INNOVATION: ITS LINKS WITH PRODUCTIVITY AND SKILL DEVELOPMENT

At a glance

INTRODUCTION

Why should we care about innovation? One reason is because it can help to make life better. More specifically, governments, enterprises and training institutions see innovation as having the potential to increase productivity and, down the track, to increase prosperity for Australia. As far back as 1934, the influential economist Joseph Schumpeter identified innovation as a driver of economic growth.

More recently, two changes in the world economy have forced governments to look at ways of improving productivity (Rice 2011). Firstly, there has been sustained economic growth over the past two decades, which has particularly affected countries like China, where manufacturing has grown, with ramifications for related industries across the world. Secondly, we are realising that there is a limit to economic growth based on the consumption of finite resources and are therefore looking for other ways to maintain this growth, including looking at more ways to innovate. As the authors of Australia's national review of the innovation system put it: 'We have known for several generations that innovation pre-eminently determines our prosperity' (Cutler & Company 2008).

While innovation may lead to increased prosperity, for some firms it is also an inherently risky activity. In addition, teasing out the relationship between innovation and improvements in productivity is not always straightforward; there are many other factors that make businesses successful.

This *At a glance* examines innovation in terms of its relationship to productivity at the enterprise level and its contribution to national prosperity. It also discusses what we mean by innovation and also what kinds of skills might contribute to innovation. It draws primarily on a suite of work presented in *Fostering enterprise: the innovation and skills nexus*, a book of readings published by NCVER (Curtin, Stanwick & Beddie 2011).

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WHAT IS INNOVATION?

Today, innovation is much more about new products, services and processes than research and development.

There are varying definitions of innovation. The meaning can change according to place, time and context. Innovation is largely now thought of as technological innovation, including research and development, or invention, but this was not always the case. According to Godin (2008), the term arose in the Middle Ages and referred to novelty and, even earlier, also change.[1] That the term began to refer to technological innovation is a result of several factors, including the impact of technology on society, the contribution of technology to productivity and economic growth, the effect of patent laws, and the role of research and development laboratories.

When it was originally released in 1992, the *Oslo manual* (OECD 2005), which has become the standard bearer when it comes to innovation surveys around the world, focused on technological innovation. However, the third edition of this manual released in 2005, also includes organisational and marketing innovation, as it is recognised that they also impact on firm performance. Cutler and Company (2008) note that innovation is much more than science and research and that enterprises should be innovating not just with technology but with operations, organisational structures, business models and relationships.

As such, the Australian Bureau of Statistics definition of innovation (see, for example, ABS 2010b), which is drawn from the *Oslo manual* (OECD 2005, p.46), is: 'The introduction or implementation of a new or significantly improved good or service, operational process, organisational managerial process or marketing method'. For something to be an innovation, it needs to be new to the organisation. It can either be developed by the firm or be introduced to the firm. Innovation does not need to be something completely new.

As the definition of innovation has expanded, more firms are deemed to be innovative. Furthermore, the definition is now more inclusive of service industries, rather than focusing only on those areas of the economy that produce goods. In terms of industry gross value-added, service industries now account for about 55 per cent of the economy (derived from ABS 2010a).

Toner (2011) explains the concept in terms of 'radical' and 'incremental' innovation. While radical innovation results in major technological change, incremental innovation occurs from ongoing minor modifications and changes to existing products/services/processes. It is incremental innovation that is the chief source of productivity growth, and Toner (2011) argues that organisational improvements play a 'momentous' role in economic development. Agarwal and Green (2011) also note that 'intangible factors', such as management practices — and related to this, the skills and education of managers — play an important role in productivity and performance.

Dalitz, Toner and Turpin (2011) cite the solar energy sector as an area where there has been incremental improvement in technology, claiming that the core photovoltaic technology has been stable for decades. While other technology in the area, such as inverters, has undergone considerable change to improve the efficiency of solar energy, with good fundamental electrotechnology skills, the technology is relatively easy to adapt. In this sector, organisational innovation also occurs to drive down costs. This involves organisational models that both outsource and insource electricians in order to achieve cost efficiencies.

Incremental innovation is also related to what is more generally seen as business improvement or continuous improvement within an enterprise. For example, Prajogo and Sohal (2003) find that a culture of quality and continuous improvement in organisations brings about the necessary conditions for innovation in products and processes.

1 The term derives from the Latin *innovare*, which means to alter or renew and goes back to about 1540 (see <http://dictionary.reference.com/browse/innovate>).

INNOVATION'S PLACE IN THE ECONOMY AND ITS LINKS TO PRODUCTIVITY

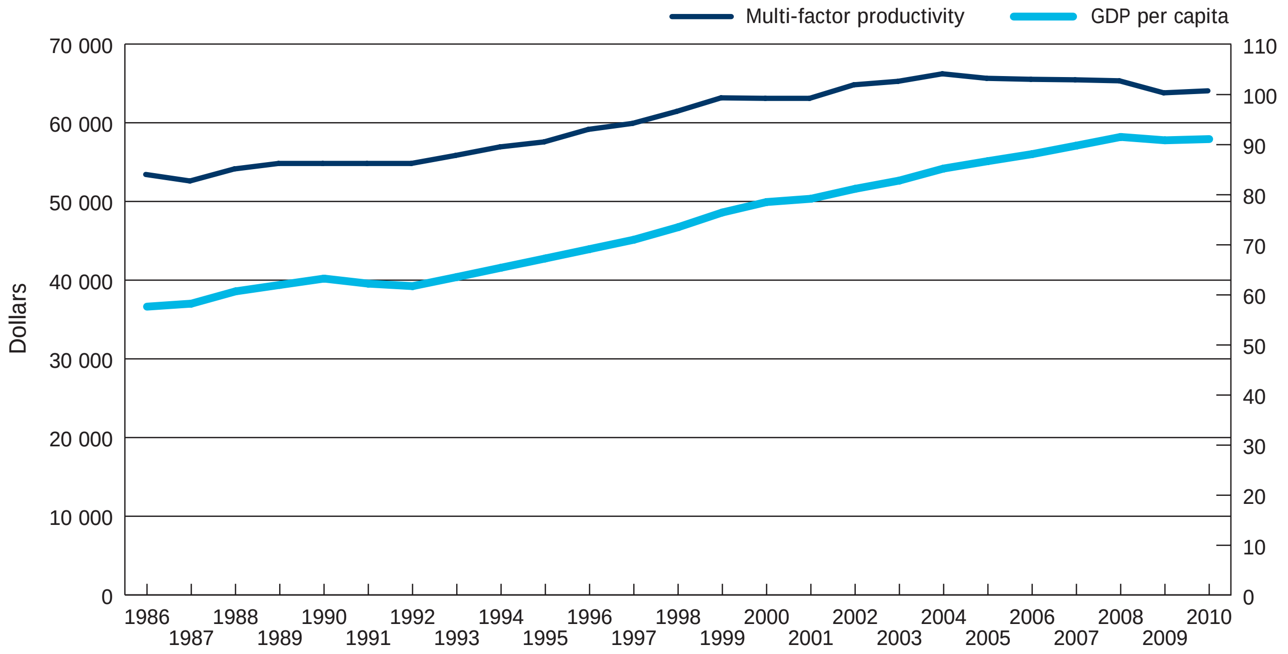
Innovative businesses report more increases in profitability and productivity than non-innovation-active firms.

Despite innovation generally being seen as a positive thing for organisations, it can be a risky activity. Rice (2011) argues that, while the effect of innovation maybe good overall, it can be detrimental to individual organisations. This is particularly the case with radical forms of innovation, where investments in invention and then research and development through to commercialisation, involve choices for firms and their managers (Rice 2011).

Some argue that one way to increase overall productivity is through 'multi-factor productivity growth'. Multi-factor productivity growth is defined by the ABS (2007) as that part of growth that is not attributable to growth in labour or capital inputs. Multi-factor productivity is effectively a residual and can be used as a proxy measure for innovation, as it includes changes in technology and continuous improvement in businesses. However, Karmel (2011) argues that multi-factor productivity will reduce with more refined measures of capital and labour.

Figure 1 shows growth change in gross domestic product (GDP) per capita and multi-factor productivity for the period 1986—2010. While there have been general increases up to the early 2000s, which are attributable to various factors such as the resources boom, multi-factor productivity has levelled out and even declined since then.

Figure 1 Multi-factor productivity index and gross domestic product per capita Australia 1986—2010



Notes: The data on multi-factor productivity are based on 12 selected industries.
The year base for the two measures is slightly different. GDP per capita is by calendar year while multi-factor productivity is by financial year.

Sources: ABS (2010c, 2010d).

The ABS data on innovation indicate some relationship between innovation and measures of performance at the firm level. For instance, for 2008—09, 33 per cent of innovation-active businesses reported an increase in profitability from the previous year, compared with 24 per cent of non-innovation-active businesses. Similarly, 34 per cent of innovation-active businesses reported an increase in productivity from the previous year, compared with 16 per cent of non-innovation-active businesses (ABS 2010b).

While it is generally argued that innovation is introduced into a firm for competitive advantage, the link is not straightforward. For example, Liao and Rice (2010) argue that the relationship between innovation and performance is complex and that there are mediating factors: there need to be market-related changes by the firm to accompany the innovation. Fieger and Rice (2011) also find no direct link between innovation and performance.

Innovation is thought to lead to increased productivity overall but the relationship is not direct; there are winners and losers.

In case studies of industries (financial services, retail, wholesale, and biotechnology), Misko and Nechvoglod (2011) find that there are a variety of drivers of innovation in firms. These drivers include adopting new or improved technologies, regulatory activity and economic constraints (such as competition, cost-containment, revenue growth and consumer demand).

Regulation can lead to innovation (though this in itself does not show that regulation has a net positive impact on innovation). An example cited by Misko and Nechvoglod (2011) was that of the therapeutic goods administration (TGA) legislation for companies wishing to trial and test drugs. The accreditation provided by TGA means that companies do not have to undergo another ethics approval to undertake research trials. This has created a niche market for companies servicing pharmaceutical trials, in that they can provide services to national and international companies that allow them to undertake their trials immediately. Dalitz, Toner and Turpin (2011) claim an indirect relationship between training for legislated occupational health and safety and innovation in the mining industry. In established mines, a lot of training is focused on regulatory issues. This training may cover the introduction of new technology and change in methods and is indirectly linked to innovation.

SKILLS FOR INNOVATION

The underlying skills and knowledge of a vocation are the foundations for innovative practice.

In 2010, the Organisational for Economic Co-operation and Development (OECD) released an innovation strategy aimed at promoting innovation for the 21st century. Among the five priorities for government action in this strategy is recognition that innovation requires a wide variety of skills, as well as people having the capacity to learn and adapt. The strategy asserts that ‘human capital is the essence of innovation’ (OECD 2010).

Given the broad nature of innovation, none of the skills it requires can be dubbed ‘innovation skills’ per se; the skills required will depend on the context of their use. They will be a mixture of technical and generic skills (often cognitive or ‘soft’ skills). For instance, Deitmer (2011) talks about apprentices learning to give feedback to engineers on the feasibility of manufacturing a new product.

Toner (2011) states that radical innovation requires ‘elite scientific, engineering and design occupations’ (and the skills associated with these), while problem-solving skills are important for incremental innovation. Dalitz, Toner and Turpin (2011) argue that the fundamental skills and knowledge of a vocation are important for innovation because they provide the ability to learn, to adapt to change and to be creative. Actual skills used in innovation are learnt on the job — often based on what was learnt formally.

The Australian Bureau of Statistics (ABS) lists ten core skills used by businesses, the prevalence of which can be investigated in terms of innovating and non-innovating businesses (table 1). It is clear from the ABS surveys that the types of skills used by innovative firms range more broadly than technical or cognitive skills.

Interestingly, the biggest differences between innovative and non-innovative firms are in marketing, business management, finance and IT, not the skills traditionally associated with innovation. This is because most firms are involved in incremental rather than radical innovation.

Table 1 Skills used by innovator status, 2008–09 (%)

Core skills	Innovation-active businesses	Non-innovation-active businesses	Difference
Engineering	15.0	10.3	4.7
Scientific	7.0	2.9	4.1
IT professionals	25.3	10.0	15.3
IT support technicians	28.8	13.4	15.4
Trades	30.7	24.0	6.7
Transport, plant & logistics	17.3	13.0	4.3
Marketing	33.2	11.0	22.2
Project management	19.6	7.9	11.7
Business management	32.1	14.8	17.3
Finance related	35.8	19.7	16.1

Source: ABS (2010b).

The ABS survey also shows that the skills used in innovation vary by industry, a point which was also raised by Dalitz, Toner and Turpin (2011). Table 2 illustrates this by presenting the difference in skill usage between innovation-active and non-active businesses for selected industries. It shows marketing to be important in innovation across industry sectors and also illustrates the variation in the skills used by industry. For example, trades, engineering, and transport, plant and logistics are important skills for innovation in mining but are considerably less so for the other industries in the table. For the mining industry, all the skills are important to innovation but scientific and research skills are of much less significance.

Table 2 Difference in skills used by innovative-active and non-active business for selected industries, 2008–09 (%)

Core skills	Manufac.	Prof., sci. & tech. services	Finance & insurance	Wholesale trade	Mining	Retail trade
Engineering	14.7	-7.0	*	6.2	**26.4**	4.6
Scientific	9.8	4.6	-1.1	3.3	6.9	1.1
IT professionals	12.5	13.5	12.7	20.1	22.6	13.3
IT support technicians	10.9	11.0	16.2	20.4	20.3	**21.2**
Trades	14.0	1.6	2.2	4.7	**26.4**	7.7
Transport, plant & logistics	16.5	-3.1	*	4.9	26.3	10.4
Marketing	**19.6**	**18.7**	**31.3**	**25.6**	22.4	**19.8**
Project management	13.1	**16.7**	9.7	9.7	20.1	6.1
Business management	11.6	13.2	**22.6**	**20.8**	19.2	17.6
Finance related	**17.6**	3.1	16.8	20.5	16.8	14.7

Notes: * This information was not available from the survey.
The bolded numbers in the table represent the two highest differences per industry category.
Note that some of these figures are subject to relatively high standard errors.
Source: ABS (2010b).

More generally, in their analysis Fieger and Rice (2011) find that organisations assemble skills in various ways in the innovation process. They looked at skills used by innovation type and found that new operational innovation and organisational process innovation use eight of the ten core skills listed by the ABS, while new goods or services innovation uses six of the skills. However, new marketing methods innovation only uses two (marketing and information technology).

The importance of skills for innovation does not imply an ever-increasing demand for more and higher levels of qualifications. Toner (2009) points out that, in some cases, innovation can reduce the need for skills. In some cases, jobs will disappear.

THE BROADER IMPLICATIONS OF INNOVATION

What it means for the training system

VET can assist the innovative process by providing specific skills but, more importantly, it should help the individual to 'learn to learn'.

In Australia the relevance of the VET system to innovation goes back to colonial times (Pickersgill 2004). Equipment brought from overseas needed to be adapted to Australian conditions and, hence, innovation was focused on adapting or modifying existing technology. People with a technical training background were required for this.

An underlying theoretical foundation is also important for innovation. For example, in the solar energy sector, electricians require a broad understanding of electrotechnology theory, which allows them to work with technological innovations across a variety of situations. Only small additions to competences are then required to work with design of installations, low voltages and inverters (Dalitz, Toner & Turpin 2011).

Toner (2011) emphasises the importance of formal VET as a basis for trades and technical jobs in the research and development (R&D) workforce. In his survey, only two of 17 trades and technicians respondents did not think their formal qualifications were useful in their current job. In addition, 16 of the 17 respondents thought that formal qualifications were important for trades and technicians working in R&D. Given the importance of these occupations in the R&D workforce, Toner believes that more formal recognition should be given to VET in science and technology policy and in innovation councils. Thus, the VET system needs to find ways to engage with these forums to promote linkages between VET and the R&D laboratories.

The links between VET and innovation have implications for the content of training packages. As suggested above, training packages should focus on the fundamental skills and knowledge of a vocation. This will increase an individual's ability to 'learn to learn', to solve problems and adapt to different situations. At the same time, VET providers must keep abreast of new technologies and changes in industry practice. This points to a role for industry skills councils[2] to ensure that fundamental skills and knowledge are taught and that training providers have the links and networks to help keep the VET sector current.

Ongoing, or top-up training, can also assist with innovation. Toner (2011), in reporting on a study of the R&D technician workforce, finds a high level of participation in post entry-level training — 68 per cent of trades and technicians surveyed acquired higher-level qualifications, mostly in VET and mostly at the diploma level.

Misko and Nechvoglod (2011) find a preference for university graduates in case studies on innovation across four industry areas. While courses such as finance, marketing, and business management can be taught by VET providers, employers seemed to prefer university graduates. They offer some suggestions on how VET can engage with industry to provide these skills. These include partnerships with professional associations and universities in delivering these courses. VET could also partner with vendors to provide short courses to existing workers in these areas.

What it means for government

Governments have a primary role in basic education and training. Beyond this, their role is contested.

A primary role for government is the provision of education and training that provides a strong foundation for work skills and also underpins knowledge. Governments can also play a role in raising awareness. One example includes involving practitioners in innovation councils and policy development. On a similar note, Toner (2011) finds that VET has an important role as a diffuser of innovation, which could be encouraged by government. However, raising awareness of

2 Industry skills councils are a set of 11 national bodies that provide advice to the Australian, state and territory governments on the training required by industry.

innovation is a two-way street and not the domain of just one party. There is a potential in VET that has not yet been realised, but has also not been seized by the VET sector.

Karmel (2011) argues for two further roles for governments. Firstly, investments in education and training should be well directed, and areas that have a low return on investment avoided. Secondly, investment should be in education and training that encourages learning to learn. Beyond this, the role of VET is somewhat more contested. Competition between firms perhaps offers the best prospect for promoting innovation, particularly in terms of incremental innovation.

What it means for enterprises

The workplace culture, leadership style and work organisation are critical to whether skills for innovation can be used.

The culture and work organisation of an enterprise plays a critical role in fostering innovation. The OECD (2011) argues that the concept of innovation needs to be widened. It states the 'need to put the organisation of work more centrally in the analysis of innovation' (p.11) and that learning within the enterprise is at least as important as externally acquired learning, with the work environment critical to fostering learning.

Misko and Nechvoglod (2011) note the importance of the leadership style and workplace culture in facilitating innovation. Indeed, they claim that if the culture does not support innovation, it will not occur despite the skills available within the firm. Deitmer (2011) also emphasises the importance of a culture of cooperation and communication in obtaining productivity gains from structured workplace learning undertaken by apprentices.

Smith et al. (2011) also point to the importance of human resource practices. They argue that there are various technological and human factors within an organisation that develop innovation 'capacity' — or the potential for innovation within an organisation. They find, in the context of their research, that human resource management and learning and development practices are tools for building innovation capacity and, in particular, that 'bundles' of practices act as innovation stimuli. These practices include employee suggestion schemes, quality circles, job rotation, delegation of responsibility and the like.

Developing innovation capacity makes it easier to assimilate information external to the firm and thereby to further innovate. Toner (2011) and Karmel (2011) also point out that the effect of innovation is cumulative so that the more the firm innovates, the easier it becomes.

Partnerships and collaboration also contribute to the innovation process (Rice 2011). The concept of openness in innovation posits that innovations are rarely achieved within the confines of one organisation. Organisations therefore need to seek innovations beyond the boundaries of the firm. This may involve a variety of collaborative arrangements such as strategic alliances and interfirm and interpersonal networks. While the concept of openness, including collaboration and sharing, is important, an overemphasis on this can be to the detriment of the firm. There is a need to protect the firm's intellectual property and capabilities.

CONCLUSION

A good educational foundation is the key to promoting successful innovative practice.

In recent years innovation has received wide attention as a way of increasing productivity and economic growth. However, it is not only major technological advances that contribute to productivity. Even more important in increasing productivity is incremental innovation, which involves a wide variety of activities that have concomitant implications for skills requirements.

Rather than there being an identifiable 'innovation' skill, there are a large variety of skills that are relevant to innovation, including less technical skills such as marketing. This presents implications for the various players involved in innovation, such as how it can be promoted and how skills can be best configured to assist in the innovation process. What is clear is the need to start from a good educational foundation.

REFERENCES

ABS (Australian Bureau of Statistics) 2007, *Information paper: experimental estimates of industry multi-factor productivity*, cat. no.5260.0.55.001, ABS, Canberra.

Agarwal & Green 2011, 'The role of educational skills in Australian management practice and productivity', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

——2010a, *Australian national accounts: national income, expenditure and product, December quarter 2010*, cat.no.5206.0, ABS, Canberra.

——2010b, *Selected characteristics of Australian businesses, 2008—09*, cat.no.8167.0, ABS, Canberra.

——2010c, *Australian system of national accounts, 2009—10*, cat.no.5204.0, ABS, Canberra.

——2010d, *Experimental estimates of industry multi-factor productivity, 2009—10*, ABS, Canberra.

Curtin, P, Stanwick, J & Beddie, F 2011, *Fostering enterprise: the innovation and skills nexus — research readings*, NCVER, Adelaide.

Cutler & Company 2008, *Venturous Australia: building strength in innovation*, Department of Innovation, Industry, Science and Research, Canberra, viewed December 2010, <http://www.innovation.gov.au/ innovationreview/Pages/home.aspx>.

Dalitz, R, Toner, P & Turpin, T 2011, 'VET and the diffusion and implementation of innovation in the mining, solar energy computer games sectors', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Deitmer, L 2011, 'Building up of innovative capabilities of workers', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Fieger, P & Rice, J 2011 'Capabilities, innovation and performance: an assessment', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Godin, B 2008, *Innovation: the history of a category, project on the intellectual history of innovation*, working paper no.1, viewed June 2011, <http://www.csiic.ca/PDF/IntellectualNo1.pdf>.

Karmel, T 2011, 'Some thoughts on VET and innovation — an economic perspective', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Liao & Rice 2010, 'Innovation investments, market engagement and financial performace: a study among Australian manufacturing SMEs', *Research Policy*, vol.39, pp.117—25.

Misko, J & Nechvoglod, L 2011, 'Why firms innovate and what it means for VET', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

OECD (Organisation for Economic Co-operation and Development) 2005, *Oslo manual: guidelines for collecting and interpreting innovation data*, viewed 3 August 2011 <http://www.oecd.org/dataoecd/35/61/2367580.pdf>.

——2010, *Innovation strategy: getting a head start on tomorrow*, viewed 25 October 2010, <http://www.oecd.org/document/15/0,3343,en_2649_ 34273_45154895_1_1_1_1,00.html>, p.11.

——2011, *Innovative workplaces: making better use of skills within organisations*, OECD Publishing, Paris.

Pickersgill, R 2004, 'The engagement of vocational education and training and innovation in Australia: some historical perspectives', in *Vocational education and training and innovation: research readings*, ed. S Dawe, NCVER, Adelaide.

Prajago, DJ & Sohal, AS 2003, 'The relationship between TQM practices, quality performance, and innovation performance: an empirical examination', *International Journal of Quality & Reliability Management*, vol.20, no.8, pp.901—18.

Rice, J 2011, 'Innovation in the modern economy', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Smith, A, Courvisanos, J, Tuck, J & McEachern, S 2011, 'Building innovation capacity: the role of human capital formation in enterprises', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

Toner, P 2009, *Workforce skills and innovation: an overview of major themes in the literature*, OECD, Paris.

——2011, 'Tradespeople and technicians in innovation', in *Fostering enterprise: the innovation and skills nexus — research readings*, eds P Curtin, J Stanwick & F Beddie, NCVER, Adelaide.

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An *At a glance* is a synthesis of research focused on a particular topic of interest, drawing on information from various sources.

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