

INNOVATION IN MANUFACTURING

AUSTRALIA

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- For more information about these and related statistics, contact John Ovington on Canberra 02 6252 5189, or Bill Pattinson on Canberra 02 6252 5019, or refer to the back cover of this publication.

NOTES

COMMENTS AND ADDITIONAL DATA

Comments on the statistics presented in this publication and suggestions for further improvement would be most welcome and should be forwarded to:

The Director
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This publication contains only a selection of the information from the survey. More detailed information is available from the Australian Bureau of Statistics (ABS) on request.

The ABS will also shortly release the results of a less detailed survey of innovative activities conducted within the Mining industries.

SYMBOLS AND OTHER USAGES

The following symbols, where shown in columns or elsewhere in tables, mean:

- * estimate has a relative standard error greater than 25% and is therefore subject to sampling variability too high for most practical uses
- ** estimate has a relative standard error greater than 25–50% and is therefore subject to sampling variability too high for most practical uses
- n.a. not available.

Where figures have been rounded, discrepancies may occur between the sum of component items and the total.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
OECD	Organisation for Economic Co-operation and Development
RSE	Relative standard error
R&D	Research and Development
SE	Standard error

W. McLennan
Australian Statistician

INTRODUCTION

This publication presents the results of the second survey by the Australian Bureau of Statistics (ABS) of innovation in the Manufacturing Sector. The survey collected details of innovative activities undertaken by manufacturers between July 1994 and June 1997. It was based on concepts and standard questions developed jointly by the Organisation for Economic Co-operation and Development (OECD) and Eurostat. The concepts have been published in 'OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data' (OECD, Paris, 1997), known as the Oslo Manual.

DEFINING TECHNOLOGICAL INNOVATION

In the manual, technological innovation is defined to '...comprise implemented technologically new products and processes and significant technological improvements in products and processes. An innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). Innovations therefore involve a series of scientific, technological, organisational, financial and commercial activities. An innovating business is one that has implemented technologically new or significantly technologically improved products or processes during the period under review'.

The manual indicates that technological innovation can comprise any of the following activities:

- design;
- research and development;
- acquisition of technology in the form of patents, licences and trademarks;
- acquisition of technology in the form of machinery and equipment;
- tooling-up and industrial engineering;
- manufacturing start-up and pre-production development;
- training; and
- marketing for new products.

As well as collecting data in a form comparable with the international standards for technological innovation, the ABS also included additional questions on non-technological innovation.

DATA VIEWS

This publication presents statistics on technological innovation in Australian manufacturing as follows:

SECTION 1 The rate of technological innovation in Australian manufacturing

This section describes the extent to which businesses and industries undertake technological innovation. Also presented are business size and State data.

SECTION 2 Qualitative aspects of technological innovation in manufacturing businesses

This section summarises the responses of businesses to attitudinal questions on the objectives of technological innovation, the sources of ideas and information for technological innovation, and the factors which hamper technological innovation.

SECTION 3 The impact of technological innovation on manufacturing businesses

This section looks at the relationships between technological innovation and business activities, as measured by changes in employment, production activities and profitability of the business.

SECTION 4 Expenditure on technological innovation activities

This section quantifies the approximate expenditure on technological innovation activities by manufacturing businesses.

SECTION 5 Profile of significant technological innovation projects

This section presents information about the significant technological innovation projects undertaken by businesses. Data presented includes the cost of the innovation, the type of innovation, the timing of the project and objective of the project.

SECTION 6 Use of advanced manufacturing technologies

This section presents information on the occurrence of selected types of advanced manufacturing technologies within manufacturing industries.

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SECTION 1

THE RATE OF TECHNOLOGICAL INNOVATION IN AUSTRALIAN MANUFACTURING

INTRODUCTION

This section presents the level of technological innovation in the Manufacturing Sector classified by the industry, employment size and sales of the business and by the State of location of the innovation activity.

In total Of the estimated 55,000 manufacturing businesses in Australia, 26% had undertaken one or more technological innovation activities in the three-year period from 1 July 1994 to 30 June 1997. The comparable figure between 1 July 1991 to 30 June 1994 was 32%.

The drop in the rate of technological innovation in the Manufacturing Sector is due mainly to the decline in the proportion of the smallest businesses (with fewer than 10 employees) which undertake technological innovation. For businesses with more than 10 employees the technological innovation rate over the two three-year periods, 1 July 1991 to 30 June 1994 and 1 July 1994 to 30 June 1997, dropped from 50% to 47%. For businesses with fewer than 10 employees the technological innovation rate dropped by almost one-third, from 27% to 19%.

While businesses that undertake technological innovation only represent about a quarter of all manufacturing businesses, they contribute about two-thirds of the total employment and three-quarters of the total turnover of all manufacturing businesses. In terms of the contribution, this dominance results mainly from the fact that the larger employers are more likely to be undertaking technological innovation.

On average, a business which is undertaking technological innovation has over 5 times as many employees as a business which doesn't undertake any technological innovation and almost 10 times as much turnover. By comparing turnover ratios at the employee rather than the business level, some allowance is made for the differences in the employment sizes of the types of business. For businesses which undertake technological innovation the turnover per employee ratio is over 50% greater than the ratio for businesses which don't undertake technological innovation.

By type Product innovation was the most prevalent type of technological innovation in the Manufacturing Sector between 1 July 1994 to 30 June 1997, occurring in 23% of businesses. Process innovation was also significant occurring in 18% of manufacturing businesses. The comparable figures between 1 July 1991 to 30 June 1994 were 30% and 23% respectively.

By industry The Petroleum, coal, chemical and associated product industry had the highest rate of technological innovation with 42% of businesses undertaking one or more technological innovation activities in the three-year period from 1 July 1994 to 30 June 1997. The industries with the next highest rates of technological innovation were the Non-metallic mineral product industry and the Food, beverage and tobacco industry, both with rates of 36% and the Machinery and equipment industry at 35%. These three industries had the highest rates of technological innovation in 1993–94; however, the order of the second and third industries were reversed.

The Textile, clothing and footwear industry recorded the lowest rate of technological innovation at 15% closely followed by the Wood and paper product industry at 16%. These two industries also had the lowest rates of technological innovation in 1993–94.

1

PROPORTION OF BUSINESSES UNDERTAKING TECHNOLOGICAL INNOVATION BY INDUSTRY

ANZSIC code	Industry subdivision	Type of technological innovation		
		Product	Process	Total
		%	%	%
21	Food, beverages and tobacco	33.0	29.1	36.3
22	Textiles, clothing, footwear & leather	14.7	*13.6	15.4
23	Wood and paper products	11.8	12.0	15.7
24	Printing, publishing and recorded media	17.6	20.7	25.6
25	Petroleum, coal, chemical and assoc. prods	34.8	29.3	42.1
26	Non-metallic mineral products	32.6	*20.7	35.5
27	Metal product	20.3	12.7	21.1
28	Machinery and equipment	33.0	19.8	35.3
29	Other manufacturing	18.9	14.7	20.9
21–29	Total manufacturing	22.9	17.8	26.0

By business size—
employment The rate of technological innovation in the Manufacturing Sector was directly related to the employment size of the businesses. The extent of technological innovation ranged from 19% for businesses with employment of less than 10, to 89% for businesses with employment of 500 or more.

2

PROPORTION OF BUSINESSES UNDERTAKING TECHNOLOGICAL INNOVATION BY EMPLOYMENT

Employment	Type of technological innovation		
	Product	Process	Total
	%	%	%
Less than 10	16.0	12.5	18.7
10–49	39.1	28.0	42.6
50–99	47.3	45.7	53.6
100–499	63.9	56.6	70.6
500 or more	83.3	80.6	89.2
Total manufacturing	22.9	17.8	26.0

By business size—sales

The rate of technological innovation in the Manufacturing Sector was directly related to the sales of the business. The extent of technological innovation ranged from 19% for businesses with less than one million dollars in sales to 85% for businesses with more than \$100m in sales.

3

PROPORTION OF BUSINESSES UNDERTAKING TECHNOLOGICAL INNOVATION BY SALES

	<i>Type of technological innovation</i>		
	<i>Product</i>	<i>Process</i>	<i>Total</i>
<i>Sales</i>	%	%	%
Less than \$1m	16.2	12.2	18.6
\$1–9m	40.5	31.6	45.3
\$10–19m	55.0	48.3	60.0
\$20–99m	63.8	59.5	73.9
More than \$100m	81.9	76.1	84.9
Total manufacturing	22.9	17.8	26.0

By location of innovation expenditure

Overall the rate of technological innovation within States was fairly consistent ranging between 24% and 29%, the exception being the Northern Territory which only had 16% of businesses undertaking technological innovation.

4

PROPORTION OF BUSINESSES UNDERTAKING TECHNOLOGICAL INNOVATION, BY LOCATION(a)

	<i>Type of technological innovation</i>		
	<i>Product</i>	<i>Process</i>	<i>Total</i>
<i>State</i>	%	%	%
NSW	21.2	17.6	24.5
Vic.	26.4	20.8	29.0
Qld	20.6	14.9	24.0
SA	24.2	19.7	28.3
WA	22.5	13.9	23.8
Tas.	22.9	17.9	26.3
NT	12.1	10.2	16.0
ACT	16.9	19.9	24.3
Total manufacturing	22.9	17.8	26.0

(a) The State where the majority of expenditure on innovation occurs.

SECTION 2

QUALITATIVE ASPECTS OF TECHNOLOGICAL INNOVATION IN MANUFACTURING BUSINESSES

INTRODUCTION

This section presents data on the qualitative aspects of the innovation survey. Each business was asked to rate the importance of certain variables from not applicable to crucial. The ratings have been combined to form the three categories, not applicable, not important and important, which are used in the tables below.

Objectives of undertaking technological innovation

'Reducing costs', 'Maximising profits' and 'Improving productivity' were most frequently identified as important objectives when undertaking technological innovation. About 90% of businesses which undertook technological innovation rated these objectives as important while less than 6% rated them as not being applicable to their business.

The objectives that were the next most frequently rated as important by businesses undertaking technological innovation were, 'Increasing the ability to be responsive to customers', 'Improving the quality or speed of service' and 'Increasing market share'.

The objective which was the least frequently rated important by businesses undertaking technological innovation was 'Seeking or increasing export opportunities'. While this objective was rated as not applicable by 32% of these businesses, 51% rated it as important.

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OBJECTIVES OF UNDERTAKING TECHNOLOGICAL INNOVATION

<i>Objective</i>	<i>Importance of the objective</i>		
	<i>Not applicable</i>	<i>Not important</i>	<i>Important</i>
	%	%	%
Reducing costs	4.1	3.9	92.0
Maximising profits	*4.4	*3.7	91.9
Improving productivity	6.2	4.7	89.2
Responsiveness to customers	6.0	6.3	87.7
Improving quality/speed of service	6.9	5.5	87.6
Increasing market share	7.3	8.1	84.6
Being at industry forefront	11.7	8.3	79.9
Expanding product range	10.7	10.3	79.1
Improving staff safety/working conditions	11.2	10.1	78.7
Establishing a new market	10.8	11.5	77.7
Being environmentally aware	16.0	14.4	69.6
Meeting Government standards/regulations	13.4	17.2	69.5
Seeking/expanding export opportunities	31.8	17.7	50.6

Source of ideas and information	<p>Businesses undertaking technological innovation identified the important sources of ideas and information for the innovation projects the business had undertaken at two stages: the initial idea and throughout the project, as well as identifying the sources of technical information and advice.</p> <p>Generally businesses use both internal and external sources to obtain ideas and information when undertaking technological innovation. However the internal or in-house sources are utilised more frequently than external sources.</p> <p>Management was considered to be an important source for the initial idea for an innovation by nearly 80% of businesses undertaking technological innovation. This source was identified nearly three times as often as any other source for the initial idea. Marketing and production staff working within the organisation were considered to be important sources of the initial idea for an innovation in about one-quarter of businesses undertaking technological innovation. Sources external to the business were considered to be important sources for initial ideas for an innovation as follows: clients or customers 32%, competitors 25% and fairs and exhibitions 24%.</p> <p>At later stages of the innovation project, Management remained the source of ideas and information most often identified, being considered important by 67% of businesses undertaking technological innovation. Other staff within the business were more often considered to be important during later stages of the innovation project than at the initial stage. The results were: Production staff 44%, Technical staff 31%, Marketing staff 23% and Research and Development (R&D) staff 16%. The importance of sources external to the business was much lower than at the initial stage, with the most often identified source being Clients or customers 20%.</p> <p>With respect to Technical information and advice, the source identified most often was still Management 34%, although this proportion is much lower than for any of the stages of the innovation project. Not surprisingly, Technical staff 22% and Production staff 19% were the next most often identified sources. The most often identified source which was external to the business was Suppliers of raw materials 15%.</p> <p>Government and Educational organisations were the sources least often identified as important. Less than 3% of businesses undertaking technological innovation considered these sources to be important under any of the three categories.</p>
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SOURCE OF IDEAS AND INFORMATION USED FOR TECHNOLOGICAL INNOVATION

Source	Proportion of Technological Innovators using Source		
	Initial idea	Throughout the project	Technical information
	%	%	%
Internal sources			
Management	79.4	66.7	34.1
Production staff	23.4	44.4	19.3
Technical staff	17.8	31.4	22.1
R&D staff	12.1	16.2	11.0
Marketing staff	26.7	22.6	10.9
External market/commercial sources			
Parent company in Australia	6.9	5.6	*3.8
Parent company overseas	4.7	3.0	3.7
Other part of business group	3.7	4.0	*3.5
Competitors	24.5	6.3	*3.8
Unrelated company	7.1	*3.5	*2.9
Clients or customers	31.7	19.8	7.5
Consultants	10.0	13.3	11.0
Suppliers of raw materials	12.6	10.4	14.8
Suppliers of components or parts	5.1	10.6	11.3
Suppliers of equipment	11.7	10.5	12.8
Educational/Government			
Universities	1.7	2.9	2.9
Government organisations	0.4	0.6	**1.3
Government research organisations	*1.3	*2.7	2.5
Generally available information			
Government standards, regulations	*2.3	*3.5	*2.5
Patents, licences	3.8	3.5	4.2
Computer information systems	4.2	3.4	5.1
Conferences, meetings, journals	14.2	8.4	11.6
Fairs and exhibitions	24.4	9.6	10.5

Diffusion of innovation capabilities

Innovation capabilities were acquired (purchased or transferred into the business) by 94% of businesses undertaking technological innovation. This was nearly double the number that transferred or sold technology (52%).

Businesses appeared to acquire the knowledge or ability to carry out technological innovation from a wide variety of sources.

Two-thirds of the businesses undertaking technological innovation acquire the knowledge or ability from within their own business group. This comes from their own staff, by using their own equipment or technical information in different ways, or from their own in-house research.

Outside the business itself, the most common sources of acquiring the knowledge or ability for innovative activity comes from: 'Purchasing equipment' 57%; 'Conferences, fairs, exhibitions, journals and publications' 56%; and 'Use of consultants' 35%.

Diffusion of innovation capabilities *continued*

The role of research in providing the knowledge for innovative activity is shown by combining the categories for in-house and contract research. When combined, research was seen as providing the knowledge or ability to perform innovation in 36% of businesses undertaking technological innovation.

Innovation capabilities are most often transferred within a business rather than being sold externally. The most common way of transferring knowledge or abilities externally are by the 'Loss of skilled employees' (13%) and employing 'Consultants' (11%).

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DIFFUSION OF INNOVATION CAPABILITIES

	<i>Acquired or purchased</i>	<i>Transferred or sold</i>
<i>Diffusion method</i>	<i>%</i>	<i>%</i>
Within your business group		
skilled staff	35.5	15.1
equipment	42.4	11.8
technical information	43.9	21.8
research results	31.2	11.3
Rights or licences of inventions	8.7	7.2
Results of R&D	9.2	8.6
Consultants	34.6	10.7
Take-over/sale of company, either in full or part	*4.6	*1.4
Equipment	57.2	7.6
Skilled employees	28.1	12.8
Conferences, fairs, exhibitions, journals, publications	55.5	n.a.
One or more	94.1	51.9

Barriers to technological innovation

Most businesses, regardless of whether they were undertaking technological innovation which hampered them when trying to start technological innovation projects identified barriers. However, the rate and order of the most frequently identified barriers, differed between those undertaking and those not undertaking technological innovation.

Over two-thirds of all businesses felt that there were important barriers that inhibit them from starting technological innovation projects. A higher proportion (95%) of businesses that are already undertaking technological innovation generally feel that there are factors that inhibit them from starting innovation projects than those businesses that are currently not undertaking any technological innovation activity (58%).

The factor which was most frequently rated by businesses as an important barrier to starting innovation projects was 'Government policy and taxation'. This was followed by 'Current economic climate not conducive to innovation', 'Insufficient retained earnings' and 'Potential market already dominated by established businesses'.

Barriers to technological innovation *continued*

Businesses undertaking technological innovation rate 'Government policy and taxation' above 'Current economic climate not conducive to innovation' as the two most frequently identified factors which hamper businesses from starting innovation projects. These are also the two most frequently identified factors for businesses not undertaking technological innovation although the order is reversed. The third most frequently identified factors were 'Excessive risk perceived by the business' for businesses undertaking technological innovation, while 'Insufficient retained earnings' was the third most frequently identified factor for businesses not undertaking technological innovation.

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BARRIERS TO STARTING INNOVATION PROJECTS

<i>Barriers</i>	<i>Importance of the barrier</i>		
	<i>Not applicable</i>	<i>Not important</i>	<i>Important</i>
	<i>%</i>	<i>%</i>	<i>%</i>
Government policy & taxation	49.3	9.3	40.7
Current economic climate	45.7	12.9	40.6
Insufficient retained earnings	52.7	10.5	36.0
Potential market already dominated	49.3	14.4	35.6
Lack of appropriate sources of finance	55.0	11.6	32.6
Excessive economic risk perceived by business or parent company	58.6	8.1	32.6
Government standards & regulations	54.6	14.1	30.5
Market too small or unknown	54.2	14.7	30.4
Insufficient funds to recruit skilled staff	57.8	11.9	29.5
Excessive economic risk perceived by financiers/investors	71.9	7.7	19.6
Innovation project too large	67.5	13.9	17.9

Abandoned innovations

Less than one tenth of all businesses reported abandoning innovation projects. As the employment size of the business increases so does the proportion who abandon projects. For businesses with fewer than 10 employees, only 6% abandoned an innovation project. This proportion increases to 52% for businesses with 500 or more employees. On average one-quarter of the innovation projects that a business commences are abandoned.

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PROPORTION OF BUSINESSES WITH ABANDONED INNOVATION PROJECTS BY EMPLOYMENT

<i>Employment</i>	<i>Businesses undertaking technological innovation</i>	<i>All manufacturing businesses</i>
	<i>%</i>	<i>%</i>
Less than 10	28.9	6.3
10-49	32.0	13.9
50-99	35.6	19.3
100-499	44.4	31.9
500 or more	57.7	51.8
Total manufacturing	31.7	9.0

Abandoned innovations The most frequently identified stages at which innovation projects were abandoned were the design (44%) and feasibility (39%) stages. The rate at which innovation projects were abandoned decreased for the later stages, ranging between 9% to 24%. The main factors in deciding to abandon the innovation projects were: 'The costs were too high or too hard too control', 'Competing resources or priorities' and 'Expected low returns'.

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REASONS FOR ABANDONING INNOVATION PROJECTS

<i>Reasons</i>	<i>Importance of the reason</i>		
	<i>Not applicable</i>	<i>Not important</i>	<i>Important</i>
	%	%	%
Financial factors			
Costs too high or hard to control	15.6	*14.2	70.1
Expected low returns	26.4	20.6	53.0
Payback period too long	27.6	23.5	49.0
Market factors			
Competitor activity in same market	21.6	27.2	51.2
Development period too long	25.8	30.5	43.7
Unable to satisfy customer's specifications	39.0	27.2	33.8
Business factors			
Competing resources or priorities	23.3	15.9	60.8
Lack of or unable to obtain skilled staff	40.8	21.7	37.5
Outside 'core' business activity	48.0	22.0	30.0
Lack of commitment within business	43.9	29.9	26.2
Failure of cooperation agreement	64.9	18.3	16.8
Parent company directive	78.5	10.5	11.1
Other factors			
Unable to resolve technical difficulties	34.0	19.3	46.7
Resistance to change from staff or unions	64.2	23.7	12.1
Unacceptable environmental impact	72.5	19.6	8.0

SECTION 3

THE IMPACT OF TECHNOLOGICAL INNOVATION ON MANUFACTURING BUSINESSES

INTRODUCTION

This section looks at indicators of the impact of undertaking technological innovation on business activities and performance. The data have been derived by asking businesses to rate whether the undertaking of innovation has affected their employment, production activities and profitability.

Overall the majority of businesses reported that undertaking technological innovation has had positive effects on the employment, production activities and profitability of the business. While this effect was not quantified it does indicate the perceived impacts of undertaking technological innovation.

Employment levels

About half of the businesses reported that the undertaking of technological innovation had an impact upon the employment of the business during the period 1 July 1994 to 30 June 1997. Of those businesses reporting an impact, most reported positive impacts on staff levels. The impact was most often felt by the production staff where almost one-third of businesses undertaking technological innovation actually reported an increase in production staff levels.

Production activities

About two-thirds of businesses reported that the undertaking of technological innovation had an impact upon the production activities of the business during the period 1 July 1994 to 30 June 1997. Most of those businesses reported that technological innovation had a positive effect on the production activities listed. The largest impact occurred in the production levels, where 61% of businesses undertaking technological innovation reported that the levels increased and only 2% reported that the levels decreased.

Profitability

Over two-thirds of the businesses undertaking technological innovation reported that their profitability had changed during the period 1 July 1996 to 30 June 1997. While 38% of businesses undertaking technological innovation reported that their innovation activities had helped increase the businesses profits, only 7% reported that their innovation activities had decreased their profits.

11

EFFECT OF INNOVATION ACTIVITY

<i>Impact</i>	<i>Proportion of Technological Innovators</i>	
	<i>Decreased</i>	<i>Increased</i>
	<i>%</i>	<i>%</i>
Employment levels		
Management	*3	12.5
Research	0.3	6.8
Technical	0.5	12.7
Production	6.3	32.7
Marketing	*1.9	12.6
Administration	3.0	12.9
External consultants	0.9	9.8
Production activities		
Production levels	2.1	61.4
Cleaner production process	**0.8	26.6
Labour usage	16.7	28.8
Materials consumption	9.8	37.4
Energy consumption	8.2	30.0
Wastage	21.1	15.0
Capital utilisation	*2.3	32.8
Maintenance support	3.9	16.9
Profitability	7.3	38.1

SECTION 4

EXPENDITURE ON TECHNOLOGICAL INNOVATION ACTIVITIES

INTRODUCTION

This section presents data on the approximate costs of technological innovation by businesses in the Manufacturing Sector. Data is presented by industry and type of expenditure.

In total The total amount spent by businesses on technological innovation during 1996–97 was \$3.9 billion. The average amount spent per employee on innovative activities during 1996–97 by those businesses that undertook one or more forms of technological innovation was \$3,900.

By industry The Machinery and equipment industry spent the most on innovative activities (\$1,500m). This was more than twice as much as the Petroleum, coal, chemical and associated product industry, which spent the second largest amount (\$640m), and the Food beverages and tobacco industry (\$590m). The Textile, clothing, footwear and leather industry spent the least on innovative activities (\$110m) and the Other manufacturing industry was the next lowest (\$140m).

By type Most innovation expenditure was on R&D (50%), followed by tooling-up (29%). These two were the main areas of expenditure in all manufacturing industries.

The least innovation expenditure was on Training associated with the introduction of new innovations (3%). This was consistent for most manufacturing industries, the exception being the Metal product industry which spent the least on the Acquisition of technology.

By size In general, as the size of the businesses increases so does the amount spent on innovation activities. Over 45% of the total innovation expenditure was spent by businesses with 500 or more employees, while 8% of the total innovation expenditure was spent by businesses with less than 10 employees.

In terms of the average expenditure on innovation activities per employee, only small differences were exhibited across the sizes. While the overall average expenditure per employee was \$3,900, businesses with fewer than 10 employees spent an average of \$2,200 while businesses with more than 500 employees spent an average of \$5,300.

By State Victoria (\$1,640m) and New South Wales (\$1,220m) contributed over 70% of the total innovation expenditure in Australia. The next highest expenditure was from Queensland (\$340m), South Australia (\$330m) and Western Australia (\$280m).

<i>Type of innovation activity</i>	<i>Less than 10</i>	<i>10-49</i>	<i>50-99</i>	<i>100-499</i>	<i>500 or more</i>	<i>Total</i>
EXPENDITURE (\$'000)						
Research and development	99.7	266.4	134.2	446.5	1 037.9	1 984.7
Acquisition of technology developed by others (eg patents, trademarks)	*21.7	*40.0	*15.1	44.2	52.9	173.9
Training & further education related to introduction of innovations	*14.8	26.0	**27.4	26.5	43.1	137.8
Expenditure on tooling-up, industrial engineering and start-up	128.5	222.3	117.8	188.9	482.3	1 139.8
Marketing of new or improved products	43.0	*82.9	47.4	119.2	128.3	420.8
Other	**3.5	10.5	27.4	8.9	33.4	83.8
Total expenditure	311.2	648.1	369.4	834.2	1 777.9	3 940.8
Average \$'000/employee	2.2	3.1	3.8	3.7	5.3	3.9
PERCENTAGE OF TOTAL (%)						
Research and development	5.0	13.4	6.8	22.5	52.3	100.0
Acquisition of technology developed by others (eg patents, trademarks)	*12.5	*23.0	*8.7	25.4	30.4	100.0
Training & further education related to introduction of innovations	*10.8	18.9	*19.9	19.2	31.3	100.0
Expenditure on tooling-up, industrial engineering and start-up	11.3	19.5	10.3	16.6	42.3	100.0
Marketing of new or improved products	10.2	19.7	11.3	28.3	30.5	100.0
Other	**4.2	12.6	32.7	10.6	39.9	100.0
Total expenditure	7.9	16.4	9.4	21.2	45.1	100.0

SECTION 5

PROFILE OF SIGNIFICANT TECHNOLOGICAL INNOVATION PROJECTS

INTRODUCTION

This section presents data on specific innovations that businesses undertook during the period 1 July 1994 to 30 June 1997. Businesses which undertook technological innovation were asked to report on one of the larger or more significant innovations that the business had implemented during the period. The statistics in this Section reflect the characteristics of the actual innovations.

Innovations that were new to the business only (i.e. implemented in the business for the first time but may already be implemented in other businesses) generally appear to be the smaller projects which cost less, are conducted over a shorter time frame and have a shorter lifespan than innovations which are new to the industry in Australia or world market. Of innovations which are new to the business, 82% cost less than \$100,000; 91% had a development period of 2 years or less; 72% had a cost recovery period 2 years or less; while 66% reported an expected innovation life of more than 2 years.

In contrast innovations which are being developed for the world market are generally the larger innovation project both in terms of cost and time. Of the innovations which are new to the world market business, 71% cost less than \$100,000; 67% had a development period of 2 years or less; 62% had a cost recovery period 2 years or less; while 69% reported an expected innovation life of more than 2 years.

The most frequently reported objective of the innovation projects being described were to maintain or increase market share (95%) or to change the products being manufactured by the business (94%). The most often reported objective under market share was 'Opening new domestic markets', while for changing products the objective reported most often was 'Improving product quality'.

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COST OF INNOVATION PROJECT

	Project cost \$'000				
	<5	5-9	10-99	100-999	1 000 or more
<i>Innovation new to</i>	%	%	%	%	%
The business	18.5	20.0	43.5	15.7	2.2
The industry in Australia	*20.6	*14.6	42.1	18.4	4.2
World market	**8.9	**6.8	51.0	27.6	5.7

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TIME UNTIL INNOVATION PROJECT IMPLEMENTED

	Time to reach implementation phase				
	<6 months	6-12 months	1-2 years	2-5 years	>5 years
<i>Innovation new to</i>	%	%	%	%	%
The business	37.7	31.9	21.5	8.4	**0.5
The industry in Australia	27.6	31.4	25.7	*14.6	*0.7
World market	*12.9	*30.9	25.6	28.4	*2.3

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TIME UNTIL INNOVATION PROJECT COSTS RECOVERED

	<i>Cost recovery period</i>				
	<6 months	6–12 months	1–2 years	2–5 years	>5 years
<i>Innovation new to</i>	%	%	%	%	%
The business	21.8	14.2	36.1	23.1	4.8
The industry in Australia	*17.6	*11.1	27.8	32.4	*11.2
World market	*10.5	*12.8	38.7	24.8	*13.1

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TIME UNTIL INNOVATION PROJECT IS OUTDATED

	<i>Period before updating/replacement required</i>				
	<6 month	6–12 months	1–2 years	2–5 years	>5 years
<i>Innovation new to</i>	%	%	%	%	%
The business	*3.8	12.9	17.4	32.9	33.1
The industry in Australia	*2.2	*7.7	*22.1	32.7	35.2
World market	**5.2	*10.8	*15.2	37.2	31.6

17

OBJECTIVES OF UNDERTAKING INNOVATION PROJECT

	<i>Not applicable</i>	<i>Not important</i>	<i>Important</i>
<i>Objective</i>	%	%	%
Change in product			
Replace products being phased out	53.6	13.3	33.1
Extend product range			
within main field	24.5	6.8	68.7
outside main field	54.6	16.7	28.7
Develop environmentally friendly products	50.0	15.5	34.5
Improve product quality	18.2	*5.3	76.5
Production process			
Improve production flexibility	23.0	10.5	66.5
Cost reduction			
Lower production costs by reducing			
labour costs	25.7	9.4	65.0
materials consumption	31.1	17.6	51.3
energy consumption	40.4	28.6	31.0
reject rate	37.7	16.2	46.1
product design costs	39.8	22.1	38.1
production lead times	32.5	12.2	55.4
production down times	39.1	18.0	43.0
Market share			
Maintain market share	24.8	6.6	68.6
Increase market share	12.1	*6.0	82.0
Open new domestic markets	17.0	5.4	77.6
Open new overseas markets	41.0	14.4	44.6
Other factors			
Improve safety/working conditions	37.6	13.0	49.3
Reduce environmental impact	43.0	16.9	40.1

SECTION 6

USE OF ADVANCED MANUFACTURING TECHNOLOGIES

INTRODUCTION

This section presents the level of advanced manufacturing technology used within industries by the main types of advanced manufacturing technologies. Ideally this type of information should be collected about individual establishments or plants. In this survey the data has been compiled in respect of management units (primarily legal entities) and as such the detail may not be directly comparable with data published in *Manufacturing Technology Statistics, Australia, 1991* (Cat. no. 8123.0) which was based on establishments.

In total Of all businesses in the Manufacturing Sector, 24% had acquired at least one of the surveyed advanced manufacturing technologies. Another 12% were currently installing advanced technologies or planned to acquire advanced technologies within the next 2 years.

Approximately 51% of businesses in the Manufacturing Sector undertaking technological innovation between 1 July 1994 and 30 June 1997 had acquired at least one of the surveyed advanced manufacturing technologies, compared to only 14% of businesses which had not undertaken technological innovation in the same period.

Type of technology within industries

The major uses of advanced technologies in the Manufacturing Sector were in design and engineering, communication and control, and fabrication and machining. Each of the activities accounted for more than 20% of businesses reporting at least one of the surveyed technologies. In contrast only 3% reported having any of the advanced technologies associated with automated handling and automated inspection. The Machinery and equipment industry had the highest proportion of businesses using advanced technologies, with 36% of businesses using one or more technologies. The Food, beverages and tobacco industry had the lowest proportion of businesses using advanced technologies, with 16% of businesses using one or more technologies.

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PROPORTION OF BUSINESSES WITH TECHNOLOGY BY BROAD TECHNOLOGY TYPE BY INDUSTRY

		Broad technology type						
ANZSIC code	Industry subdivision	Design & engineering	Fabrication, machining and assembly	Automated material handling	Automated, inspection and/or testing equipment	Communications and control	Any AMT	Expected by 1998-99
		%	%	%	%	%	%	%
21	Food, beverages and tobacco	*5.2	*2.6	1.2	2.0	12.5	16.4	32.5
22	Textiles, clothing, footwear & leather	*7.8	*5.9	**1.9	**1.7	*9.5	18.5	26.6
23	Wood and paper products	10.0	8.9	0.2	*0.2	8.1	17.8	30.5
24	Printing, publishing and recorded media	*14.4	*7.0	**1.4	*0.5	*11.7	21.1	31.6
25	Petroleum, coal, chemical and assoc. products	13.1	13.0	**1.7	*4	18.9	28.6	45.4
26	Non-metallic mineral products	*15.2	*12.0	**3.5	*0.9	6.2	25.0	35.4
27	Metal product	13.3	11.6	0.2	1.1	9.7	23.8	39.0
28	Machinery and equipment	26.9	16.7	*0.9	2.9	18.9	36.1	48.7
29	Other manufacturing	15.2	9.7	0.0	**2.5	*6.5	21.8	29.8
21-29	Total manufacturing	14.7	10.2	*1.0	1.8	11.6	24.0	36.0

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PROPORTION OF BUSINESSES WITH TECHNOLOGY BY EMPLOYMENT

	1988	1991	1996-97	Expected by 1998-99
<i>Employees</i>	%	%	%	%
Less than 10	n.a.	n.a.	17	29
10 -19	17	26	32	46
20-49	31	42	53	62
50-99	46	61	53	78
100-199	67	77	76	83
More than 200	82	88	84	90
Total manufacturing (10+ employees)	33	41	44	57

EXPLANATORY NOTES

Description	1 The Innovation in Industry Survey collected information about a business's innovative activities during the period 1 July 1994 to 30 June 1997. This publication presents information for the Manufacturing Sector.
Survey methodology	2 A questionnaire was mailed to approximately 5,800 businesses in the manufacturing industries. The sample was drawn from the ABS's Business Register. The sample was chosen to produce reliable estimates at State, ANZSIC subdivision and employment group levels.
Scope and coverage	3 The survey included businesses of all sizes operating in the manufacturing industry, regardless of whether those businesses had undertaken innovative activities during the period. Data contained in this publication relates to all businesses that were operational at 30 June 1997. If a business ceased operations before that date it has been excluded from the scope of the survey.
Statistical unit	4 The business unit from which the information was collected and published is the management unit which is the highest-level accounting unit within a business, having regard to industry homogeneity. In nearly all cases it coincides with the legal entity owning the business (i.e. company, partnership, trust, sole operator, etc.). In the case of large diversified businesses, however, there may be more than one management unit, each coinciding with a 'division' or 'line of business'. A 'division' or 'line of business' is separately identified where separate and comprehensive accounts are maintained.
Classification by industry	5 The statistics in this publication are classified by industry in accordance with the 1993 edition of the <i>Australian and New Zealand Standard Industrial Classification (ANZSIC)</i> (Cat. no. 1292.0). Each management unit is classified to a single industry. The industry allocated is the one which provides the main source of income for the management unit irrespective of whether a range of activities or a single activity is undertaken by the unit.
Reliability of estimates	6 The estimates presented in this publication are subject to non-sampling and sampling error.
Non-sampling error	7 Non-sampling error may result from deficiencies in the register of businesses, non-response, imperfections in what is reported and errors in the process of aggregating the results. Non-sampling error can occur in any type of collection. The extent to which non-sampling error affects the results of the survey is unknown, however efforts were made to minimise this type of error. 8 Being the second iteration of the survey, improvements were made to the questionnaire to assist businesses to understand the concepts about which information was being sought. Comprehensive consultation with respondents was conducted before finalising the questionnaire to minimise this specific source of non-sampling error.

Non-sampling error *continued*

9 Any errors in the estimates caused by non-response is expected to be negligible since 95% of businesses returned completed questionnaires.

Sampling errors

10 The estimates in this publication are derived from the responses from a sample of businesses in the manufacturing industries. These estimates are likely to differ from estimates derived from responses from all businesses in the manufacturing industries. One measure of that difference is the standard error (SE).

11 There are about two chances in three that a sample estimate will differ by less than one SE from the figure that would have been obtained if all units had been included in the survey, and approximately nineteen chances in twenty that the difference will be less than two SEs.

12 Where the relative standard error (RSE) of an estimate included in this publication exceeds 25% it has been annotated with an asterisk (*) as a warning to users. Where the RSE of an estimate exceeds 50% it has been annotated with a double asterisk (**).

13 The following tables contain estimates of the SE for only a selection of the statistics presented in this publication. SEs for other tables will generally be higher than those presented below and are available upon request from the ABS.

STANDARD ERRORS ASSOCIATED WITH PROPORTION OF BUSINESSES UNDERTAKING TECHNOLOGICAL INNOVATION

ANZSIC code	Industry subdivision	Type of technological innovation activity		
		Product	Process	Technological
		%	%	%
21	Food, beverages and tobacco	5.4	5.1	5.4
22	Textiles, clothing, footwear & leather	3.5	3.5	3.5
23	Wood and paper products	2.0	2.2	2.4
24	Printing, publishing and recorded media	4.2	4.4	4.9
25	Petroleum, coal, chemical and assoc. prods	4.0	3.6	4.3
26	Non-metallic mineral products	6.4	5.2	6.5
27	Metal product	3.4	2.6	3.4
28	Machinery and equipment	2.7	2.1	2.7
29	Other manufacturing	3.0	2.8	3.1
21-29	Total manufacturing	1.2	1.1	1.3

STANDARD ERRORS ASSOCIATED WITH EXPENDITURE ON TECHNOLOGICAL INNOVATION

Employees	Expenditure	Average per employee
	\$m	\$'000
Less than 10	43.0	0.3
10-49	64.9	0.3
50-99	29.0	0.4
100-499	14.1	0.1
More than 500	15.4	0.1
Total expenditure	83.8	0.1

Examples of the use of standard errors are given below.

14 The rate of product innovation is 22.9% and this estimate has a SE of 1.2%. There are two chances in three that the true rate of product innovation lies in the range 21.7% to 24.1%, while there are 19 chances in 20 that the true rate lies in the range 20.5% to 25.3%.

15 Expenditure on innovation activities is \$3,940.8m and this estimate has a SE of \$83.8m. There are two chances in three that the true value of R&D expenditure lies in the range \$3,857.0m to \$4,024.6m while there are 19 chances in 20 that the true value lies in the range \$3,773.2m to \$4,108.4m.

DATA ADJUSTMENTS

16 Estimates have been adjusted to allow for the omission of some businesses from the ABS Business Register. First, adjustments have been made to allow for new businesses which had commenced operations but for which details had not been processed to the ABS Business Register in time for inclusion in the survey. Second, adjustments have been made for businesses which have been in existence for several years, but for various reasons, were not previously added to the ABS Business Register. For more information on these various adjustments refer to the *Information Paper: Improvements to ABS Economic Statistics, 1997* (Cat. no. 1357.0).

17 Estimates from the previous Innovation Survey have also been adjusted and figures presented in this publication are consistent, in terms of scope and coverage, with the latest survey figures.

Related Statistics

18 Other statistics relevant to innovation are contained in the following publications:

Innovation in Australian Manufacturing, 1994 (Cat. no. 8116.0) released in September 1995

Manufacturing Technology Statistics, Australia, 31 December 1991 (Cat. no. 8123.0)

Mining Technology Statistics, Australia, 30 June 1994 (Cat. no. 8413.0)

Research and Experimental Development, Business Enterprises, Australia, 1996–97 (Cat. no. 8104.0)

19 In addition to the above, the ABS also expects to soon release further statistics in *Innovation in Mining, Australia, 1996–97* (Cat. no. 8120.0).

Unpublished Statistics

20 More detailed Innovation statistics for the Manufacturing Sector are available, at a cost, from the ABS. Most of the statistics in this publication can be cross-classified by more detailed employment and industry categories. Also, case studies can be done for individual employment sizes or industries.

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