Australian INNOVATION RESEARCH Centre

STRUCTURE, BUSINESS DEMOGRAPHICS AND INNOVATION IN TASMANIAN MANUFACTURING

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Structure, Business Demographics and Innovation in Tasmanian Manufacturing

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1 EXECUTIVE SUMMARY

This report uses firm-level data from the Tasmanian Innovation Census to explore activities that make up the manufacturing industry, the composition of the population of firms, and the innovation behaviour of the Tasmanian manufacturing sector as a whole.[1]

Much of the available data on manufacturing is very aggregate in character. By contrast, we seek to go into detail. The Tasmanian Innovation Census is a firm-level survey covering all firms with 5 or more employees in Tasmania. A total Tasmanian population of 2807 firms yielded 1591 responses; of the population, a total of 497 were manufacturing firms, of whom 316 (or 63.6%) responded. As in all advanced economies, the population is skewed towards small firms: 84.8% of respondents have less than 50 employees. Within manufacturing the largest sectors are four so-called "low technology" or "medium technology" industries: food products, metals and metal products, transport equipment and machinery.

We show that these sub-industries of manufacturing are clustered into a small number of localities. They are very innovation-active, with 80% of firms introducing new or improved products or changing their production processes, or both during the past three years. Manufacturing firms invest heavily in innovation, particularly in acquiring advanced technologies through capital investment, or through R&D – more than 60% of Tasmanian manufacturing firms undertake in-house R&D. On the output side, approximately 31% of sales in the most recent financial year came from products that had been innovated within the past three years.

However although innovation activity is wide in Tasmania, it is not deep. Most innovation activity comes from a small group of "highly innovating firms". Just over 70% of all innovation investment is carried out by a small group of around 25 firms (around 10% of total firms investing). Similarly with innovation sales: around 10% of firms (i.e. around 20 firms) are responsible for 80% of such sales. We show in the report that these highly innovative firms are widely distributed across sub-industries in manufacturing, but that the characteristics of highly innovative firms differ across inputs and outputs. The industry sub-sectors with the most contributors to the set of highly innovative firms are:

- Food product manufacturing
- Pulp, paper and converted paper manufacturing
- Textile, leather, clothing and footwear manufacturing

The Tasmanian Innovation Census has data on the destinations of sales by industry, and this enables a preliminary mapping of the value chains within which Tasmanian manufacturers are embedded. We show that the innovative outputs of Tasmanian manufacturing firms are widely used in such industries as fishing and aquaculture, food processing, forestry and agriculture/horticulture. Manufacturing also draws on inputs from other sectors in Tasmania, in particular Professional, Scientific and Technical Services.

[1] We would like to thank Sophie Jerrim for her work on the development of data for this report.

The picture that emerges from this work is of a small but innovative manufacturing sector that is closely integrated into the Tasmanian industrial structure and the business life of the region.

This paper is a revised version of a report commissioned by Enterprise Connect and the Cradle Coast Authority as part of their ongoing work in support of Tasmanian manufacturing firms. Opinions and conclusions are those of the AIRC team only, and do not necessarily reflect those of either Enterprise Connect or the Cradle Coast Authority.

2 INTRODUCTION

Although the manufacturing sector usually comprises less than 20 percent of GDP in OECD economies, it is important by virtue of its contributions to exports and to the generation and diffusion of innovations. Even in a small regional economy such as Tasmania, manufacturing plays a central role. But its structure, dynamics and innovation performance tend not to be well understood. This report looks at some of the main characteristics of manufacturing in Tasmania, in terms of its structure and innovation performance.

3 OBJECTIVE

The objective of this report is to present a quantitative overview of the Tasmanian manufacturing industry and innovation within it, through analysis of data from the Tasmanian Innovation Census. As its name implies, the Census is a detailed survey of all businesses – in this case all businesses with five or more employees in Tasmania.

The report reviews the structure of the manufacturing sector, the nature of innovation activities, investment in innovation, and outputs of innovation (in terms of sales from innovative products). In exploring the nature of innovation activities the report looks at Research and Development (R&D), collaboration, and most important innovations. The distribution of innovative activities is presented, with some discussion of basic characteristics of the most intensive innovators. It also develops a data framework for a preliminary understanding of the value chains in which Tasmanian manufacturing is embedded. This involves tracking sector inputs (sectors selling into) and outputs (sectors buying from) to and from Tasmanian manufacturing. We show that Tasmanian manufacturing is closely linked to the key value chains of the Tasmanian economy, both as a source of technology and as a recipient of inputs.

4 DATA ON THE MANUFACTURING SECTOR IN TASMANIA

The Tasmanian Innovation Census (TIC) is distinct from any other major source of data on the manufacturing industry, specifically in terms of its coverage of Tasmanian manufacturing firms. The reason is that the TIC attempted to survey the entire target population, rather than a sample of the target population, as is the case with most other data sources.

The wide coverage enables us to overcome some limitations in the currently available data. Two of the main ABS publications covering manufacturing include *Manufacturing Industry, Tasmania* (ABS 8221.6.55.001), and *Manufacturing Industry, Australia* (ABS Cat No. 8221.0). Although some data is included to 4 digit ANZSIC class, around half the 200 industry categories are not published for Tasmania at class level, and for the most part there is a distinct trade off between the level of detail accessible in terms of industry, firm size and area classifications. For instance some data at industry subdivision level is mostly only available at State level, where data at sub-state level is often only available at industry division level, and the most detailed ABS manufacturing data for Tasmania is from 2001-2002.

In terms of performance analysis, industry briefs produced at the Federal level do not contain breakdowns by state.[2] Neither do the various reports on manufacturing innovation, and on "business innovation" - which derive from the ABS national innovation survey - have sub-state level data with analysis beyond the two digit level. In fact most of the data presented in these reports covers Australian manufacturing as a whole.[3]

To better understand the structure and business demographics of the manufacturing sector in Tasmania, there is a need for greater granularity in the data, specifically in terms of industry classification, but also in terms of the make up of various industry sub-sectors based on the distribution of firms by size, and contribution to, output, economic growth and productivity–characteristics typically measured through indicators such as number of employees, turnover, value added, and innovation.

With the wider and more detailed coverage of the innovation census data, it is possible to undertake analyses in more precise detail for industry, location, and size and to cross classify these dimensions of manufacturing to provide a richer picture of the structure and business demographics of the sector than is currently possible with available data sources.

In attempting to understand the dynamics of innovation activity in the Tasmanian manufacturing sector, the innovation census presents the most comprehensive available data source, and is the first major attempt to map out the extent of innovation activity occurring across the Tasmanian economy at firm level. The other main data source relating to innovation activity in Tasmania comes from the national ABS innovation survey, which is primarily designed to provide data at a national level, and as such features innovation data for Tasmania only at the State level, and at ANZSIC division level for industry.

Thus the census data augments available data sources to provide richer insights into the structure of the manufacturing sector in Tasmania, and provides a unique means of better understanding the dynamics of innovative activity within the sector. In utilising the census data however, it is necessary to consider the objectives, methods and background to how it was collected to provide the context for analysis.

5 BACKGROUND INFORMATION ABOUT THE INNOVATION CENSUS

There were 2807 firms in the target population, which comprised all firms with 5 or more employees, across all sectors of the Tasmanian economy. Of these, 1591 firms completed the innovation census questionnaire, giving a response rate of 56.7%.

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[2] See for example, Department of Industry, Tourism and Resources, (2006) *Manufacturing Sector 2004-5. Industry Brief* (Canberra)

[3] See: ABS/DITR (2006) *Patterns of Innovation in Australian Businesses 2003* Report 8163.0; ABS (2007) *Patterns of Innovation in Australian Businesses 2005*, Report 8163.0; ABS (1998), *Innovation in Manufacturing,* Report 8116.0; DITR (2007), *Patterns of Innovation in Australian Manufacturing 2003* (Canberra).

The census involved computer assisted telephone interviews that covered innovation activities by type, investment in innovation, sales from innovative products, research and development and collaboration activities, and business demographic information such as firm ownership structure, export status, and turnover and number of employees at two time intervals. The main reference period for the census is the three-year calendar period 2004-2006. Financial data relates to the most recent financial year ended on or before 30 June 2006. Some data relate to the calendar year 2006.

Further information regarding the specific methodology behind the census project can be found in TIC working paper no 2: *Technical and methodological issues in the Tasmanian innovation census*, available at www.airc.net.au.

6 THE MANUFACTURING SECTOR IN TASMANIA – INDUSTRY STRUCTURE

Within the TIC, firms were classified by industry using the standard ANZSIC 2006 classification, to maximise consistency and compatibility with other available data.

As can be seen in Table 1, the census response rate for manufacturing firms, at 63.6% was higher than for the population as a whole, indicating good coverage and good sector representation in the data.

Table 1. Census response for manufacturing industry

Response for manufacturing industry	
Responding population	316
Number of manufacturing firms in the population	497
Response Rate for Manufacturing Sector	63.6%

6.1 Business counts by industry subdivision, responding and total population

A comparison of the distribution of manufacturing categories in the responding population and total population or economy as a whole provides an indication of how well the sector is represented in the response data. Figure 1 shows the distribution of manufacturing firms in the responses, and Figure 2 for the whole population of manufacturing firms.

Figure 1. Tasmanian manufacturing industry by ANZSIC subdivision, responding firms N=316

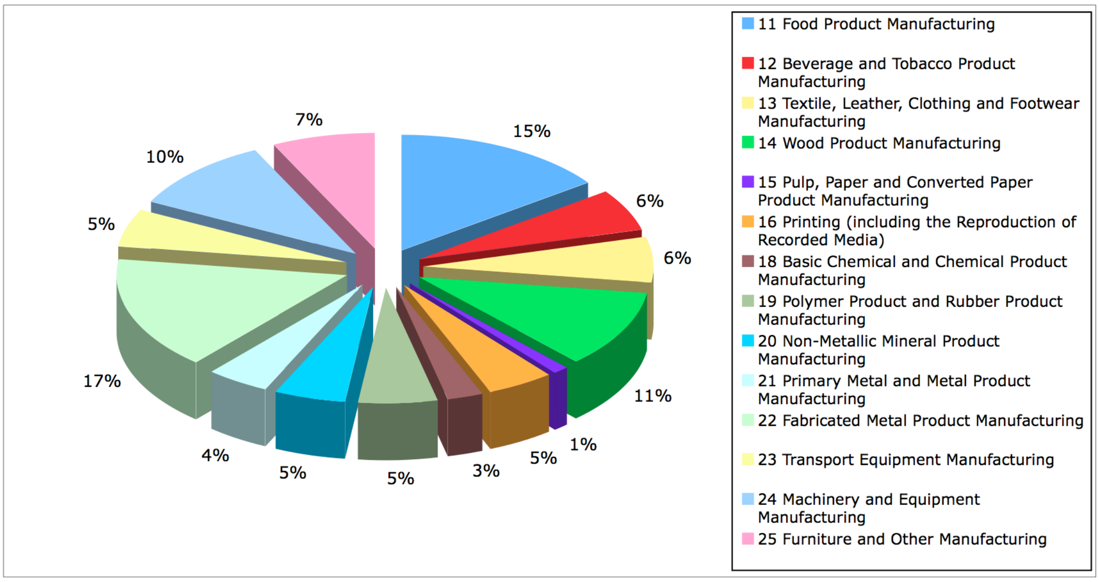
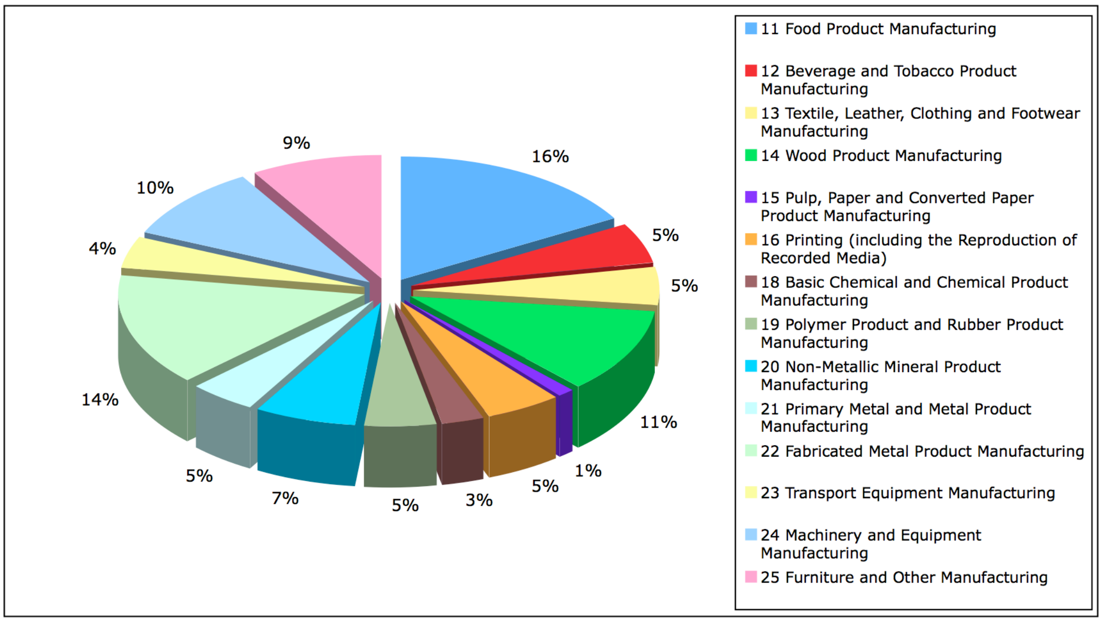


Figure 2. Tasmanian manufacturing industry by ANZSIC subdivision, total population N=497



The distributions of firms by industry subdivision in Figure 1 and Figure 2 are very similar, with the four largest sectors (in terms of number of firms) in each figure consisting of food product manufacturing, fabricated metal product manufacturing, machinery and equipment manufacturing, and wood product manufacturing. In all cases the sectoral response shares are within a few percentage points of the industrial structure share. This indicates a good representation of the sector as a whole in the response data.

A point to note here is that one subdivision was removed from the total population in Figure 2 to facilitate comparison of like industries. The subdivision removed was

Petroleum and Coal Product Manufacturing, because it included very few firms in the total population and was not represented in the response data.

A note on the census population construction

The population list of all firms in Tasmania with 5 or more employees was constructed over a period of a year and a half, from the integration of a number of existing commercial, administrative and State and Federal government data sources (including the ABR and ASIC business listings) combined with fieldwork and local investigation.

Although AIRC is confident in the quality of the coverage - the population list has been comprehensively quality assured against every available source - there can be no ultimate guarantee in terms of the figures generated and users are urged to consider the methodological and statistical issues when using the data. Methodological issues are discussed in the working paper *Technical and methodological issues in the Tasmanian innovation census*, available through www.airc.net.au.

6.2 Business counts by firm size class

Tasmania reflects a size distribution of firms that is invariably found across all major economies, with a small proportion of large firms, and a very large proportion of SMEs. The overall size distribution of firms can be seen in Table 2.
Within the innovation census 84.8% of respondents had less than 50 employees; over 35% had less than ten employees.

Table 2. Manufacturing industry by firm size class (Full Time Equivalent employee range)

Firm size class	No of responding firms	Proportion of responding firms (%)
5-9 FTE	114	36.1
10-19 FTE	80	25.3
20-49 FTE	74	23.4
50-99 FTE	22	7
100-249 FTE	15	4.7
250 + FTE	11	3.5
Total	316	100

6.3 Descriptive statistics for employment

The descriptive statistics in Table 3 provide information about the distribution of firms by size within each manufacturing subdivision. We calculated the arithmetic mean number of employees for each subdivision, and also the median (the value at the middle of the distribution, with 50% of firms on either side).

Table 3. Descriptive statistics for number of employees

No of Full Time Equivalent (FTE) employees - manufacturing			
ANZSIC 2006 Subdivision - 2 digit level	**N**	**Mean**	**Median**
15 Pulp, Paper and Converted Paper Product Manufacturing	4	210.63	210.00
21 Primary Metal and Metal Product Manufacturing	14	120.36	23.75
23 Transport Equipment Manufacturing	17	97.00	20.50
18 Basic Chemical and Chemical Product Manufacturing	8	55.31	24.00
13 Textile, Leather, Clothing and Footwear Manufacturing	20	49.90	14.25
24 Machinery and Equipment Manufacturing	32	47.16	15.25
11 Food Product Manufacturing	47	45.26	19.00
12 Beverage and Tobacco Product Manufacturing	19	31.68	13.00
14 Wood Product Manufacturing	34	30.06	14.00
16 Printing (including the Reproduction of Recorded Media)	15	29.55	16.00
20 Non-Metallic Mineral Product Manufacturing	16	18.14	20.00
19 Polymer Product and Rubber Product Manufacturing	17	16.82	10.00
22 Fabricated Metal Product Manufacturing	50	16.59	10.55
25 Furniture and Other Manufacturing	23	12.30	9.50
Total	316	41.17	13.25

The sub-division with the highest mean and median numbers of employees is also characterised by a low number of firms. This sector, pulp and paper, is characterised by relatively large firms, deriving from economies of scale in production. Where the mean is significantly higher than the median, then the proportion of large firms is small, indicating that within the sector there is scope for specialisation by smaller firms.

6.4 Industry sub-divisions by total contribution to employment

Table 3 indicated the patterns of employment within sub-divisions, but what is the relative contribution of each sub-division to total manufacturing employment? This becomes clearer by looking at the ranking of sub-divisions by total employment in Table 4 below.

Table 4. Manufacturing sub-divisions by total no of FTEs

ANZSIC 2006 Subdivision - 2 digit level	Full time equivalents for employees 2006 (Sum)
11 Food Product Manufacturing	2,127
21 Primary Metal and Metal Product Manufacturing	1,685
23 Transport Equipment Manufacturing	1,649
24 Machinery and Equipment Manufacturing	1,509
14 Wood Product Manufacturing	1,022
13 Textile, Leather, Clothing and Footwear Manufacturing	998
15 Pulp, Paper and Converted Paper Product Manufacturing	843
22 Fabricated Metal Product Manufacturing	830
12 Beverage and Tobacco Product Manufacturing	602
16 Printing (including the Reproduction of Recorded Media)	443
18 Basic Chemical and Chemical Product Manufacturing	443
20 Non-Metallic Mineral Product Manufacturing	290
19 Polymer Product and Rubber Product Manufacturing	286
25 Furniture and Other Manufacturing	283
Total	**13,009**

Food product manufacturing is the largest manufacturing employer in Tasmania, something not uncommon in developed economies (this is generally a large sector across the OECD). It is followed by primary metal and metal product manufacturing and transport and equipment manufacturing. What we have here is a strong focus – not untypical of advanced economies generally – of manufacturing employment in what are usually referred to as low-technology industries.[4] Tasmania simply does not have any high-tech manufacturing capacity of significant size. Although there are quite different collection methodologies and slightly different reference periods, it is noteworthy that the top 5 employing manufacturing subdivisions above overlap closely with top 5 in the most recent ABS manufacturing data for Australia as a whole (*2006-2007 Manufacturing Industry, Australia -ABS Cat No. 8221.0*). In other words, it may be reasonable to see Tasmania as a microcosm of Australian manufacturing in terms of its structure.

6.5 Business counts by turnover range

Manufacturing firms are similarly distributed in terms of turnover range, with 85.2% of firms having a turnover of less than $10 million in the 2005-2006 financial year, although with a slightly different clustering pattern between the lower categories than for employment.

Table 5. Manufacturing firms by turnover range category

Turnover range category	Number of responding firms	Proportion of responding firms (%)
Less than $1m	73	23.9
$1m-less than $5m	151	49.5
$5m-less than $10m	36	11.8
$10m-less than $50m	28	9.2
$50m-less than $100m	6	2
$100m or more	11	3.6
Total	305	100

6.6 Descriptive statistics for turnover

Again the descriptive statistics provide further indication of the distribution across industry subdivisions in Table 6. This is similar to the data for employment. The fact that the mean value is so much higher than the median indicates that across all industries output is disproportionately derived from a small number of large firms. Economies of scale do not necessarily dominate the picture however: the existence of skewed distributions of output, across all subdivisions, can also be interpreted to mean that niches and specialisation are also present within these subdivisions.

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[4] Only three OECD economies (Ireland, Korea and Finland) have more than 5% of GDP coming from so-called high-technology manufacturers; see OECD 2007, *OECD Science, Technology and Industry Scoreboard 2007*, 'Technology and Knowledge Intensive Industries' (Table I.5) (OECD: Paris), p. 211

Table 6. Descriptive statistics for turnover

2005/2006 Turnover - manufacturing			
ANZSIC 2006 Subdivision - 2 digit level	**N**	**Mean**	**Median**
15 Pulp, Paper and Converted Paper Product Manufacturing	4	111,314,750.00	67,500,000.00
21 Primary Metal and Metal Product Manufacturing	14	104,214,285.71	2,450,000.00
11 Food Product Manufacturing	45	17,405,395.07	1,800,000.00
18 Basic Chemical and Chemical Product Manufacturing	7	16,785,714.29	5,000,000.00
23 Transport Equipment Manufacturing	17	16,295,000.00	1,600,000.00
12 Beverage and Tobacco Product Manufacturing	13	9,253,846.15	1,700,000.00
13 Textile, Leather, Clothing and Footwear Manufacturing	20	8,494,500.00	1,350,000.00
24 Machinery and Equipment Manufacturing	31	8,337,096.77	2,500,000.00
20 Non-Metallic Mineral Product Manufacturing	16	5,410,687.50	3,000,000.00
14 Wood Product Manufacturing	34	5,308,823.53	1,600,000.00
16 Printing (including the Reproduction of Recorded Media)	15	4,693,333.33	3,000,000.00
19 Polymer Product and Rubber Product Manufacturing	17	3,390,588.24	2,500,000.00
22 Fabricated Metal Product Manufacturing	49	3,128,757.16	1,500,000.00
25 Furniture and Other Manufacturing	23	1,838,695.65	1,400,000.00
Total	305	13,840,547.14	2,000,000.00

As in table 3, for turnover the same two manufacturing sub-divisions are characterised by relatively low numbers of firms in the sector, and marked differences between mean and median figures, indicating dependence of sub-divisions on a few firms, with policy implications for those particular firms and firms dependent on provision of services to them. A firm does not have to be big to be a player in the industry.

6.7 Industry sub-divisions by total turnover

Table 7. Relative ranking of industry subdivisions by total turnover.

ANZSIC 2006 Subdivision - 2 digit level	Total turnover for the 2005/2006 financial year ($sum)
21 Primary Metal and Metal Product Manufacturing	1,459,000,000.0
11 Food Product Manufacturing	783,242,778.0
15 Pulp, Paper and Converted Paper Product Manufacturing	445,259,000.0
23 Transport Equipment Manufacturing	277,015,000.0
24 Machinery and Equipment Manufacturing	258,450,000.0
14 Wood Product Manufacturing	180,500,000.0
13 Textile, Leather, Clothing and Footwear Manufacturing	169,890,000.0
22 Fabricated Metal Product Manufacturing	153,309,101.0
12 Beverage and Tobacco Product Manufacturing	120,300,000.0
18 Basic Chemical and Chemical Product Manufacturing	117,500,000.0
20 Non-Metallic Mineral Product Manufacturing	86,571,000.0
16 Printing (including the Reproduction of Recorded Media)	70,400,000.0
19 Polymer Product and Rubber Product Manufacturing	57,640,000.0
25 Furniture and Other Manufacturing	42,290,000.0
Total	**4,221,366,879.0**

The responding firms represent a total turnover in excess of 4 billion dollars for the 2005-2006 financial year, which is approximately 28% of the turnover for the entire economy (represented by the responding population). In table 7, there are 11 firms missing from the count, being firms that did not provide a figure for turnover, either due to refusal, or inability to provide a figure.

6.8 Manufacturing firms by location

Manufacturing firms can of course be classified by geographical location. The innovation census recorded address data for the location of firms, which can be assigned to Local Government Areas (LGAs) for a picture of how firms are distributed in the region.

Table 8 and 9 below show the distribution of manufacturing firms by their business location within LGAs. For firms with multiple locations, the state head office was surveyed and provides the LGA street address, and in some cases the head office of the firm was located interstate as seen below, and so it was not possible to map the firm location to a Tasmanian LGA.

Although it would be possible to cross classify manufacturing firms by industry subdivision and other dimensions by location, the lower numbers of firms can limit presentation of data due to privacy and confidentiality restrictions. This type of analysis is outside of the scope of this report, and we have simply provided the distribution across LGA ranked by frequency.

Table 8. Responding population by LGA

LGA	Number of firms	Proportion of firms (%)
Launceston	57	18.0
Glenorchy	55	17.4
Hobart	37	11.7
Clarence	18	5.7
Devonport	16	5.1
Burnie	13	4.1
Central Coast	13	4.1
George Town	13	4.1
Kingborough	12	3.8
Northern Midlands	11	3.5
Huon Valley	8	2.5
Waratah/Wynyard	8	2.5
West Tamar	8	2.5
Meander Valley	6	1.9
Circular Head	5	1.6
Sorell	5	1.6
Brighton	4	1.3
Dorset	4	1.3
Glamorgan/Spring Bay	4	1.3
Southern Midlands	4	1.3
Latrobe	3	0.9
West Coast	3	0.9
Break O'Day	2	0.6
Kentish	2	0.6
New Norfolk	2	0.6
Flinders	1	0.3
Interstate HQ	1	0.3
King Island	1	0.3
Total	316	100.0

Table 9. Total population by LGA

LGA	Number of firms	Proportion of firms
Launceston	95	19.1
Glenorchy	83	16.7
Hobart	59	11.9
Clarence	29	5.8
Devonport	26	5.2
Kingborough	22	4.4
Burnie	21	4.2
George Town	17	3.4
Central Coast	15	3.0
Huon Valley	14	2.8
Meander Valley	14	2.8
West Tamar	13	2.6
Northern Midlands	12	2.4
Waratah/Wynyard	11	2.2
Circular Head	10	2.0
Brighton	7	1.4
Dorset	6	1.2
Interstate HQ	6	1.2
Sorell	6	1.2
Southern Midlands	6	1.2
Glamorgan/Spring Bay	5	1.0
King Island	4	0.8
Latrobe	4	0.8
West Coast	4	0.8
Kentish	3	0.6
Break O'Day	2	0.4
New Norfolk	2	0.4
Flinders	1	0.2
Total	497	100.0

6.9 Clustering in Tasmania

It is worth noting that the ability to specify firms by location opens up the possibility of identifying specific clusters of firms in particular areas. A key idea in industrial economics and management has been that shared access to skilled labour, infrastructures or other resources often leads to geographic clustering of firms in similar activities; this idea dates from the work of Alfred Marshall in the late 19th century, but has been a major part of policy discussion in recent years.[5] The TIC data opens up the possibility to identify these clusters in Tasmania, and through that explore the innovative potential of entire groups of firms.

In the table that follows, we define a 'cluster' in 'horizontal terms': that is, it is any group of four or more firms in the same 2-digit ANZSIC category and the same LGA. This is very much a 'first approximation' way of identifying clusters. However it leads to 24 regional manufacturing clusters in Tasmania spread across eleven industries and seven LGAs. As we might expect, Glenorchy, Hobart and Launceston are important cluster sites, especially in metal manufactures, transport equipment and machinery and equipment. But Burnie is also present in these industries. Other clusters are found in food processing; beverages; and textiles, clothing and footwear.

Table 10. Industry clusters

LGA	11 Food Product Manufacturing	12 Beverage and Tobacco Product Manufacturing	13 Textile, Leather, Clothing and Footwear Manufacturing	14 Wood Product Manufacturing	16 Printing (including the Reproduction of Recorded Media)	20 Non-Metallic Mineral Product Manufacturing	21 Primary Metal and Metal Product Manufacturing	22 Fabricated Metal Product Manufacturing	23 Transport Equipment Manufacturing	24 Machinery and Equipment Manufacturing	25 Furniture and Other Manufacturing
Burnie								4		4	
Clarence	4	4									
Devonport	4										
George Town							4				
Glenorchy				7				13	6	6	5
Hobart	5		5		4	4			4		
Launceston	6		6	4	4			7	4	8	10

7 NATURE OF INNOVATION IN THE MANUFACTURING INDUSTRY

Against the background of the business demographic structure described above, how well does the Tasmanian manufacturing sector innovate? There may be many who would argue that because of its lack of high technology industry, Tasmania would be a low-innovation economy. Is this so? What proportion of manufacturing firms are innovators and what is the distribution of innovative activities across industry sub-divisions, firms size classes and turnover ranges? What kinds of innovation outputs can be found? To address these questions, we can begin by examining the number and spread of innovation-active firms across manufacturing sub-divisions. We show that overall, Tasmanian manufacturing firms are predominantly innovating through products that are more likely to be new to the market than simply new to the firm, they are adopting production process innovations more than developing new methods, and are innovating through extensive R&D and through purchase of new capital goods.

[5] See for example, P. de Hartog (ed) (2003) *Innovative Clusters. Drivers of National Innovation Systems* (OECD: Paris); A. Cumbers and D. McKinnon, 2006, *Clusters in Urban and Regional Development* (London: Routledge)

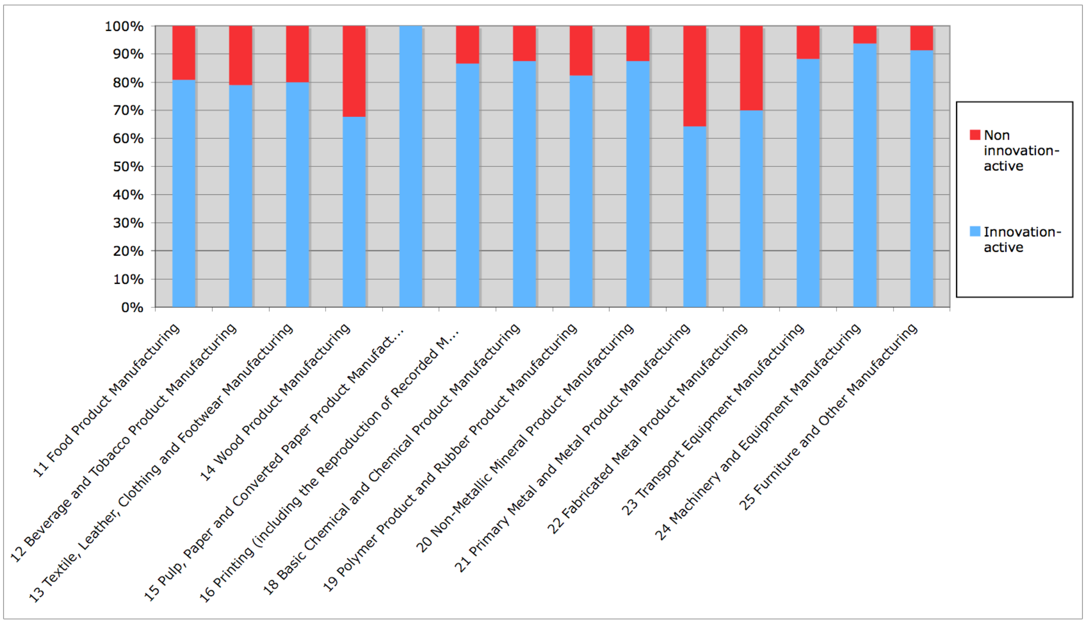
7.1 Innovation-active firms

An 'innovation-active' firm is defined here as any firm that has introduced a new or significantly improved product (good or service) or production process over the reference period (2004-2006). This definition is consistent with the OECD's Innovation manual, and that used with outputs from the European Community Innovation Surveys (CIS).[6]

Overall, there is a comparatively high proportion of innovative firms in manufacturing, with 80.4% of manufacturing firms innovation-active compared with 70.1% of firms across all industries in the economy (for the total responding population).

Figure 3 below shows that innovation activity is evenly distributed across manufacturing sub-divisions, with a low level of statistical variation around the industry mean of 80.4% (the standard deviations is 10.1%). This means that innovation activity is not only pervasive in Tasmanian manufacturing, it is widely distributed within the sector. It is noteworthy that the sub-division with an innovation-active rate of 100% consists of only 4 firms, 3 of which are quite large.

Figure 3. Innovation-active manufacturing firms by industry sub-sector



Similarly, innovation activity is fairly evenly distributed across firm size classes, although with a steady increase with firm size apart from the highest size class. The broad pattern of increasing activity with firm size is consistent with the findings of other studies of the connection between size and innovativeness, although we would argue that the shared high level is the salient point here.

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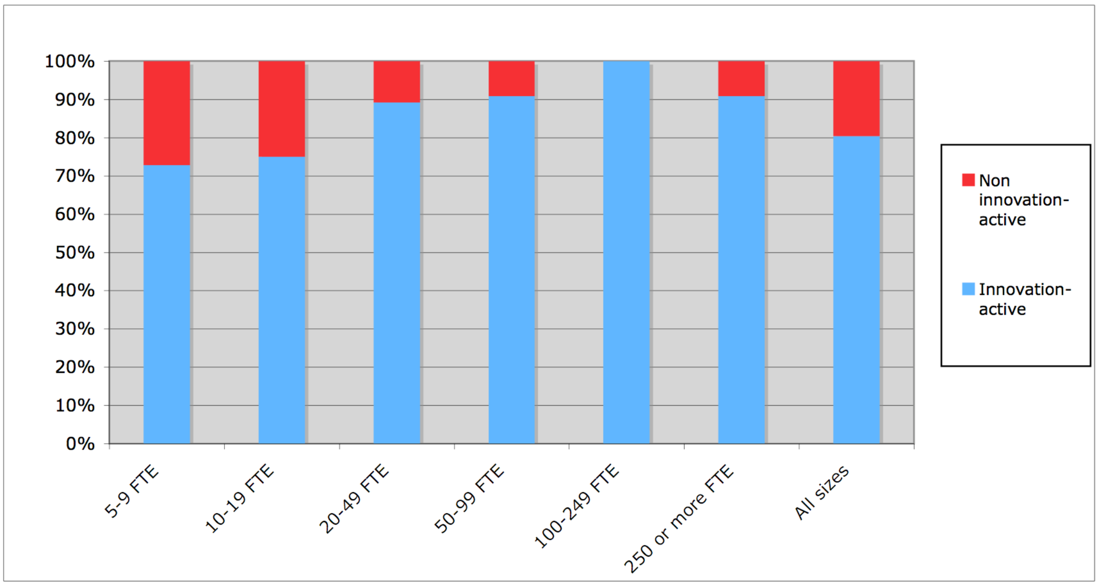
[6] OECD, *Oslo Manual. The Collection and Interpretation of Innovation Data* (OECD: Paris) Third Edition, 2005

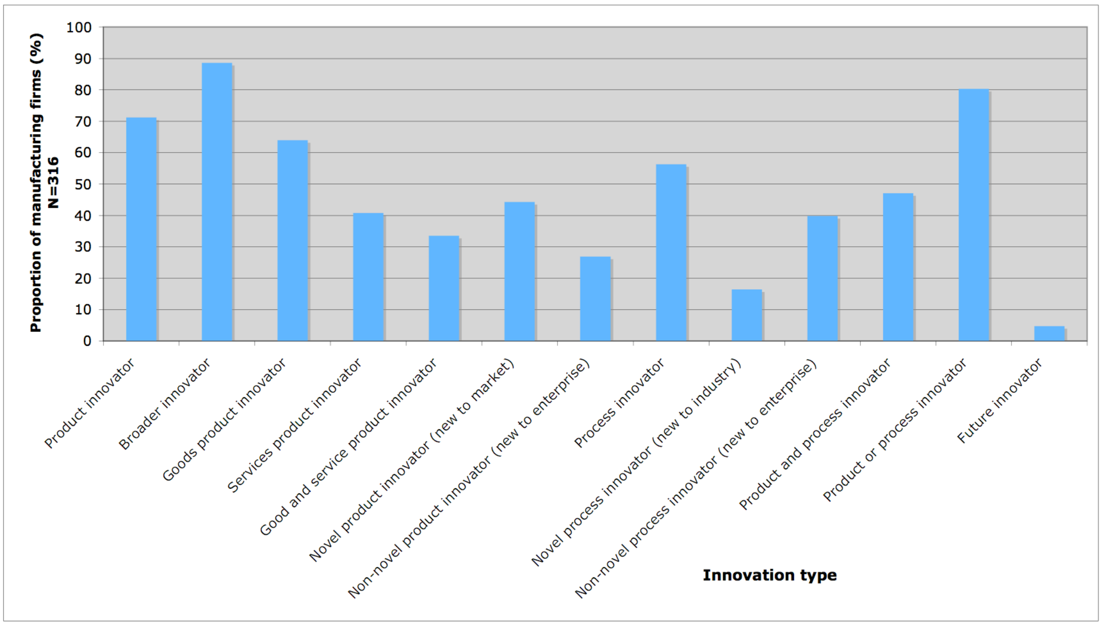
Figure 4. Innovation-active manufacturing firms by firm size class



7.2 Innovation activity by type

So the rate of innovation is high across the board for the manufacturing sector in Tasmania, by both industry sub-divisions and different firm sizes. To understand the character of innovation we can firstly look at the breakdown of activity classified by type of innovation occurring, as demonstrated in Figure 5.

Figure 5. Manufacturing innovation by type



(Definitions for type of innovation can be found at appendix B)

There are some key points evident from the mix of innovation types above. Firstly, manufacturing is characterised by product innovators: 71.2% of manufacturing firms were product innovators in comparison with 58% for the whole economy (represented by responding firms), so this is the key sector for product innovation in Tasmania.

Perhaps less obviously there are more novel than non-novel product innovators, with 44.3% of firms surveyed reporting the implementation of products new to market in comparison to 26.9% with products new to the enterprise (but not new to market). It is sometimes claimed that manufacturing is a key site for the innovation of new technologies, and we suggest that the claim receives some confirmation from this data.[7]

But process change is also prevalent. There were 56.7% of firms that reported new production processes; of those 16.5% had processes new to the industry with 39.9% implementing processes new to the enterprise only. This suggests that firms are quick to adopt process innovations developed elsewhere, and that diffusion of process innovations is an important component of innovation as a whole in Tasmanian manufacturing.

8 INNOVATION INPUTS – INVESTMENT IN INNOVATION

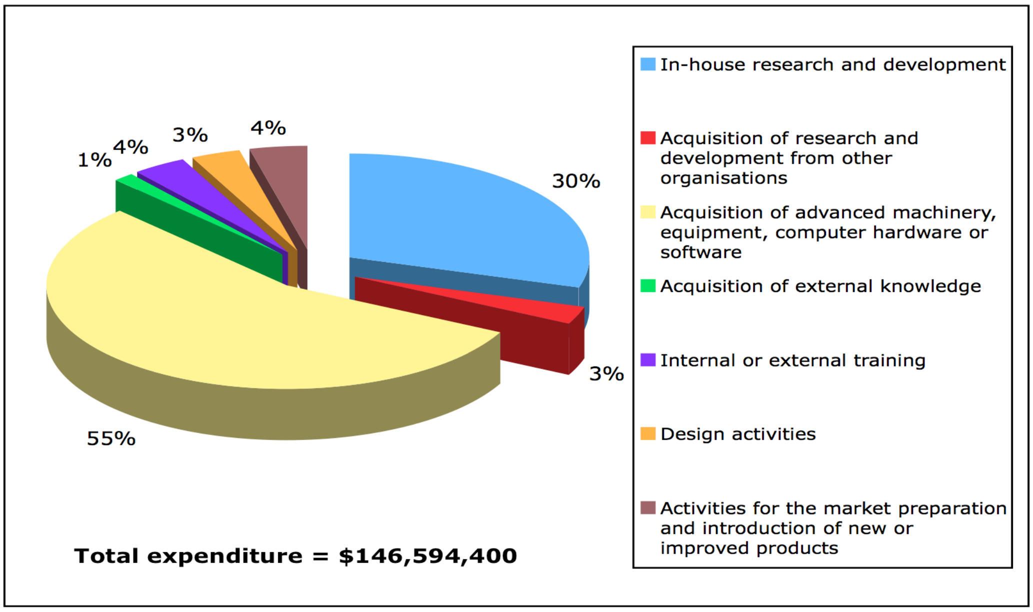
So far we have reviewed the level and basic character of innovation, but to better understand the variation in innovation intensity and activity across manufacturing we need to consider the inputs (investment into) and outputs (sales from) firm innovation efforts.

8.1 Investment by activity

The innovation census questionnaire asked whether firms undertook particular types of innovative activity, and for expenditure figures on the particular activity in the most recent financial year (2005-2006). The majority of firms were able to provide good estimates, and as a result it is possible to review the patterns of expenditure, or investment in innovation. Firstly, Figure 6 shows the breakdown of total innovation investment by type of expenditure for all manufacturing firms. Manufacturing firms committed almost $150 million to various forms of innovation activity (it should be noted firstly, that this figure cannot be compared directly with turnover data, because not all firms were able to supply innovation input data, and secondly, that the innovation input data is therefore almost certainly an underestimate).

[7] For example, Stephen Cohen and John Zysman, in *Manufacturing Matters. The Myth of the Post-Industrial Economy* (New York, 1987) make this point strongly.

Figure 6. Manufacturing total innovation expenditure by activity



Acquisition of capital and intermediate goods - advanced machinery, equipment, components, computer hardware or software is clearly the most important mode of investment in innovation, accounting for approximately $81 million. There is also a relatively large proportion of expenditure on R&D at $40 million or 30% of total manufacturing innovation expenditure, in comparison to the whole economy where R&D accounts for 21% of total innovation expenditure. The capital investment side of innovation investment is somewhat neglected in public policy thinking, which tends to focus on R&D expenditure as a key innovation input; the data here suggests that the risks, financing problems and depreciation issues associated with capital goods acquisition might be an important area for policy attention.

With a total investment in innovation activities of $146,594,400, the manufacturing sector accounts for approximately 27% of total known innovation expenditure in the Tasmanian economy.

8.2 Investment mix within industry sub-division

Reviewing the mix of investment across different innovation activities for each industry subdivision provides insight into how the innovation process differs across manufacturing itself, and can inform any sub-sector specific efforts to stimulate innovative activity based on the current input mix for innovation processes.

Figure 7. Composition of innovation expenditures by industry sub-sector

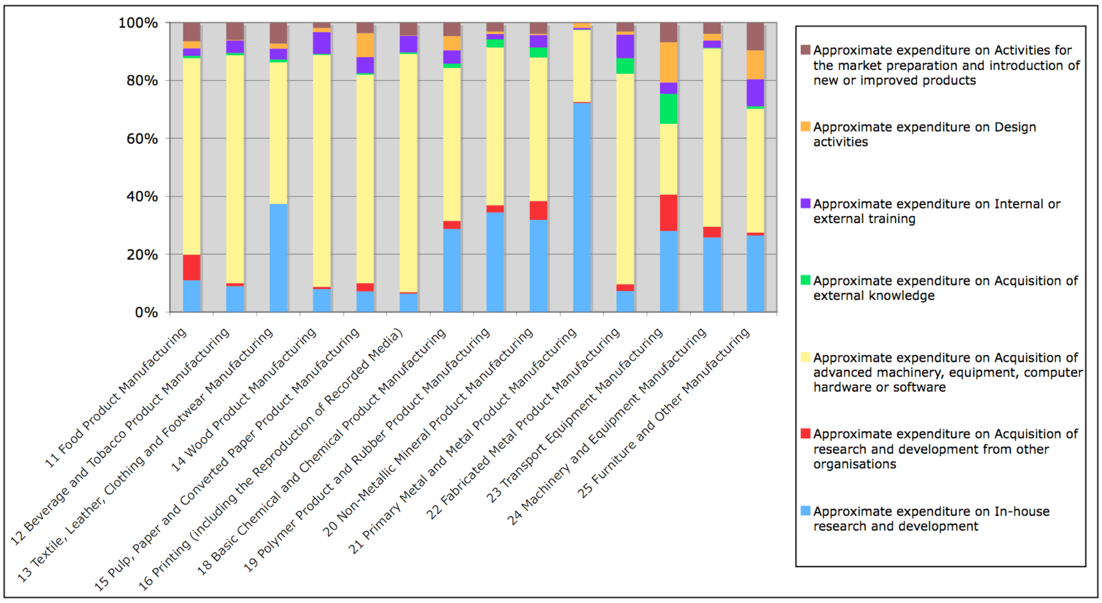
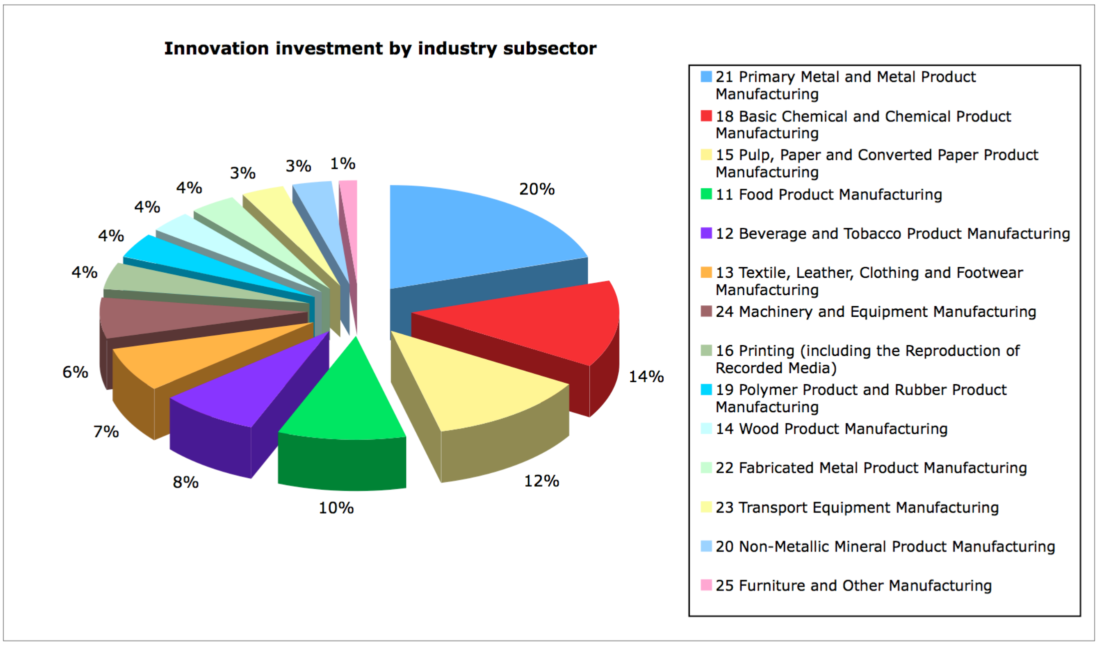


Figure 7 shows the breakdown of total innovation expenditure by activity within each industry sub-division. The mix of innovation activity and investment is different for each sub-division, so there are varied combinations of inputs important to the innovation process. Still, expenditure on acquisition of capital – advanced machinery, equipment, computer hardware or software, and in-house R&D absorb the highest proportions of expenditure in general for each sub-division, as for the manufacturing sector as a whole. The overall importance of capital goods acquisition is repeated across the sub-sectors.

R&D makes up the largest proportion of expenditure in primary metal and metal product manufacturing, and in transport equipment, and is surprisingly high in textile, leather, clothing and footwear manufacturing. Closer investigation of the objectives and research fields associated with these R&D efforts would be an important element in future work on manufacturing.

To gauge the significance of each industry subdivision in terms of contribution to total innovation investment in manufacturing, each subdivision's contribution to total investment is shown in Figure 8.

Figure 8. Manufacturing total innovation expenditure by industry subdivision



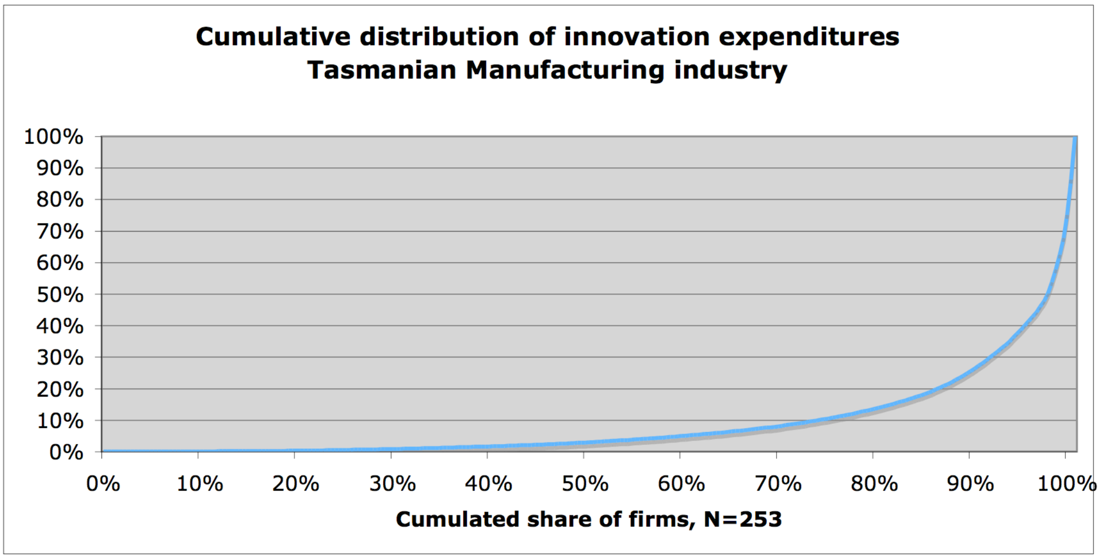
As could be expected, the contribution of each subdivision to the total investment tracks fairly closely with its relative size within manufacturing. Two sub-divisions that appear to have a slightly larger weighting in the investment total than their relative size rankings are beverage and tobacco product manufacturing and basic chemical and chemical product manufacturing. This may be indicative of potential future growth in these sub-sectors assuming that the innovation investment yields returns.

8.3 Cumulative distribution of innovation investment

The discussion so far has considered the contribution of individual industry sub-divisions to the total innovation investment, and the varying inputs within each sub-division, though a key question of policy relevance remains: how is the total investment distributed across individual firms?

To address this, each firm was ranked by their total innovation expenditure (sum of expenditure on individual activities shown in Figures 6 & 7). Then we cumulated the ranked totals, in order to track the contribution of firms to the overall total investment for the sector, which is shown in Figure 9.

Figure 9. Cumulative distribution of innovation expenditures – Tasmanian manufacturing industry



The distribution of firm contributions for the manufacturing sector follows the same pattern as for all industries combined, that is, a distribution that is extremely skewed. The first 50% of firms account for just under 3% of the total innovation expenditure, while approximately 10% of firms account for just over 70% of the total innovation expenditure. At an industry wide level, the policy implication here is the same as for the overall economy – should the focus be on assisting the majority of lower performing firms to improve, and if so how and who specifically - or should the focus be kept on the highly performing innovators?

We should note that these figures refer to expenditure in a single financial year, which poses the question as to whether this skewed distribution would persist over time or is influenced by one-off type innovations. The research suggests that indeed innovators tend to be innovative over time.

If the focus is to be on improving the performance of the lower performing firms, then the challenges revolve around whether a particular subset of firms is targeted, how to identify or select that subset, and what types of behaviour to stimulate to elevate performance. These are all difficult questions, and can perhaps be informed somewhat through trying to better understand the characteristics of the higher performers - is better performance simply a function of firm size or industry sub-division? These questions are further considered with the characteristics of intensive innovators.

9 INNOVATION OUTPUTS (SALES)

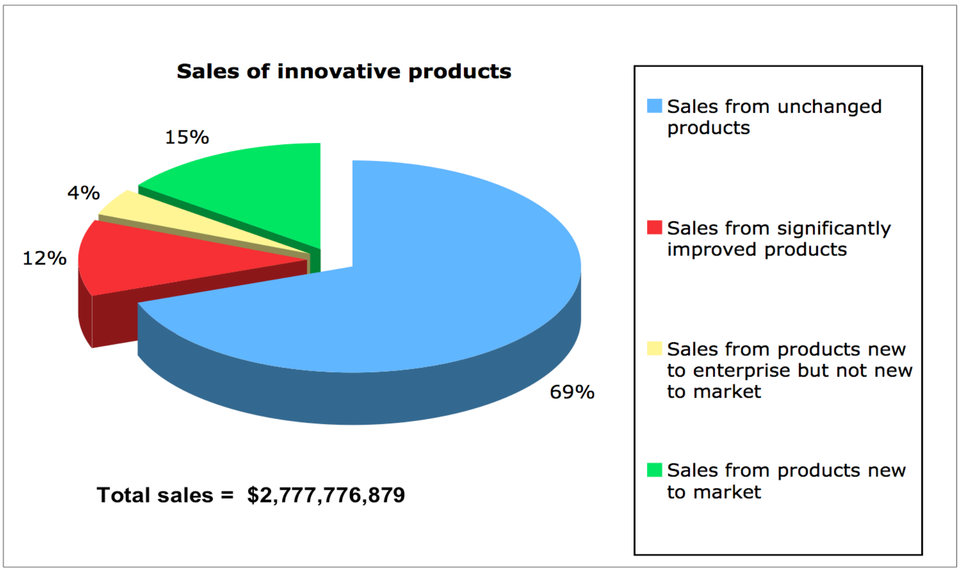
Turning the focus to innovation outputs, it is possible to provide a measure of the impact or outcomes of innovation from sales of innovated products. Here there are similar results encountered as with inputs. Innovated products fall into 3 categories: sales from significantly improved products, sales from products new to the enterprise but not new to the market, and sales from products new to the market. These three categories are also referred to in aggregate as ‘all altered products’ or ‘innovative products’.

In the TIC, firms were asked to estimate the percentage of sales in the most recent financial year (2005-2006) that were generated from unchanged products, and from the 3 categories of innovated products.

9.1 Sales of innovative products

Figure 10 shows that 31% of total sales in the 2005-2006 financial year came from innovative products. This proportion is higher than for all industries in the economy at 27%. Also of note is the larger share of sales sourced from products new to market – 15% in comparison to 8% for the rest of the economy. Again this is consistent with the pattern of novel product innovation evident right across the data, which is more than likely a necessary element of firm survival in a sector increasingly subject to competitive global pressures.

Figure 10. Sales of innovative products

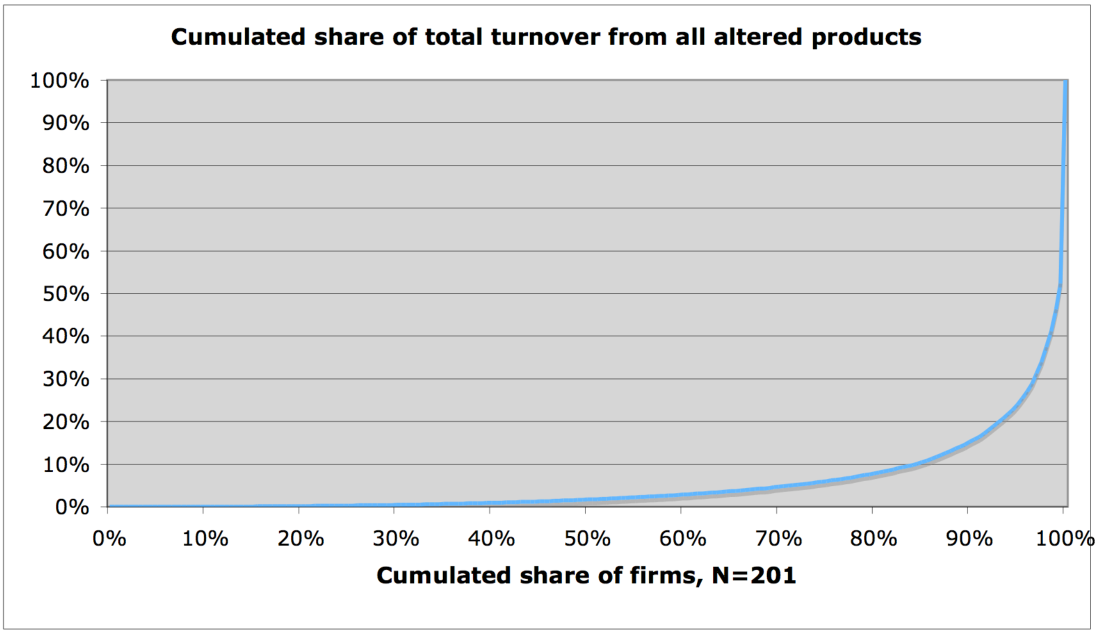


A point to note here, is that sales in Figure 10 are the sales corresponding to 201 firms. This sales value could only be derived for product innovators who answered the sales and turnover questions.

9.2 Cumulative distribution of sales of innovative products

To determine how sales of innovative products were distributed across individual firms, it was possible to rank and cumulate the distribution of sales of individual firms in the same way as for investment, shown in Figure 11.

Figure 11. Cumulative share of total turnover from all altered products



Similarly, there is an extremely skewed distribution for sales, with approximately 50% of firms accounting for less than 2% of total turnover (2005-2006) from innovative or altered products, and around 10% of firms accounting for just under 85% of total turnover from innovative products.

So for both innovation inputs and outputs, there are around 10% of firms accounting for the majority of investment and sales. Some key questions emerge – what are the defining characteristics of these 10% of firms, or most intensive innovators? Are the same firms responsible for driving both inputs and outputs, and why? Is it possible to identify a common set of characteristics or attributes for the most intensive innovators? Is it possible to work to develop these characteristics in lower performing firms?

Although some of these questions are outside the scope of this report, it is possible to progress some way towards addressing them by reviewing the most intensive innovators for inputs and outputs (the 10% contributing to the majority of the totals).

10 CHARACTERISTICS OF INTENSIVE INNOVATORS

The basic characteristics in terms of industry subdivision, turnover range and firm size class of the most intensive innovators can be reviewed for both investment and sales to seek some preliminary insight.

Figure 12. Most intensive innovators by industry sub-division – innovation investment

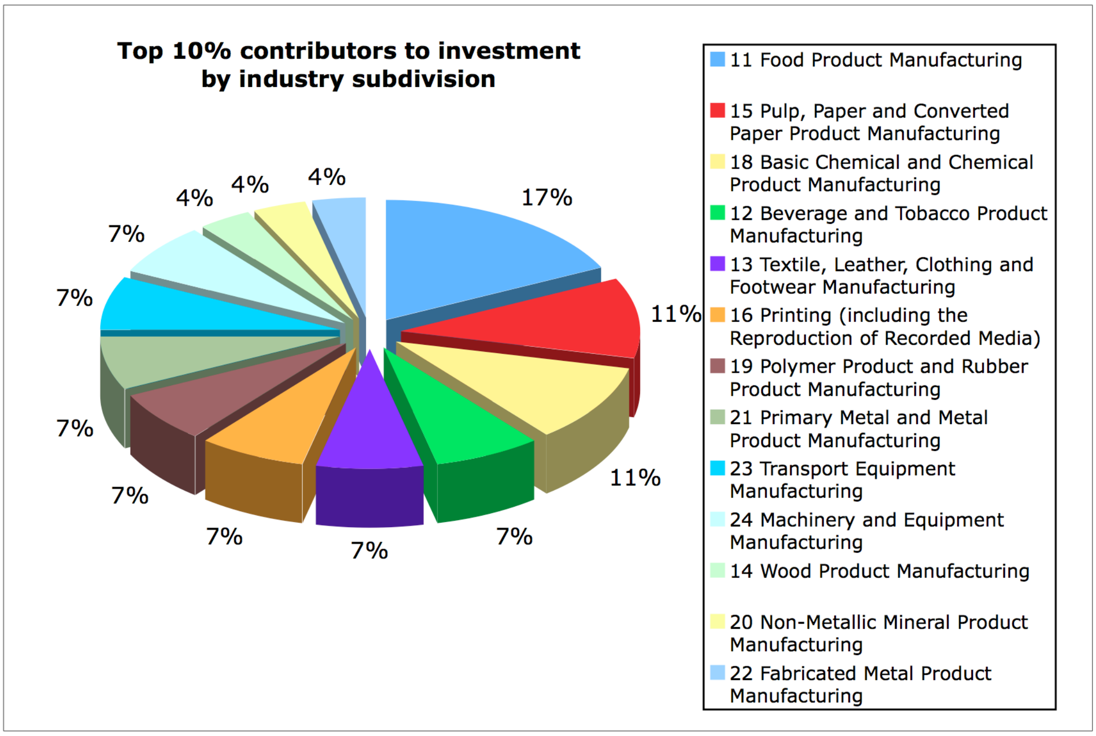


Figure 13. Most intensive innovators by industry subdivision – sales of innovative products

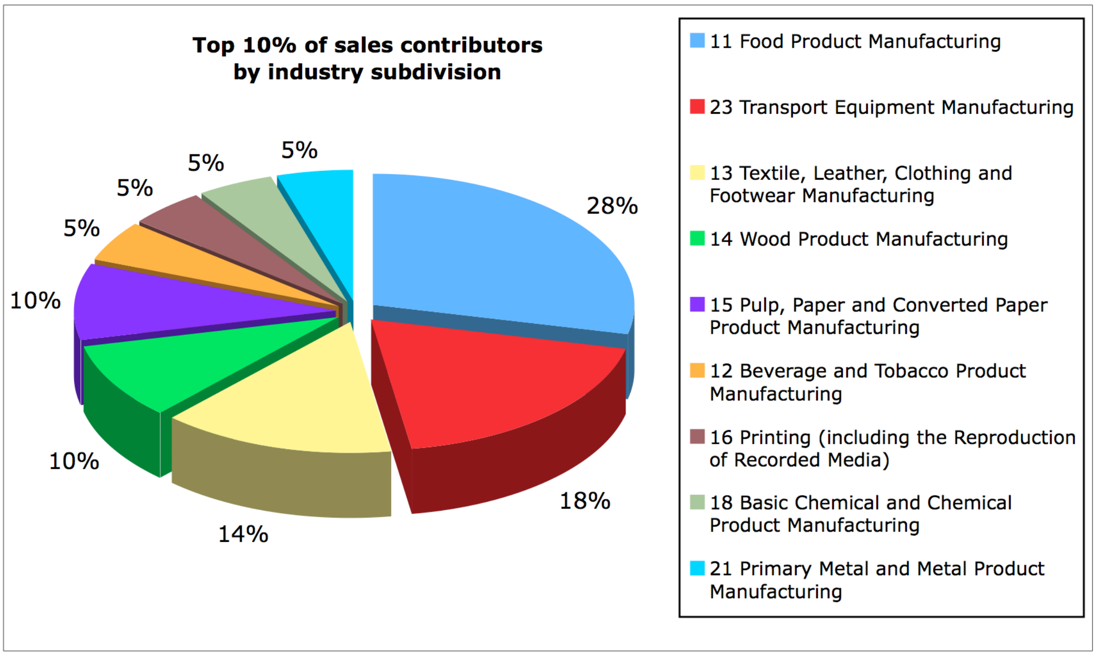


Figure 12 and 13 show different combinations of industry subdivision for sales and investment, suggesting that the mix of intensively innovating firms is different for inputs and outputs. Only 9 of 14 industry sub-divisions are driving the majority of sales from innovative products, while the firms contributing to the majority of innovation investment are spread across 13 of 14 industry sub-sectors. The figures for both measures here refer to the most recent financial year, so one explanation for the difference might be that sales from investment in innovation activities for some industries are not realised for some time proceeding the initial firm investment.

Another point to consider is that there are more firms contributing to the investment figures, with 253 responding firms, as opposed to 201 contributing to the sales figures – which are restricted to product innovators who answered the output question and provided a figure for turnover. The question response rates were very good for this question (only 3.1% of respondents in manufacturing did not answer due to refusal or inability to answer) so should not have a significant impact on the figures.

Regardless of these points, it is still possible to identify the industry sub-sectors with the most intensive levels of innovation as measured by input and output indicators, and again there are common sectors appearing in the top contributors for both inputs and outputs including:

- food product manufacturing,
- pulp, paper and converted paper product manufacturing,
- textile, leather, clothing and footwear manufacturing.

Is it the case that these are simply the largest firms driving the input and output measures? Classifying the most intensive innovators for both inputs and outputs by turnover range, there are no firms in the lowest range (less than $1 million), but apart from that firms are fairly evenly distributed across the remaining turnover categories.

Classifying intensive innovators for inputs and outputs by firm size class, there are no firms in the bottom two size classes for sales, and lower numbers for the bottom two categories for investment, but no distinctive patterns apart from that.

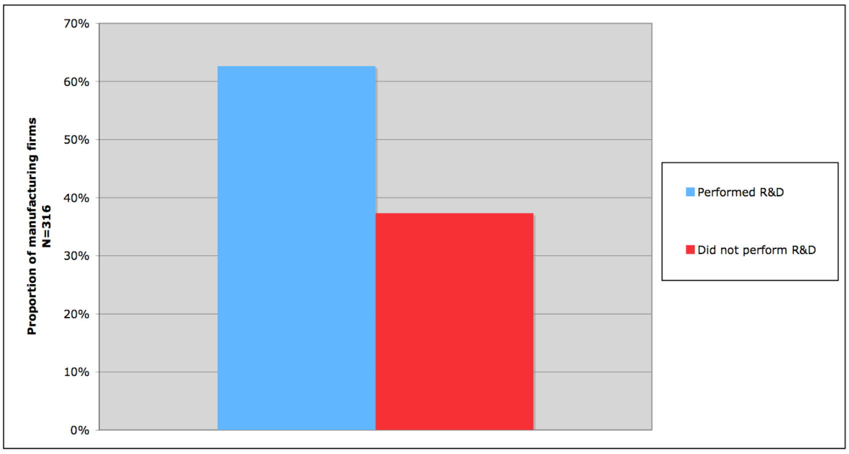
Reviewing the specific sets of firms that make up the top 10% of sales of innovative products and investment in innovation shows that there is some crossover, but it is not simply the same firms in both groups – 43% of the firms in the top 10% for investment are also responsible for the top 10% in sales.

Thus from a preliminary overview of the intensive innovators by industry, size and turnover, there do not appear to be any obvious defining characteristics, and understanding these intensive innovators would seem to warrant a far more detailed investigation, perhaps at the firm level, which is not attempted here.

11 R&D BY TASMANIAN FIRMS – ACTIVITIES AND COSTS

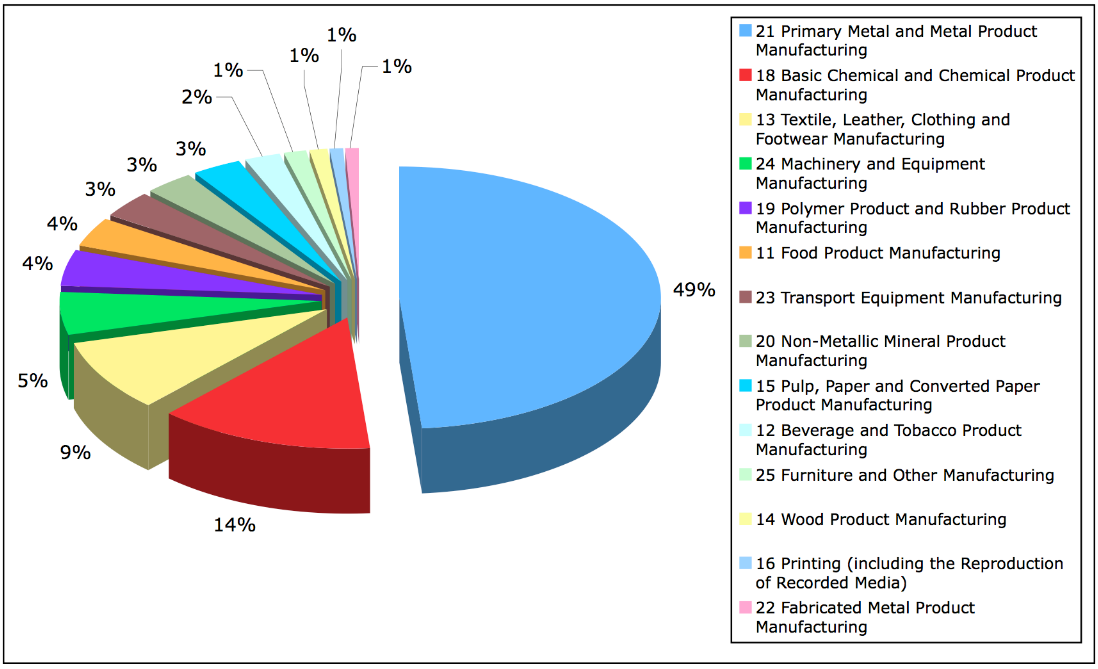
Manufacturing firms are intensive performers of R&D. Figure 14 shows that 61% of firms surveyed undertook R&D, which is a substantially higher proportion than for the overall economy at around 40%, and is consistent with the higher levels of investment in R&D. In total, the manufacturing accounts for about 40% of all business R&D in Tasmania, which is significantly higher than its share of either output or employment.

Figure 14. Manufacturing firms undertaking R&D



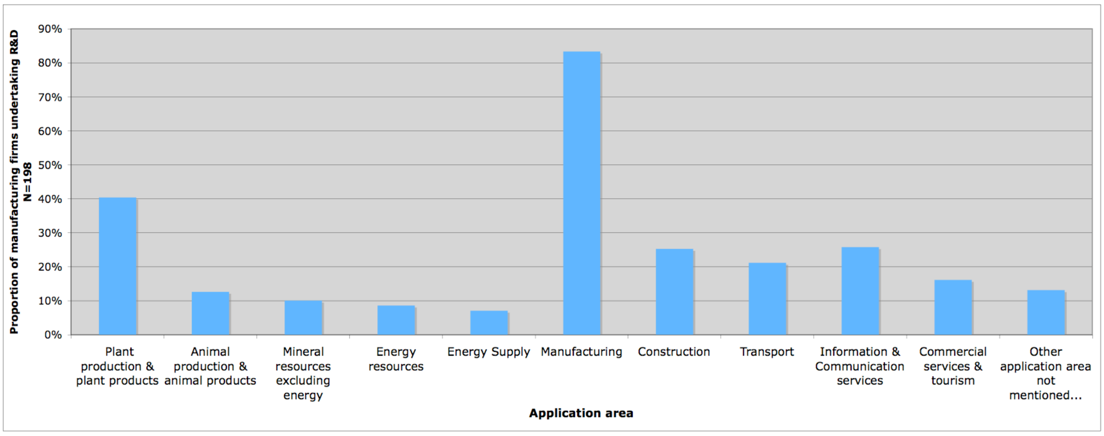
R&D performance is somewhat asymmetrically distributed within manufacturing. Figure 15 shows the contribution to total manufacturing expenditure on R&D by industry subdivision. The three dominant contributors are primary metal and metal product manufacturing, basic chemical and chemical product manufacturing, and textile, leather, clothing and footwear manufacturing. All other industry sub-divisions are fairly even contributors. The manufacturing sector as a whole is also the largest contributor to R&D expenditure across the economy, with a total expenditure on R&D of $43,430,500.

Figure 15. Expenditure on research and development by manufacturing industry sub-division



Firms undertaking R&D were asked to classify their R&D activities firstly by categories of socio-economic objective (the field of economic or public activity to which the results of R&D might be applied) and secondly by research field category (the scientific or technological fields in which the research is being conducted), the results are shown in Figures 16 and 17.

Figure 16. Manufacturing firms undertaking R&D by socio-economic objective



Excluding manufacturing, the next three largest areas are plant production and plant products, information and communication services, and construction. These results concord with the importance of the food sector in manufacturing, and the dominance of metal product manufacturing.

Figure 17. Manufacturing firms undertaking R&D by research field

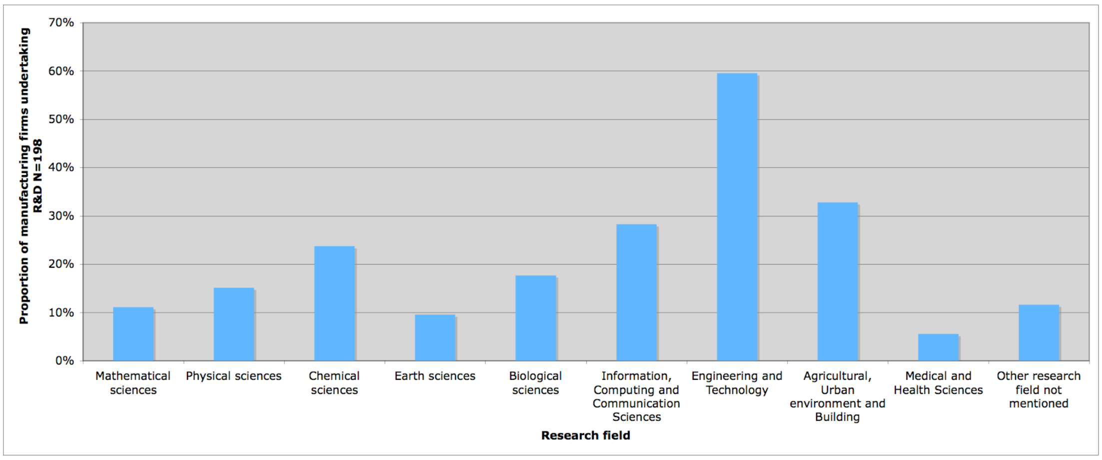


Figure 17 shows engineering and technology, agricultural, urban environment and building, and information, computing and communication sciences as the three most frequently cited fields.

This result is reflective of the size and levels of R&D undertaken in engineering based sub-divisions including primary metal and metal product manufacturing, machinery and equipment manufacturing and transport equipment manufacturing. Both figures 16 and 17 indicate the importance of ICT as an input in the manufacturing innovation process. A key result from the Innovation Census showed a greater number of firms outside of the ICT sector undertaking ICT related R&D than there were firms within the ICT sector. It is noteworthy that manufacturing firms make up the larger proportion of this group of firms, again indicating the importance of ICT related R&D for manufacturing and a need to better understand the nature of this type of R&D across manufacturing.

12 MANUFACTURING AND TASMANIAN VALUE CHAINS

An important area of policy interest relates to the value chains in which the manufacturing industry is embedded. For Tasmania more specifically, a key issue in building capacity, sustainability and growth across manufacturing is understanding the value chain dependencies of manufacturing firms, and developing industry capacity away from narrow or restrictive dependencies that are vulnerable to shift in technology or supply conditions. In analysing value chains a central issue is where in the chain is value created and appropriated: revenues and value-added are rarely distributed evenly throughout the chain, and so decisions on where in the chain activity and effort should be focused are important for economic development.

An important preliminary task in addressing this policy issue is to develop a better understanding of the value chain structures in which Tasmanian manufacturing operates. This involves tracking sector inputs (sectors selling into manufacturing) and outputs (sectors buying from manufacturing). Understanding value chains in detail is a large task, which we begin here by presenting a data framework for analysis and secondly by presenting a first analysis of census data within the framework.

The innovation census questionnaire asked firms that were product innovators about the industries their new or improved products were sold to. Firms were provided with a subset of industries of interest and asked simply whether any of their new or improved products were sold into these industries (see the actual question in appendix A). The non-exhaustive list of 'key industries' for this question focused on sectors that are significant in a quantitative sense for Tasmania, not only in their own right, but as central elements of value chains that are important to the Tasmanian economy. So we consider them both as 'key destinations' for Tasmanian manufactured products, and 'key sources' for inputs to manufacturing.

The industries covered in this 'input-output' question were:

- the mining industry
- engineering industries
- forestry or forest products industries
- the food processing industry
- fishing or aquaculture industries
- agriculture or horticulture industries
- the wine industry

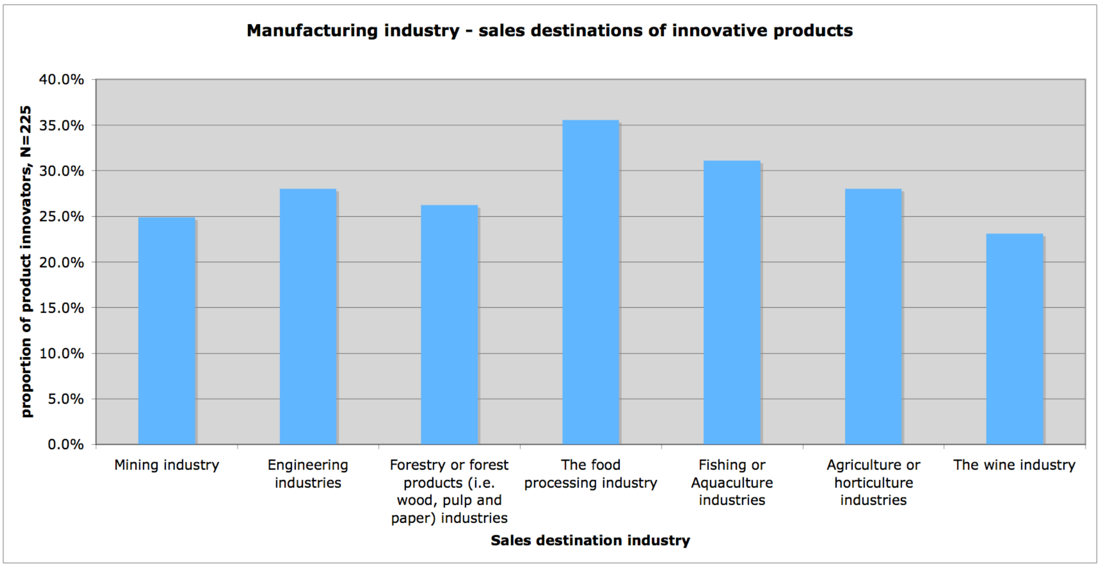
Given that 72.1% of manufacturing firms were product innovators, the data from this question provides a solid basis for developing a preliminary understanding of value chains for Tasmanian manufacturing.

12.1 Value chains in Tasmania: the destinations of manufacturing products

On the output side of the manufacturing value chain, the task is fairly straightforward, in the sense that we can simply review the numbers of manufacturing firms selling products to the industries above. This provides both an indication of the industries upon which the manufacturing sector is dependent for sales of new and improved products, but also of how the recipient sectors source their capital and intermediate inputs from manufacturing firms in Tasmania.

Although the above industry categories do not align precisely with ANZSIC industry categories, it is possible to map them to ANZSIC categories for understanding value chain dynamics. Figure 18 provides the proportion of firms selling new products to key destination industries, or a picture of the output side of the manufacturing value chain.

Figure 18. Manufacturing output value chain – destination sectors for sales of innovative manufacturing products



Despite a fairly even distribution of sales from manufacturing firms to destination industries above, the food processing industry is the most important sector for sales of new products with 80 firms, or 35.6% of manufacturing product innovators selling to this sub-sector. This is followed by fishing or aquaculture industries with 70 firms, and engineering industries, with 63 firms.

This is consistent with the size and significance of the food related and aquaculture industries in Tasmania, and the predominance of engineering based subsectors that make up the largest proportion of manufacturing (in particular primary metal and metal product manufacturing, fabricated metal product manufacturing, machinery and equipment manufacturing and transport equipment manufacturing).

Of course it is important to understand in more detail the interplay between manufacturing sub-divisions and these sectors. Is there a dependence on particular firms or groups of firms in these destination industries for sales? How susceptible to changes in destination industries are particular manufacturing firms?

To address these questions in any great detail requires more in depth analyses and is not attempted here; a more detailed review could involve analysis of manufacturing firms by industry subdivision selling products to particular industries, and reviewing the interplay between firm size and location, sales and value chain inputs, and export status and value chain outputs.

12.2 'Key source' of inputs to manufacturing

In terms of tracking value chain inputs, or sectors selling into manufacturing, this involves reviewing the responses across the whole economy (excluding manufacturing) for the value chain question. A picture of the input side can be built by examining the total responding population of product innovators selling into manufacturing industry categories above, breaking down the economy by ANZSIC industry division and identifying the largest sectors, or the sectors upon which the manufacturing sector has the most dependence for inputs.

How can we review responses to the value chain question for the total population? There are some assumptions to consider for this side of the framework. For the industries shown in Figure 18, we assume that a subset of those are within the manufacturing sector, and map them to corresponding ANZSIC categories as follows:

Engineering

- 21 Primary Metal and Metal Product Manufacturing
- 22 Fabricated Metal Product Manufacturing
- 23 Transport Equipment Manufacturing
- 24 Machinery and Equipment Manufacturing

Forestry or forest products (i.e. wood, pulp and paper)

- 14 Wood Product Manufacturing
- 15 Pulp, Paper and Converted Paper Product Manufacturing
- 25 Furniture and Other Manufacturing
    - 251 Furniture Manufacturing
        - 2511 Wooden Furniture and Upholstered Seat Manufacturing

The food processing industry

- 11 Food Product Manufacturing

The wine industry

- 12 Beverage and Tobacco Product Manufacturing
    - 121 Beverage Manufacturing
        - 1214 Wine and Other Alcoholic Beverage Manufacturing

Although we do not have a complete picture in terms of manufacturing subdivisions for inputs, we can review the subset of industries that map closely to ANZSIC sub-divisions shown above. We are making the assumption that each industry category includes the mapped ANZSIC sub-divisions as shown above.

It is possible that the industry categories have been interpreted by respondents to include elements of other sub-divisions or industries altogether, but for the purposes of constructing a framework for understanding the input side of the manufacturing value chain, we assume that each industry category above, at a minimum includes some firms in the manufacturing mapped ANZSIC subdivisions.

Some industries map very accurately – ie the food processing industry to food product manufacturing, and the framework is likely to be stronger where this is the case.

A picture of input industries (industries selling into) in the manufacturing value chain is presented in Table 11.

Value chain inputs	Number of firms	Proportion of all firms (excluding manufacturing) selling into industry
Engineering industries		
M. Professional, Scientific and Technical Services	36	16.8%
E. Construction	27	12.6%
F. Wholesale Trade	27	12.6%
G. Retail Trade	27	12.6%
H. Accommodation and Food Services	17	7.9%
Forestry or forest products (i.e. wood, pulp and paper) industries		
M. Professional, Scientific and Technical Services	41	17.2%
G. Retail Trade	27	11.3%
F. Wholesale Trade	26	10.9%
H. Accommodation and Food Services	22	9.2%
A. Agriculture, Forestry and Fishing	18	7.5%
The food processing industry		
F. Wholesale Trade	32	14.9%
M. Professional, Scientific and Technical Services	28	13.0%
E. Construction	24	11.2%
G. Retail Trade	20	9.3%
H. Accommodation and Food Services	18	8.4%
The wine industry		
F. Wholesale Trade	31	17.3%
G. Retail Trade	26	14.5%
M. Professional, Scientific and Technical Services	26	14.5%
E. Construction	20	11.2%
H. Accommodation and Food Services	18	10.1%

Table 11. manufacturing value chain – inputs (sectors selling into manufacturing)

Table 11 shows the top 5 industries (in the total responding population) by ANZSIC division selling into the four industry categories that we mapped to manufacturing ANZSIC above.

A first general point about this data is that innovative firms in Tasmania are clearly involved in both sides of the value chains in which they are located. A key point to note here is the importance of professional, scientific and technical services as a source of innovative products consumed in the four relevant manufacturing sub-sectors (engineering, forestry products, food processing and wine). Both wholesale and retail trade are to be expected as sources of intermediary products for manufacturers, and the data also indicates a dependence on the construction industry for inputs.

Although the census data provides a basis for constructing a framework to understand manufacturing value chains, we are simply presenting a first iteration of the framework, which involves analysis of data only at the lowest level of detail in terms of industry and business demographic dimensions. Although possible to expand on the data with more detailed/in depth analysis of cross-classifications by industry sub-division, firm size (employee numbers and turnover) and location, here we merely focus on presenting a framework for consideration, with potential to be built on and explored in further detail.

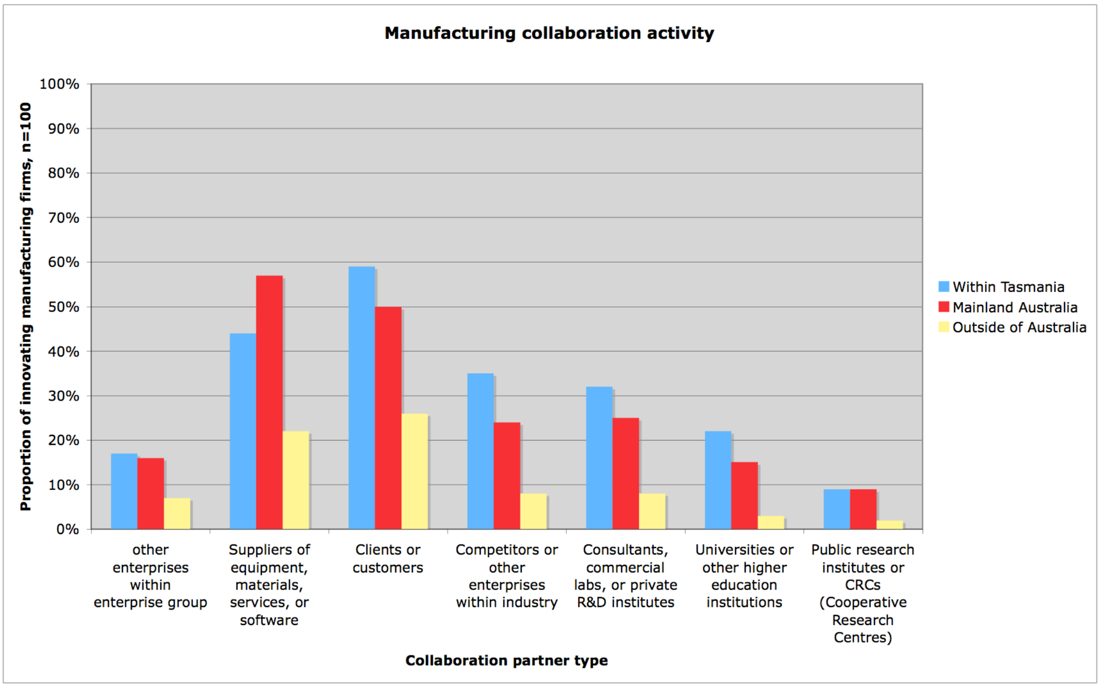
13 COLLABORATION PATTERNS OF INNOVATING FIRMS

Collaboration is widely acknowledged as a key activity undertaken by innovating firms. Innovation often requires firms to develop new knowledge and to find solutions that may lie well outside their existing competences and knowledge bases. A classic solution to this is collaboration with customers, suppliers, or even competitors, as well as such knowledge-creating institutions as universities and research institutes.

The manufacturing sector has shown to have a higher proportion of innovation-active firms than the wider economy as a whole, and to be active in new to market product innovations, so how do manufacturing firms collaborate? And do the patterns of collaboration in the manufacturing sector differ from those in the wider economy?

In the innovation census firms were asked whether they collaborated, what collaboration partners they collaborated with, and the location of collaboration partners. The results for manufacturing are shown in Figure 19.

Figure 19. Manufacturing collaboration activity



There were 39.4% of innovating manufacturing firms collaborating. This is slightly lower than for the economy as a whole at 45.5%, although there were a larger proportion of firms innovating in manufacturing.

The distribution of collaboration activity for manufacturing is remarkably similar to that for the population as a whole, with collaboration occurring primarily with customers and suppliers, competitors and consultants. The notable differences are higher proportions of supplier, client and consultant collaboration partners based on the mainland, and a higher proportion of client collaboration partners based overseas than for the general population. It is noteworthy that more than 20% of innovative manufacturing firms are collaborating with the University of Tasmania, and just under 10% with research institutes.

14 CONCLUSION

This study has sought to show that data from the Tasmanian Innovation Census can be used to illustrate key dimensions of the business demography, structure and innovation performance of manufacturing in Tasmania. We have shown that manufacturing is central to Tasmania's innovating economy, that it is closely integrated into the value chains surrounding the key sectors of Tasmania, that it is an intensive R&D-performing sector, that its innovation inputs are complex, and that it is a major producer of innovative products and processes. The fundamental structural problem facing the manufacturing sector is that although innovation is widespread, the base of intensive innovators is very narrow.

15 APPENDICES

15.1 APPENDIX A - Innovation census value chain question

Q7. During the past three calendar years 2004 to 2006, were any of [business name]'s new or improved goods or services sold to the following industries in Tasmania?

		Yes	No
[Q20]	7a. The mining industry	☐	☐
[Q21]	7b. Engineering	☐	☐
[Q22]	7c. Forestry or forest products (i.e. wood, pulp and paper)	☐	☐
[Q23]	7d. The food processing industry	☐	☐
[Q24]	7e. Fishing or Aquaculture	☐	☐
[Q25]	7f. Agriculture or horticulture	☐	☐
[Q26]	7g. The wine industry	☐	☐

15.2 APPENDIX B - Definitions of type of innovation

A firm is a *Product innovator* if they:
- Produced new or significantly improved goods in 2004-06
- Or, produced new or significantly improved services in 2004-06

A firm is a *Broader innovator* if they are an:
- Innovation-active firm
- Or, wider innovator

A firm is a *Wider innovator* if they:
- Implemented a new or significantly changed corporate strategy in 2004-06
- Or, implemented advanced management techniques in 2004-06
- Or, implemented major changes to organisational structure in 2004-06
- Or, implemented changes in marketing concepts or strategies in 2004-06

A firm is a *Goods Product Innovator* if they:
- Produced new or significantly improved goods in 2004-06

A firm is a *Services Product Innovator* if they:
- Produced new or significantly improved services in 2004-06

A firm is a *Good and Service Product Innovator* if they:
- Produced new or significantly improved goods in 2004-06
- And, produced new or significantly improved services in 2004-06

A firm is a *Novel Product Innovator - New to Market* if they:
- Introduced a new good or service onto the market before competitors in 2004-06 – i.e. new to the market

A firm is a *Non–Novel Product Innovator - New to Enterprise* if they are a:

- Product innovator
- And, *did not* introduce a new good or service onto the market before competitors in 2004-06 – i.e. new to the market

A firm is a *Process innovator* if they:
- Introduced any new or improved processes for producing or supplying goods or services in 2004-06

A firm is a *Novel Process Innovator - New to Industry* if they:
- Introduced any new or improved processes for producing or supplying goods or services in 2004-06 that were new to the industry

A firm is a *Non-Novel Process Innovator - New to Enterprise* if they are a:
- Process innovator
- And, *did not* introduce any new or improved processes for producing or supplying goods or services in 2004-06 that were new to the industry

A firm is a *Product and process innovator* if they are a:
- Product innovator
- And, process innovator

A firm is a *Product or process innovator* if they are a:
- Product innovator
- Or, process innovator

A firm is a *Future innovator* if they:
- *Did not* produce new or significantly improved goods in 2004-06
- And, *did not* produce new or significantly improved services in 2004-06
- And, *did not* introduce any new or improved processes for producing or supplying goods or services in 2004-06
- And, plans to introduce a new good, service or process in next three years 2007-09

15.3 APPENDIX C - ANZSIC codes for the manufacturing sector

ANZSIC 2006 DIVISION, SUBDIVISION, GROUP AND CLASS CODES AND TITLES FOR MANUFACTURING

C MANUFACTURING
11 Food Product Manufacturing
- 111 Meat and Meat Product Manufacturing
  - 1111 Meat Processing
  - 1112 Poultry Processing
  - 1113 Cured Meat and Smallgoods Manufacturing
- 112 Seafood Processing
  - 1120 Seafood Processing
- 113 Dairy Product Manufacturing
  - 1131 Milk and Cream Processing
  - 1132 Ice Cream Manufacturing
  - 1133 Cheese and Other Dairy Product Manufacturing
- 114 Fruit and Vegetable Processing
  - 1140 Fruit and Vegetable Processing
- 115 Oil and Fat Manufacturing
  - 1150 Oil and Fat Manufacturing
- 116 Grain Mill and Cereal Product Manufacturing
  - 1161 Grain Mill Product Manufacturing
  - 1162 Cereal, Pasta and Baking Mix Manufacturing
- 117 Bakery Product Manufacturing
  - 1171 Bread Manufacturing (Factory based)
  - 1172 Cake and Pastry Manufacturing (Factory based)
  - 1173 Biscuit Manufacturing (Factory based)
  - 1174 Bakery Product Manufacturing (Non-factory based)
- 118 Sugar and Confectionery Manufacturing
  - 1181 Sugar Manufacturing
  - 1182 Confectionery Manufacturing
- 119 Other Food Product Manufacturing
  - 1191 Potato, Corn and Other Crisp Manufacturing
  - 1192 Prepared Animal and Bird Feed Manufacturing
  - 1199 Other Food Product Manufacturing n.e.c.

12 Beverage and Tobacco Product Manufacturing
- 121 Beverage Manufacturing
  - 1211 Soft Drink, Cordial and Syrup Manufacturing
  - 1212 Beer Manufacturing
  - 1213 Spirit Manufacturing
  - 1214 Wine and Other Alcoholic Beverage Manufacturing
- 122 Cigarette and Tobacco Product Manufacturing
  - 1220 Cigarette and Tobacco Product Manufacturing

13 Textile, Leather, Clothing and Footwear Manufacturing
- 131 Textile Manufacturing
  - 1311 Wool Scouring
  - 1312 Natural Textile Manufacturing
  - 1313 Synthetic Textile Manufacturing
- 132 Leather Tanning, Fur Dressing and Leather Product Manufacturing

1320 Leather Tanning, Fur Dressing and Leather Product Manufacturing
133 Textile Product Manufacturing
1331 Textile Floor Covering Manufacturing
1332 Rope, Cordage and Twine Manufacturing
1333 Cut and Sewn Textile Product Manufacturing
1334 Textile Finishing and Other Textile Product Manufacturing
134 Knitted Product Manufacturing
1340 Knitted Product Manufacturing
135 Clothing and Footwear Manufacturing
1351 Clothing Manufacturing
1352 Footwear Manufacturing
14 Wood Product Manufacturing
141 Log Sawmilling and Timber Dressing
1411 Log Sawmilling
1412 Wood Chipping
1413 Timber Resawing and Dressing
149 Other Wood Product Manufacturing
1491 Prefabricated Wooden Building Manufacturing
1492 Wooden Structural Fitting and Component Manufacturing
1493 Veneer and Plywood Manufacturing
1494 Reconstituted Wood Product Manufacturing
1499 Other Wood Product Manufacturing n.e.c.
15 Pulp, Paper and Converted Paper Product Manufacturing
151 Pulp, Paper and Paperboard Manufacturing
1510 Pulp, Paper and Paperboard Manufacturing
152 Converted Paper Product Manufacturing
1521 Corrugated Paperboard and Paperboard Container Manufacturing
1522 Paper Bag Manufacturing
1523 Paper Stationery Manufacturing
1524 Sanitary Paper Product Manufacturing
1529 Other Converted Paper Product Manufacturing
16 Printing (including the Reproduction of Recorded Media)
161 Printing and Printing Support Services
1611 Printing
1612 Printing Support Services
162 Reproduction of Recorded Media
1620 Reproduction of Recorded Media
17 Petroleum and Coal Product Manufacturing
170 Petroleum and Coal Product Manufacturing
1701 Petroleum Refining and Petroleum Fuel Manufacturing
1709 Other Petroleum and Coal Product Manufacturing
18 Basic Chemical and Chemical Product Manufacturing
181 Basic Chemical Manufacturing
1811 Industrial Gas Manufacturing
1812 Basic Organic Chemical Manufacturing
1813 Basic Inorganic Chemical Manufacturing
182 Basic Polymer Manufacturing
1821 Synthetic Resin and Synthetic Rubber Manufacturing

1829 Other Basic Polymer Manufacturing
183 Fertiliser and Pesticide Manufacturing
1831 Fertiliser Manufacturing
1832 Pesticide Manufacturing
184 Pharmaceutical and Medicinal Product Manufacturing
1841 Human Pharmaceutical and Medicinal Product Manufacturing
1842 Veterinary Pharmaceutical and Medicinal Product Manufacturing
185 Cleaning Compound and Toiletry Preparation Manufacturing
1851 Cleaning Compound Manufacturing
1852 Cosmetic and Toiletry Preparation Manufacturing
189 Other Basic Chemical Product Manufacturing
1891 Photographic Chemical Product Manufacturing
1892 Explosive Manufacturing
1899 Other Basic Chemical Product Manufacturing n.e.c.
19 Polymer Product and Rubber Product Manufacturing
191 Polymer Product Manufacturing
1911 Polymer Film and Sheet Packaging Material Manufacturing
1912 Rigid and Semi-Rigid Polymer Product Manufacturing
1913 Polymer Foam Product Manufacturing
1914 Tyre Manufacturing
1915 Adhesive Manufacturing
1916 Paint and Coatings Manufacturing
1919 Other Polymer Product Manufacturing
192 Natural Rubber Product Manufacturing
1920 Natural Rubber Product Manufacturing
20 Non-Metallic Mineral Product Manufacturing
201 Glass and Glass Product Manufacturing
2010 Glass and Glass Product Manufacturing
202 Ceramic Product Manufacturing
2021 Clay Brick Manufacturing
2029 Other Ceramic Product Manufacturing
203 Cement, Lime, Plaster and Concrete Product Manufacturing
2031 Cement and Lime Manufacturing
2032 Plaster Product Manufacturing
2033 Ready-Mixed Concrete Manufacturing
2034 Concrete Product Manufacturing
209 Other Non-Metallic Mineral Product Manufacturing
2090 Other Non-Metallic Mineral Product Manufacturing
21 Primary Metal and Metal Product Manufacturing
211 Basic Ferrous Metal Manufacturing
2110 Iron Smelting and Steel Manufacturing
212 Basic Ferrous Metal Product Manufacturing
2121 Iron and Steel Casting
2122 Steel Pipe and Tube Manufacturing
213 Basic Non-Ferrous Metal Manufacturing
2131 Alumina Production
2132 Aluminium Smelting
2133 Copper, Silver, Lead and Zinc Smelting and Refining
2139 Other Basic Non-Ferrous Metal Manufacturing

214 Basic Non-Ferrous Metal Product Manufacturing
2141 Non-Ferrous Metal Casting
2142 Aluminium Rolling, Drawing, Extruding
2149 Other Basic Non-Ferrous Metal Product Manufacturing
22 Fabricated Metal Product Manufacturing
221 Iron and Steel Forging
2210 Iron and Steel Forging
222 Structural Metal Product Manufacturing
2221 Structural Steel Fabricating
2222 Prefabricated Metal Building Manufacturing
2223 Architectural Aluminium Product Manufacturing
2224 Metal Roof and Guttering Manufacturing (except Aluminium)
2229 Other Structural Metal Product Manufacturing
223 Metal Container Manufacturing
2231 Boiler, Tank and Other Heavy Gauge Metal Container Manufacturing
2239 Other Metal Container Manufacturing
224 Sheet Metal Product Manufacturing (except Metal Structural and Container Products)
2240 Sheet Metal Product Manufacturing (except Metal Structural and Container Products)
229 Other Fabricated Metal Product Manufacturing
2291 Spring and Wire Product Manufacturing
2292 Nut, Bolt, Screw and Rivet Manufacturing
2293 Metal Coating and Finishing
2299 Other Fabricated Metal Product Manufacturing n.e.c.
23 Transport Equipment Manufacturing
231 Motor Vehicle and Motor Vehicle Part Manufacturing
2311 Motor Vehicle Manufacturing
2312 Motor Vehicle Body and Trailer Manufacturing
2313 Automotive Electrical Component Manufacturing
2319 Other Motor Vehicle Parts Manufacturing
239 Other Transport Equipment Manufacturing
2391 Shipbuilding and Repair Services
2392 Boatbuilding and Repair Services
2393 Railway Rolling Stock Manufacturing and Repair Services
2394 Aircraft Manufacturing and Repair Services
2399 Other Transport Equipment Manufacturing n.e.c.
24 Machinery and Equipment Manufacturing
241 Professional and Scientific Equipment Manufacturing
2411 Photographic, Optical and Ophthalmic Equipment Manufacturing
2412 Medical and Surgical Equipment Manufacturing
2419 Other Professional and Scientific Equipment Manufacturing
242 Computer and Electronic Equipment Manufacturing
2421 Computer and Electronic Office Equipment Manufacturing
2422 Communications Equipment Manufacturing
2429 Other Electronic Equipment Manufacturing
243 Electrical Equipment Manufacturing
2431 Electric Cable and Wire Manufacturing

2432 Electric Lighting Equipment Manufacturing
2439 Other Electrical Equipment Manufacturing
244 Domestic Appliance Manufacturing
2441 Whiteware Appliance Manufacturing
2449 Other Domestic Appliance Manufacturing
245 Pump, Compressor, Heating and Ventilation Equipment Manufacturing
2451 Pump and Compressor Manufacturing
2452 Fixed Space Heating, Cooling and Ventilation Equipment Manufacturing
246 Specialised Machinery and Equipment Manufacturing
2461 Agricultural Machinery and Equipment Manufacturing
2462 Mining and Construction Machinery Manufacturing
2463 Machine Tool and Parts Manufacturing
2469 Other Specialised Machinery and Equipment Manufacturing
249 Other Machinery and Equipment Manufacturing
2491 Lifting and Material Handling Equipment Manufacturing
2499 Other Machinery and Equipment Manufacturing n.e.c.
25 Furniture and Other Manufacturing
251 Furniture Manufacturing
2511 Wooden Furniture and Upholstered Seat Manufacturing
2512 Metal Furniture Manufacturing
2513 Mattress Manufacturing
2519 Other Furniture Manufacturing
259 Other Manufacturing
2591 Jewellery and Silverware Manufacturing
2592 Toy, Sporting and Recreational Product Manufacturing
2599 Other Manufacturing n.e.c.