 2021.

The GDP growth rate from YE March 2019 to YE March 2021 was applied to all industries.

An example is provided below.

Calculation for CC Manufacturing using the employee count:

- YE March 2019 GDP was $30,654 million
- GDP growth from YE March 2019 to YE March 2021 was 5.99 percent
- Derived YE March 2021 GDP (30,654 *1.0599) = $32,489 million
- Employee count (at February 2020) 235,200
- Average GDP per person GDP/EC 32,489m/235,200 = $138,135
- Number of engineers in industry (from original workshop) 17,260
- Change in FTEs from June 2016 (204,200) to March 2021 (207,300) = 1.518 percent
- Updated number of engineers 17,260 * (1+1.518) = 17,522
- Average GDP per person multiplied by the total number of engineers $138,135 * 17,522 = $2,420 million.

This calculation was made for all the high level ANZSIC06 industries. The total estimated GDP contribution according to this calculation was $14.6 billion.

Calculation for CC Manufacturing using FTEs:

- YE March 2019 GDP was $30,654 million
- GDP growth from YE March 2019 to YE March 2021 was 5.99 percent
- Derived YE March 2021 GDP (30,654 *1.0599) = $32,489 million
- Employee count (at March 2021) 207,300
- Average GDP per person GDP/EC 32,489m/207,300 = $156,726
- Number of engineers in industry (from original workshop) 17,260
- Change in FTEs from June 2016 (204,200) to March 2021 (207,300) = 1.518 percent
- Updated number of engineers 17,260 * (1+1.518) = 17,522
- Average GDP per person multiplied by the total number of engineers $156,726 * 17,522 = $2,746 million.

This calculation was made for all the high level ANZSIC06 industries. The total estimated GDP contribution according to this calculation was $15.4 billion.

By Occupation

The industry approach builds on calculations undertaken for the original report, updating for data to estimate growth in salaries and wages and the number of engineers.

The starting point for this calculation was the estimated total remuneration for each occupation from the original workshop. This uses 2018 Census data by occupation, estimates the proportion of the occupation is engineering, and estimates the average remuneration. Updates to this are applied at the highest (ANZSCO) level as this is the level that more up to date data is available.

The latest available data on the LCI and the number of engineers by occupation is for the March 2021 quarter. The movement used for these updates is from the September 2019 quarter (when the workshop took place) to the March 2021 quarter (latest available data).

The latest data available on compensation of employees in the national accounts is for the year ended March 2020. This period is used to estimate the CoE to GDP ratio.

Calculation for Engineering managers (ANZSCO 133211):

- Estimated total remuneration (from original workshop) $292 million
- Compensation of employees (CoE) to GDP ratio (year ended March 2020) CoE $138,142 million divided by GDP $323,142 million = 0.427
- Estimated value add $292 million / 0.427 = $685 million
- Growth in salary and wages from the LCI (ANZSCO 1) September 2019 quarter to March 2021 quarter 2.05 percent
- LCI wage rate growth applied $685 million * 1.0205 = $699 million
- Growth in number of people in the high-level occupation category (ANZSCO 1) from September 2019 to March 2021 10.24 percent
- Growth in occupation category from workshop to latest data applied $699 million * 1.10205 = $771 million.

This calculation was made for all the occupations identified in the original workshop. The total estimated GDP contribution according to this calculation was $18.1 billion.

For more information, go to www.pwc.co.nz