

Chapter 4

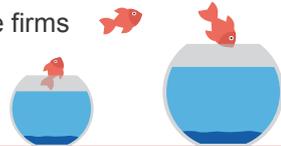
This chapter focusses on the relationship between firm growth and innovation. It shows existing statistical evidence of the general benefits of innovation to firm performance, as well as new econometric evidence on the positive relationship between different types of innovation and firm growth, irrespective of whether growth is measured by turnover or employment.

The impact of innovation on firm growth

Innovation-active businesses report greater increases in

sales **profitability**
productivity

than non innovation-active firms



Innovation in goods and services increased firm turnover growth by

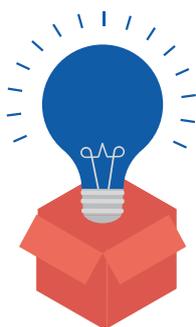
3.3 percentage points



Firms focussing on innovation performance increased turnover growth by **4 percentage points**



The more a firm innovates, the more it grows. Persistent innovators generated **4x** the employment growth and **5x** the sales growth of regular innovators



Innovation in marketing increased firm growth by **4 percentage points**



Turnover HGFs focussing on innovation performance increased turnover growth by

9.7 percentage points



Sources (left to right): 1) Department of Industry, Innovation and Science (2016) Australian Innovation System Report 2016, Office of the Chief Economist, Canberra, p. 30–31; 2–6) ABS (2017) Characteristics of Australian Business, 2015–16, cat. no. 8167.0; ABS (2017) Business Longitudinal Analysis Data Environment (BLADE), Analysis by Department of Industry, Innovation and Science



KEY POINTS

- Innovation-active firms are more likely to report increases in sales, profitability, productivity, firm size, and other growth-related measures than firms that don't innovate.
- Across all firms, innovation in goods and services increased firm growth by an average of 3.3 percentage points, while innovation in marketing increased turnover growth by around 4 percentage points.
- For Turnover HGFs, goods and services innovation increased the turnover growth rate by around 7.4 percentage points. However, Turnover HGFs did not seem to derive extra benefit from marketing innovation or operational process innovation.
- There was also a positive relationship between the strategic focus on business innovation performance and firm growth — turnover growth rates were boosted by an average of 4 percentage points for all firms and 9.7 percentage points specifically for Turnover HGFs.

4.1 Innovation is related to firm growth

There is extensive international evidence on the importance of innovation to firm performance. In Australia, compared to firms that don't innovate, a higher proportion of innovation-active firms consistently report increases from the previous year in their sales, profitability, productivity, other growth-related performance measures. Innovation-active firms were also three times as likely to report improved performance in export markets they targeted (Figure 4.1).

The *Australian Innovation System Report 2016* suggested this relationship was causal, whereby innovation had a direct positive influence on firm growth.¹ Looking at innovation over a period of time, rather than as a snapshot, showed the influence on firm growth becomes stronger the more a firm innovates. Put another way, the frequency of innovation matters.

This report extends the evidence on the link between innovation and firm growth, by examining the specific types of innovation which might be causally related to turnover growth. Based on econometric analysis conducted by OCE (see Methodology 4.1), the results suggest that after controlling for various other influences, only goods and services innovation seems to be related to high turnover growth (see Section 4.3).

Definition 4.1: Low-, medium- and negative-growth firms

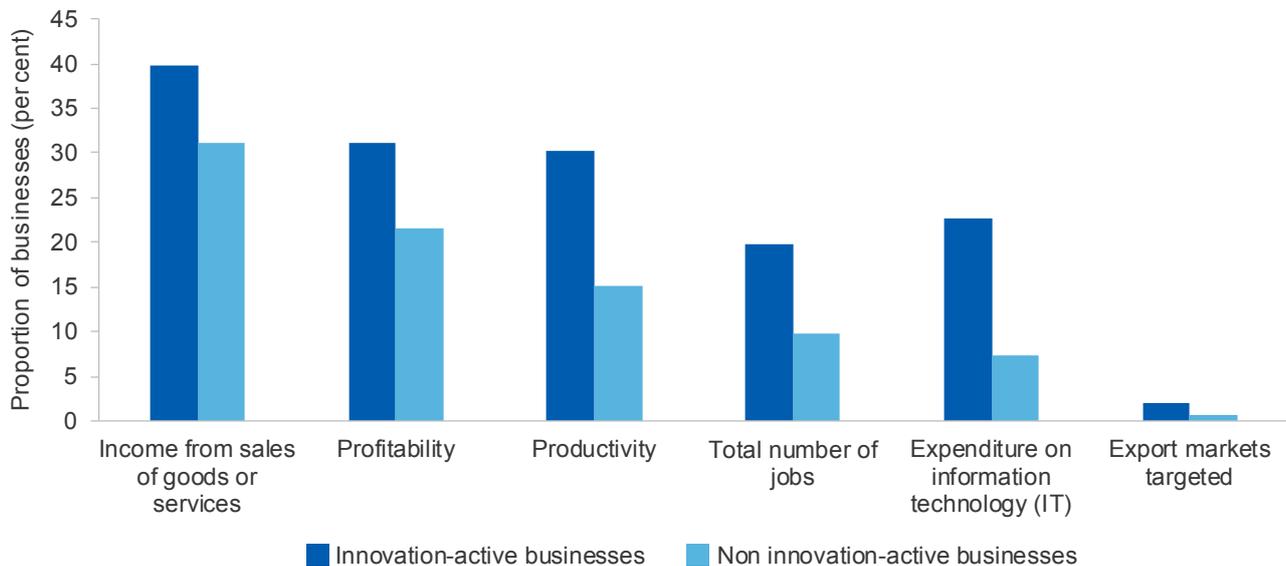
This chapter includes a comparison of the following growth categories:

High-growth firms: Refers to the HGF cohort as described in Section 2.1.

Low/medium-growth firms: Firms with at least five employees and turnover higher than \$75,000, with an average annualised turnover growth greater than 0 but less than 20 per cent over a three-year period. For employment growth, only firms with at least five employees are in scope. For turnover growth, only positive turnover firms are in scope.

Negative-growth firms: Firms with at least five employees and turnover higher than \$75,000 with an average annualised turnover growth over the three-year period of 0 per cent or negative. For employment growth, only firms with at least five employees are in scope. For turnover growth, only positive turnover firms are in scope.

Figure 4.1: Businesses reporting improved performance on various metrics since the previous year, by innovation status, 2015–16



Source: ABS (2017) *Characteristics of Australian Business, 2015–16*, cat. no. 8167.0.

4.2 HGFs are generally more innovation-active

Over the period 2005–2013, around three in five firms were innovation active, and this was the case for both Turnover HGFs and non-HGFs.^(v) When disaggregated by the type of innovation and the rate of growth, the differences are slightly more pronounced (Figures 4.2[a] to [d]).

For most types of innovation (Definition 4.1), firms undertaking innovation are more common in the high and low-medium growth categories and less common in the negative growth category, compared to firms that do not innovate. Marketing innovation was the exception to this pattern — firms undertaking marketing innovation were more common in the low-medium growth category compared to the high-growth category.

For employment growth, the relationship between innovation and growth is very similar to turnover growth. Generally, all types of innovation show positive relationships with firm employment growth, and this relationship appears to be most pronounced for goods and services innovation.

(v) Here the definition of HGFs in Definition Box 2.1 is used. Analysis of innovation activity by the ABS, including all employing firms, shows 46.7 per cent of Turnover HGFs and 41.7 per cent of other firms were innovation-active in 2015–16.

Definition 4.2: Types of innovation

Good and services innovation: A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user-friendliness or other functional characteristics.

Operational process innovation: A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

Organisational/managerial innovation: A new organisational method in business practices, workplace organisation or external relations.

Marketing innovation: A new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

Source: OECD (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition*, OECD Publishing, Paris.

Figure 4.2: Innovation activity in firms, by turnover growth category and innovation type, 2005–06 to 2012–13



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.



Feature Article: Uncovering Australia's high-growth companies of tomorrow

CSIRO Data61



Lack of skills is a barrier to innovation frequently cited by businesses. At the same time, students entering the labour market with new skills often struggle to find suitable jobs.

Recognising this matching problem, CSIRO Data61 has created a new online marketplace called [Ribit.net](#) to connect students with digital skills to career-related work and internships while they are studying.

To help boost Australia's innovation ecosystem, CSIRO Data61 is researching the possibility of using data and analytics to uncover young companies on a high-growth hiring trajectory before they become successful and connect them with the best students that have the digital skills to help them scale up rapidly.

Researching the relationship between digital maturity and growth of ASX200 companies

In 2016, CSIRO's Data61 undertook a pilot research project that found there were clear relationships between digital maturity and the growth and success of ASX-listed companies.

Digital maturity refers to the combination of a company's investment in technology-enabled initiatives meant to change how the company operates (its digital intensity) and its investment in the leadership capabilities needed to create digital transformation within the business.² The research analysed data relating to the 200 largest ASX-listed companies, including established measures of online authority, engagement, advertising and use of modern digital technology platforms.

Data for each company was collected and a composite index of customer-facing 'digital maturity' was calculated for each company and relative to its peers within its sector — recognising sectoral differences affect digital maturity. Consumer-facing companies such as REA Limited or Carsales.com Limited, for example, whose businesses are largely online, are naturally more likely to have an advanced digital footprint compared with companies in the industrial or mining sectors.

Next, the companies were clustered using machine learning into distinct 'tech tribes', or groups of companies which had a similar digital footprint based on their usage of over 1,000 online services and technologies. While no two companies use the exact same set of technologies or 'tech stack', each of the tribes had some distinguishing 'signature' features — such as whether the companies host their own website using their own server or whether they used cloud hosting.

New tech means greater returns

We found the 'tech tribes' distinguished by use of more contemporary technologies outperformed the market in total shareholder return, while those using older technologies were found to perform below the index benchmark.

This analysis has identified an important correlation between the digital maturity of companies and their performance. It is assumed that the signal about the digital footprint of a company reflects several factors such as corporate strategy and management capability to leverage emerging digital platforms, as well as contextual variables relating to market

dynamics of their industry sector and the age of a company.

With the success of this initial pilot project, Data61 decided to experiment with a similar approach to see whether analysing digital signals could be used to predict which of the 300,000+ small, private companies in Australia are more likely to become high-growth enterprises.

Identifying Australia's Joeys

Previous research in Australia and overseas has shown that a small number of high-growth firms are responsible for a disproportionate share of new net job creation.^{3, 4} These high-growth firms have been called the 'vital 6 per cent' and also Gazelles for their speed, youth and agility.

In this project, we name Australian high-growth firms Joeys — young, high-growth firms who are likely to provide the best opportunities for students to intern and also, once graduated, find future employment. We define Joeys as small to medium-sized companies from all industries and from all around Australia that have grown their employee headcount by over 20 per cent per annum over the past two years.

Early identification of Joeys has the potential to create a more efficient marketplace for digital talent in Australia but also for others, including suppliers, partners and investors. By discovering and promoting Australia's most promising and innovative high-growth companies of the future, ultimately we hope to help accelerate the transformation and growth of the Australian economy.

Many of the smartest companies in the world are now using unconventional data signals to discover and rank companies. Two of the world's top-ten hedge funds, Two Sigma (New York) and Winton Capital (London), both use a data-centric approach, accessing trillions of data points from many data sources to inform their highly successful investment strategies. Winton Capital was not founded by a business school graduate but by a first-class honours student who studied Physics at Cambridge University. Its quantitative approach to investment has led to spectacular success. Starting with \$1.6 million in 1997, it now holds over \$25 billion under management.

Finding the Joeys

In order to identify Australia's Joeys, we used machine learning on a small sample of companies whose digital footprint and employment growth rates are known. We identified the digital technologies used that were statistically significant in relation to company employment growth. Based on this analysis, the next step was to identify a larger cohort of companies that could qualify as Joeys, using only knowledge of their digital footprint.

We collected data on a sample of 563 Australian companies from a representative sample of industries with between 11 and 200 staff and known headcount growth rates from LinkedIn over the two years to March 2017. For each of these companies, we created a database of 1,500 online services and technologies used on the main website of each of these companies, as noted by the global web analytics service [BuiltWith](#). We examined each technology individually to explore the possibility of a correlation between any given technology and headcount growth. For each technology, we separated companies into two separate groups: companies that used a technology and companies that did not. We also only examined technologies that were used by more than 20 per cent of the sample (100 companies) to ensure the growth rates of the companies in each sample followed a normal distribution.

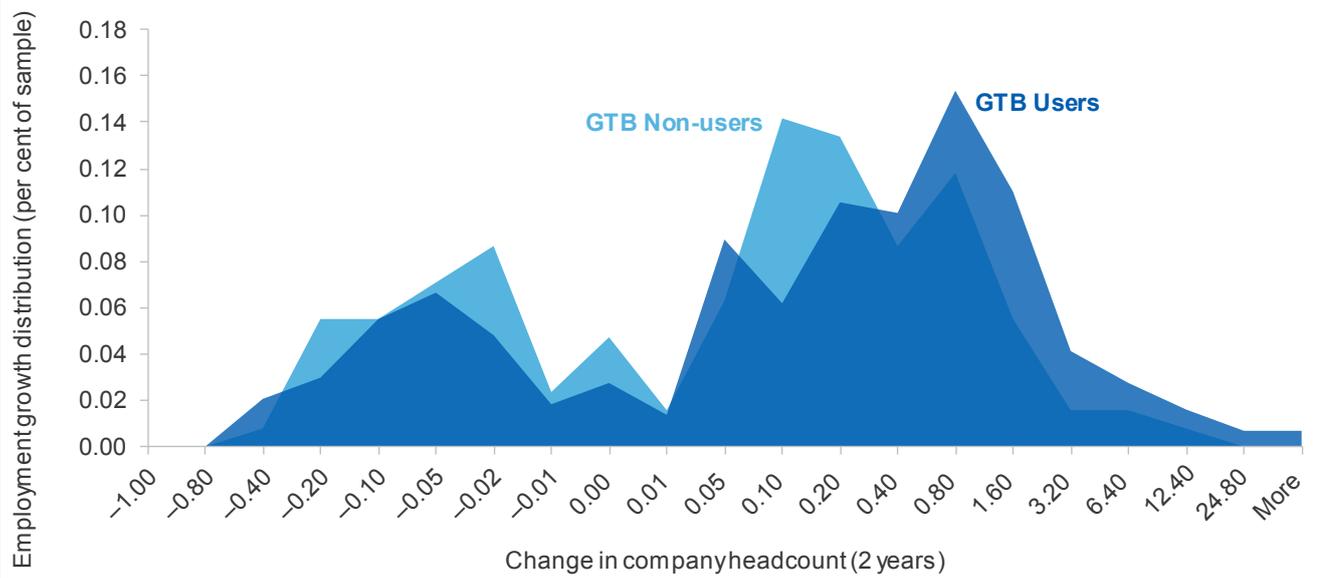
Using a two-tailed T-test, we examined the difference in the growth trends of two groups: users and non-users. The T-tests revealed that there were 20 features which showed a statistically significant difference between the distribution of companies (using a 95 per cent confidence interval), revealing a statistically different distribution among users and non-users of the technologies — 11 of these features had an association with a distribution of companies with higher employment growth and we have labelled these the Growth Technology Basket (see results below).

Table 4.1: Growth Technology Basket, 2017

Feature	P-value	Median growth per cent (without feature)	Median growth per cent (with feature)	Difference in median growth (Users to non-users) percentage points
Google Apps for Business	0.00	10	41	31
Sitelinks Search Box	0.00	10	30	20
Yoast SEO Premium	0.01	10.5	30	19.5
Wordpress Plugins	0.00	10	27	17
Yoast WordPress SEO Plugin	0.03	11	27	16
Yoast Plugins	0.03	11	26.5	15.5
Live Writer Support	0.00	10	25.5	15.5
jQuery Form	0.02	13	25	12
WordPress	0.00	9	23	14
Really Simple Discovery	0.00	10	23	13
Twemoji	0.00	10	23	13
jQuery Masonry	0.05	13	19	6
Device Pixel Ratio	0.01	10	17	7
Total Growth Technology Basket		8	16	8

Notes: Due to the range of the growths spanning from small losses to very large growths we chose to consider the median instead of the mean to better reflect the range in the distribution of each group. Overall, companies which used growth technologies showed an 8 per cent higher median headcount growth when compared with companies which didn't use these technologies.

Figure 4.3: Growth Technology Basket: technology users vs non-users



Source: Data61 (2017)

Next steps

This work illustrates a clear link between a company's digital footprint and its employment growth. In turn, companies likely to be higher-growth companies can be distinguished from their peers through comparison of their digital footprints.

We are now fine tuning to establish a more comprehensive and scalable method to identify Australian companies predicted by the machine learning algorithms to have higher growth than their peers, filtered by state, industry and age. This will include updating the Growth Technology Basket, based on time series data to allow for changes in its composition, as well as investigating access to more accurate information about the employment growth of a small sample of private companies for training the machine learning algorithms.

Based on this work, CSIRO Data61 aims to identify and launch a list of Australian Joeys (Joey 500) that has the potential to create improved and more timely insight about Australia's innovation ecosystem. It will also be available as an online resource to improve services such as Rikit as well as other new and emerging investment, collaboration and education initiatives.

Further work will investigate applying this approach to explore how digital footprints can help identify growth companies measured in other dimensions such as exports, innovation and revenue growth.

4.3 Type of innovation matters for firm growth

Econometric analysis suggests firm growth is related to particular types of innovation, rather than innovation activity in general (see Methodology box 4.1).

Across all firms, and after controlling for all other factors, innovation in goods and services increased firm growth by an average of 3.3 percentage points. Similarly, innovation in marketing increased turnover growth by around 4 percentage points.^(w) However, organisational/managerial and operational process innovations did not appear to have an independent impact on turnover growth (Figure 4.4).

The growth benefits from goods and services innovation are magnified for Turnover HGFs. The analysis suggests that undertaking goods and services innovation increased the turnover growth rate of HGFs by around 7.4 percentage points, more than double the impact for all firms. In other words, some of the firms in scope became Turnover HGF as a direct result of undertaking goods and services innovation. There is also tenuous evidence that Turnover HGFs may benefit from organisational/managerial innovation (Figure 4.7).^(x)

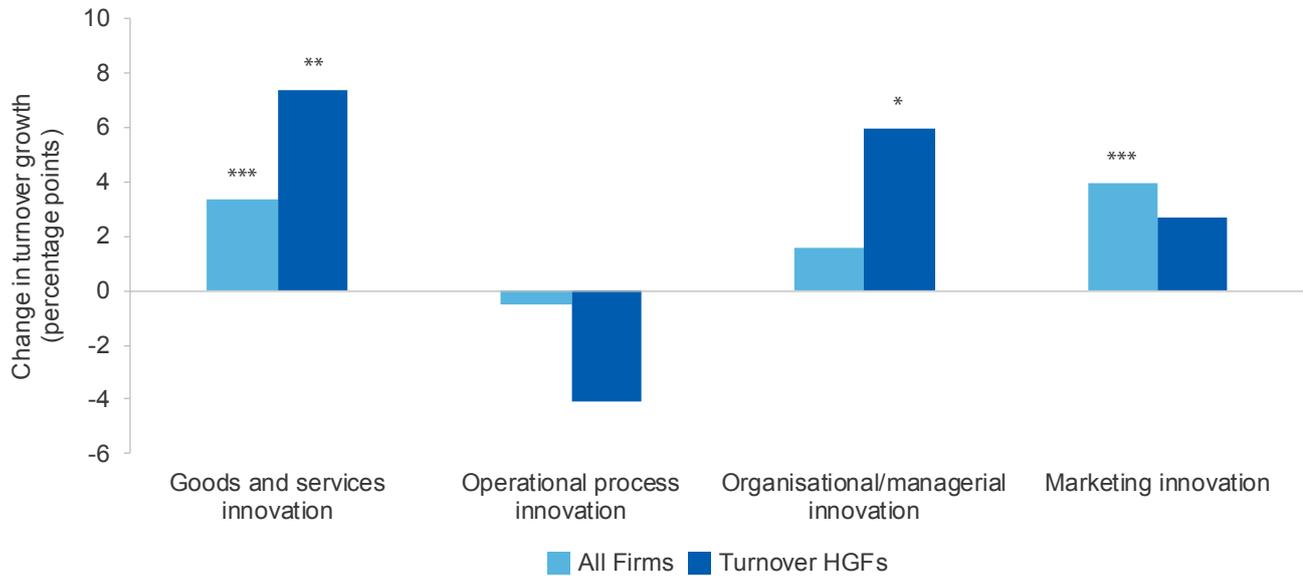
However, Turnover HGFs do not seem to derive any benefit from marketing innovation once all other factors were taken into account. And similar to the average firm, operational process innovation does not have a statistically significant impact on HGFs (Figure 4.7).^(y)

(w) These are calculated across all firms in the sample (BCS data for both HGFs and non-HGFs pooled over 2002–2013, see Box 2.3)

(x) Significant only at the 10 per cent level

(y) Further research should be undertaken to see if the various types of innovation impact industries differently

Figure 4.4: Impact on turnover from undertaking different types of innovation, by turnover growth category, 2005–06 to 2012–13



Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Methodology 4.1: Econometric analysis

The analysis presented in this chapter is based on a study by Majeed et al. (2017), which looks at the impact of innovation and business focus on firm growth using data covering 2005 to 2013.

The study examines causal relationships using econometrics based on the BCS and BERD components of BLADE. The econometric analysis starts by using Ordinary Least Squares (OLS), which seeks to explain the casual link between the control variables and dependent variables. In the regressions the study controlled for different types of innovation, firm strategy, skills, business age, size, industry division, and macroeconomic effects. To account for any growth rate autocorrelation or other omitted variables, lagged growth rates were included in the regressions (similar to Coad and Rao, 2008).

OLS can suffer from time-invariant omitted variable bias, including innate ability of the firm. To control for this, panel data techniques such as Fixed Effects were used.

Reverse causality remains one important concern, where innovation can impact firm growth but concurrently firm growth can impact the ability to undertake innovation. This study and the literature deal with this by lagging the variables or using lagged variables as instruments. The idea being that the current turnover growth will not affect the past innovations that have already been undertaken — for detail see Coad and Rao (2008) and Majeed et. al. (2017).^{5, 6}

Separate estimations were carried out using a sample of all firms and a sample with only HGFs. HGFs have much higher growth compared to the average for the whole population. As such, this high-growth rate will be reflected by a level shift. Including a constant in the regression means that level shift will be captured by the constant. The coefficients of the innovation and business focus variable still capture marginal effects.

Various robustness measures were undertaken and the most conservative results are presented.

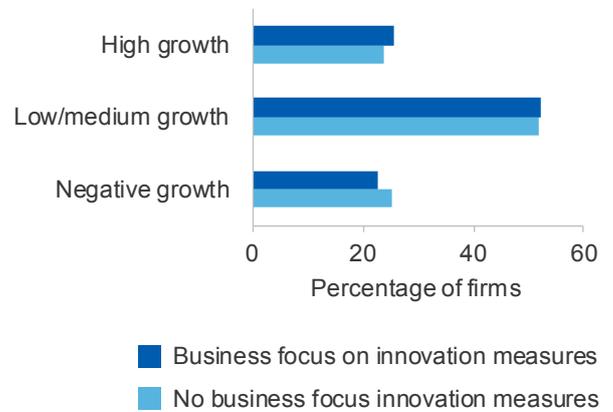
4.4 Business strategy impacts firm growth

Many firms that pursue innovation in a deliberate and systematic fashion will put in place ways of explicitly measuring and tracking their own innovation performance, which can then inform business planning. Firms that take into account innovation measures when assessing their business performance are more common among high-growth and low/medium-growth firms, compared to firms that do not. For negative-growth firms, the opposite is observed, suggesting a positive relationship between strategic focus on business innovation performance and firm growth (Figure 4.5).

Across all firms, those that focussed on innovation performance increased their turnover growth rate by an average of 4 percentage points. The increase in turnover growth rate from focusing on innovation performance is even more pronounced for Turnover HGFs, with an average increase of 9.7 percentage points (Figure 4.6).

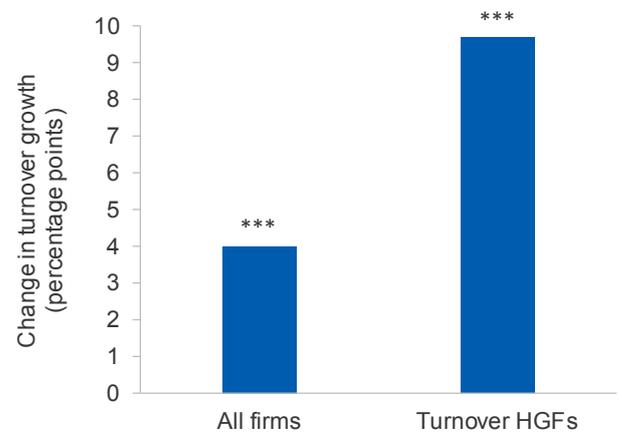
The positive impact of business focus on innovation may be linked to management capability, as specific business strategies are typically determined by managers and entrepreneurs. More capable managers and entrepreneurs may be more likely to proactively measure and assess the innovation performance of their firm. In this case, managers and entrepreneurs may be more capable than others in finding innovative ways to increase firm turnover.

Figure 4.5: Business assessment of performance included a focus on innovation measures, by turnover growth category, 2005–06 to 2012–13



Source: ABS (2017) Business Longitudinal Analysis Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.

Figure 4.6: Impact of business focus on innovation measures, by turnover growth category, 2005–06 to 2012–13



Notes: *** $p < 0.01$

Source: ABS (2017) Business Longitudinal Data Environment (BLADE). Analysis by Department of Industry, Innovation and Science.



Case Study: Redbubble

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REDBUBBLE

Redbubble was founded by Martin Hosking, Paul Vanzella and Peter Styles in Melbourne in 2006.

The core concept always centred on the internet and print-on-demand, but quickly evolved beyond the basic idea of printing customers' photos onto mugs or t-shirts. Now, Redbubble links over 400,000 independent visual artists with customers who can use those artists' designs on everyday products.

How Redbubble works

Artists upload designs to Redbubble's website, where customers select their favourite design and choose their product. The customer's order is then sent to a network of third-party fulfillers, one of whom will print the design onto the customer's chosen product (such as wall art, apparel, stationery, housewares or electronic accessories), and ship to the customer. Redbubble has created a three-sided marketplace by facilitating the exchange between the seller (the artist), the producer (the fulfiller) and the customer.

In 2006–07 the founders developed the initial concept and the website, raised seed funding, recruited a core team, and launched the firm.

Redbubble began trading in 2007 and grew rapidly to become one of the largest Australia-based consumer technology companies. Since 2009, its revenue has increased by more than 40 times (an annual average growth rate of 69 per cent) and the number of employees has grown by more than 15 times. By June 2016, Redbubble had channelled over \$55 million to independent artists, and in the 2015–16 financial year alone reached over two million buyers. The company has won many awards for its concept, website and growth, making the BRW Fast 100 list in 2012 and 2014, and more recently, the 2016 Goods Growth Company of the Year.

In these early days, the founders' personal networks provided vital access to advice, talent and capital. Martin Hosking, the current CEO, was a consultant with McKinsey and an experienced leader of emerging high-tech firms, particularly those entering overseas markets and going through the process of scaling and raising capital.

Learning from the start

Learning from early feedback caused Redbubble's business model to evolve, driving changes in strategy, tactics and operations, but affirming the core concepts. Redbubble has maintained a clear long-term focus with a strategy that is reviewed and updated every six months at group and corporate levels, rather than a long-term business plan. Strategy reviews are informed by analyses of market dynamics, website and marketing effectiveness, and indicators of customer satisfaction.

In 2007, orders were shipped from the first Australian and American suppliers, and in 2010 the first European supplier joined the network. In 2011, Redbubble opened an outfit in San Francisco. In 2015, \$15.5 million was raised from institutional investors. In 2016, Redbubble raised \$12 million of pre-IPO funding, and later that year the company listed on the ASX, raising a further \$30 million.

Sustainable relationships with creatives

Although the founders of Redbubble saw the market opportunity, they also sought a sustainable relationship with their artists. As Martin reflects, "Bringing more creativity into the world was a mission we all shared".

Redbubble enables artists to select how their work is used and at what price, while removing the logistical overhead by organising online marketing, payment processing and fulfilment. There are now 12 suppliers in 18 locations, close to their customers. In

2015–16 the US accounted for about 60 per cent of sales, Europe about 25 per cent and Australia less than 10 per cent.

Value for artists and customers

Creating value for artists and for customers through an internet platform became Redbubble's defining insight. It was clear to the founders that the potential market was large and growing, and that Redbubble needed to be "born global" says Martin. Redbubble's website started in English, but German, French and Spanish-language sites launched in 2016. This multilingualism reflects the international nature of Redbubble's artists, the majority of whom live in North America, Europe and Australia.

A global niche

Like many firms that sustain high-growth, Redbubble focusses on a specific niche. But Redbubble's niche is global, and is a multibillion-dollar market. Its innovative business model has enabled it to use the internet to mitigate the tyranny of distance and reach customers all around the world.

"We have an unrelenting focus on our niche, we have actually got narrower in our focus over time and will not allow ourselves to be distracted. This has meant forgoing opportunities for growth in the local market and adhering rigorously to our vision," says Martin.

Organic growth

Redbubble is reliant on increasing demand for de-branded, made-to-order creative products enabled by print-on-demand technology. Growth has been largely organic; suppliers and customers learn what is possible and more artists join. As more artists join, Redbubble's critical mass builds, attracting more customers and more sales, in turn attracting more artists. This example of network effects increases returns and entrenches Redbubble's competitiveness.

Most growth is because of existing users introducing new users, and from free searches, aided by Google and Facebook. The market grows as more customers become comfortable buying online and value the convenience and range of choice available. Redbubble's product range has grown steadily, to over 50 products.

Responding to change

Redbubble responds rapidly to changes in the market and technology. In the beginning, management didn't realise just how widely creative

content could be used on products — but the development of print-on-demand, cut/print/sew and sublimation printing technologies has presented significant opportunities for the company.

Realising these opportunities required Redbubble to work with its supplier network and negotiate operating agreements to ensure consistent quality and customer service.

Growth without losing flexibility

Aligning individual and company motivations and approaches is easier in a small firm. As Redbubble grew, management found that the scope for individual autonomy shrank, and new approaches were needed to standardise procedures without losing flexibility.

"The transition from start-up to sustained growth was challenging; having an experienced Chief Operating Officer and Board was important for steering the firm through this phase. We learned that the flexibility that is vital for entrepreneurial firms has to be supplemented by routines and systems, particularly in operational planning and human resource management," says Martin.

As part of a change process that has taken three years, Redbubble has reorganised around decision groups with high levels of accountability. For example, responsibility for developing the European websites is delegated to a cross-functional decision group drawing expertise from Europe, the US and Australia.

Real passion and meaningful purpose

Looking back on the Redbubble journey since 2006, Martin reflects on why Redbubble exists, the value it creates and for whom.

"How are we benefitting customers? And is the benefit we provide much better than the alternatives? The biggest threat in both strategy and marketing is to lose sight of the customer and to try and frame everything from the company's point of view."

"You need to be driven by a genuine passion for what you are doing (and this cannot just be money). There will not be a single hard moment but many hard moments. Each of these will challenge you to surrender or continue forward. You will only continue forward if the passion is real and the purpose meaningful. Further, you will need others to share the journey with you. A shared passion is all that will both get you and keep you together."