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Discussion Paper

Measuring a Knowledge-based Economy and Society

An Australian Framework

2002

New Issue

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Australian Statistician

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PREFACE

There is no internationally agreed framework for measuring the extent to which an economy or society is knowledge-based. As a contribution to debate on this topic, the Australian Bureau of Statistics has developed a framework for measuring a knowledge-based economy or society.

The aim of the framework is to enable assessment, through use of relevant statistics, of the degree to which Australia is a knowledge-based economy and society. In putting forward this framework the ABS is not assuming the merit or otherwise of a knowledge-based economy or society.

The framework and its indicators have a national focus. However, for many of the indicators suggested, information at a regional level (state/territory or lower) may be available from the original sources.

Given the subject matter of the framework, its structure and indicators will clearly need to change over time to remain relevant. The reasons for change include:

- changes in views and policy interests
- changes in availability and use of technology
- changes to indicators as users and Australian Bureau of Statistics (ABS) become more familiar with data sources and as statistical developments lead to improved data.

Most other work in this field refers to the so-called *Knowledge-based Economy* (sometimes called the *New Economy* or *Modern Economy*). The framework presented in this paper explicitly includes the concept of a knowledge-based society because of the presumed importance of social factors to economic change and the potential impacts on society of an increasing emphasis on the importance of knowledge. It is, however, acknowledged that the treatment of knowledge in society in this framework is most strongly focussed on aspects which are related to the economy, either as inputs or outcomes.

The aim of this Discussion Paper is to stimulate discussion on the proposed framework. Readers are therefore invited to comment on the theoretical basis and structure of the framework, as well as the range of indicators proposed.

Dennis Trewin
Australian Statistician

ABBREVIATIONS

The following abbreviations have been used in this publication.

ABS	Australian Bureau of Statistics
APEC	Asia-Pacific Economic Co-operation
ASX	Australian Stock Exchange
DSL	Digital subscriber line
FDI	Foreign direct investment
GDP	Gross Domestic Product
GVA	Gross Value Added
ICT	Information and communication technology
ISP	Internet Service Provider
KBE	Knowledge-based economy
KBE/S	Knowledge-based economy/society
MAP	Measuring Australia's Progress
OECD	Organisation for Economic Co-operation and Development
POP	Point of presence
R&D	Research and experimental development
WEF	World Economic Forum
WIPO	World Intellectual Property Organisation

CHAPTER 1 INTRODUCTION

The importance of knowledge to economies and societies has been much debated in recent years. In particular, many commentators have linked an increasing level of knowledge in society with economic growth.

WHAT IS KNOWLEDGE?

There are a number of ways of viewing and defining knowledge. For instance, a number of authors distinguish knowledge from information (and information from data). Alan Burton-Jones (1999) defines knowledge as 'the cumulative stock of information and skills derived from use of information by the recipient'. He distinguishes knowledge from data (signals which can be sent by an originator to a recipient) and information (data which are intelligible to the recipient).

Most writers contrast codified and tacit knowledge. Stevens (1998) describes codified knowledge as being able to be reduced to information (the know-what) and tacit knowledge as including skills such as insight, creativity and judgement (the know-how).

Drucker (1998) describes historical and cultural views of knowledge. He contrasts the self-knowledge philosophy of Socrates with the Protagoras view of knowledge as the ability to know what to say and say it well. Drucker considers that the latter interpretation has, until recently, dominated Western learning. He regards our current concept of knowledge as being knowledge which 'proves itself in action' and is focused on results.

Dahlman (1999, cited in Asia-Pacific Economic Co-operation(APEC) 2000) described four phases of knowledge flow: acquisition, creation, dissemination and use of knowledge. Others, including the Organisation for Economic Co-operation and Development (OECD) (1996) have referred to the production, distribution and use of knowledge. Howitt (1998) talked about the production and exchange of knowledge. He also mentioned the depreciation and obsolescence of knowledge in the context of its use.

It is suggested that the different forms of knowledge and knowledge flows described above are all likely to be relevant to a knowledge-based economy or society (KBE/S) and are a useful way of viewing knowledge.

WHAT IS A KNOWLEDGE-BASED ECONOMY OR SOCIETY?

Previous work in this field has emphasised the knowledge-based economy, so the concept of a knowledge-based society has not been as well explored in a statistical sense. However, a number of commentators have discussed the impact of knowledge, such as use of information and communication technologies (ICTs), to society. Many of these are cited by Lee *et al.* (2002) who also discuss the knowledge-based society in Australia. They argue that ICTs, particularly the Internet, are creating a knowledge-based society by breaking down barriers to knowledge and participation.

WHAT IS A KNOWLEDGE-BASED ECONOMY OR SOCIETY? *continued*

In contrast to a knowledge-based society, significant research has been done on the concept and measurement of a knowledge-based economy (KBE). The term 'knowledge-based economy' was coined by the OECD and defined as an economy which is 'directly based on the production, distribution and use of knowledge and information' (OECD 1996). The Asia-Pacific Economic Co-operation (APEC) Economic Committee extended this idea to state that in a KBE 'the production, distribution and use of knowledge is the main driver of growth, wealth creation and employment across all industries' (APEC 2000). According to this definition, a KBE does not rely solely on a few high technology industries for growth and wealth production. Rather, all industries in the economy can be knowledge intensive, even so called 'old economy' industries like mining and agriculture. Further, the APEC Economic Committee states that 'the knowledge required by a knowledge-based society is wider than purely technological knowledge; for example it includes cultural, social and managerial knowledge' (APEC 2000).

The following references provide overviews of the characteristics of a KBE: APEC Economic Committee 2000; Houghton and Sheehan 2000; Lamberton and Neutze 1999; OECD 1996 and Smith 2000.

WHY IS MEASURING A KNOWLEDGE-BASED ECONOMY OR SOCIETY IMPORTANT?

There is a growing belief that knowledge can do more than increase economic growth; it can also lead to structural change in an economy and therefore society. Such change differs from the incremental changes to which all economies are constantly subjected. Neef (1998) states that the new products and services resulting from technology growth may bring about profound changes in the way we live and work. He argues that this economic transition is characterised by the changing nature of work from low skill to high skill. This is reflected in the rapid growth in the services sector since the 1960s and in more recent changes in the goods-producing sector towards employing higher-skilled employees. Landes (1998) distinguishes the ephemeral nature of windfall growth, for instance arising from a favourable change in prices, from growth derived from advances in technique and organisation. The OECD, in its final Growth Project report (OECD 2001a) stated '...evidence suggests that something new is taking place in the structure of OECD economies.' It concluded that there was an uneven divergence of growth in several OECD economies and attributed this to ICT (particularly investment in ICT), increased use and quality of labour and multifactor productivity growth arising, in part, from increased business innovation. All these elements would be part of a knowledge-based economy and society.

THE AUSTRALIAN PERSPECTIVE

There has been increasing focus on the degree to which Australia is a 'knowledge-based' economy and society.

In February 2000, the National Innovation Summit was held in Melbourne. It brought together government, academia and business representatives to discuss innovation in Australia and, in particular, how the level of innovative activity in Australia can be increased. The final report from the Summit, *Innovation: Unlocking the Future*, was released in August 2000 (Innovation Summit Implementation Group 2000). The report, also known as the Miles Report, made a number of recommendations about government and business funding for innovative activities, including a recommendation to increase the measurement of innovative activity.

In August 2000, the Government Chief Scientist released a report on Australia's Science, Engineering and Technology Base. The report, *The Chance to Change*, made a number of recommendations about general university funding and research grant funding within Australia (Batterham 2000). These recommendations were made with a view to encouraging the study of science and engineering subjects and increasing the commercialisation of Australian research activities.

The Federal Government released the strategy, *Backing Australia's Ability*, in January 2001. *Backing Australia's Ability* outlined the Government's strategy to further 'encourage and support innovation and enhance Australia's international competitiveness, economic prosperity and social wellbeing' (Commonwealth of Australia 2001).

STRUCTURE OF THE PAPER

Chapter 2 of the paper considers theoretical and empirical work relating to the role of knowledge in the economy and, to a lesser extent, society. It briefly examines economic theories of growth and social perspectives then goes on to describe empirical work in the field.

Chapter 3 considers approaches to the measurement of a KBE/S. It discusses the need for a measurement framework, the type of framework and the appropriate approach. It lists examples of existing measurement frameworks and describes, in some detail, APEC and OECD work in this field.

Chapter 4 generally describes the proposed framework, discusses its limitations and outlines the proposed framework dimensions and characteristics.

Chapter 5 discusses the approach to choosing indicators then lists the statistical indicators included in the framework in their dimension-characteristic context.

Finally, Chapter 6 discusses the user consultation process, the Web release of this paper, options for disseminating statistical information from the framework and related ABS work.

INFORMATION ABOUT DATA SOURCES

The Web version of this paper provides additional information about each of the indicators shown in Chapter 5. See Chapter 6 for further information.

CHAPTER 2 THEORETICAL AND EMPIRICAL PERSPECTIVES

ECONOMIC PERSPECTIVES

It is not within the scope of this paper to comprehensively document the changes in economic theory and/or observed changes in national economies which have led to the increasing emphasis on knowledge and to the formulation of the KBE/S concept. Instead, a broad introduction to the area is given in this Chapter and references to further reading are provided in the Bibliography for those interested in following this further.

Various economic models attempt to explain the role of knowledge and technology in growth. The models and theories developed so far tend to fall into one of two types: new growth theories or evolutionary economic theories.

New growth theories

New growth theories attempt to clarify the role of knowledge and technology by incorporating these into the neoclassical production function. A non-technical overview of these theoretical developments can be found in Gera *et al.* (1998), OECD (1996), Rogers (1999) and Smith (1998).

Evolutionary economic theories

Evolutionary economic theories (also referred to as systems theories) encompass a number of streams of thought. 'The unifying thread is the perception that innovation, and the technological and organisational changes associated with it, are the key drivers of long-run economic growth' (Bryant and Wells 1998).

Rather than viewing the market as being in a state of static equilibrium, these models specifically acknowledge that the market is constantly changing and that businesses need to innovate in order to adapt to the changing environment. Evolutionary theories therefore do not attempt to incorporate knowledge into a neo-classical equilibrium framework through a production function.

Empirical studies show that knowledge flows around the whole innovation system, i.e. within and between firms, within and between business and academia. In fact, these non-linear knowledge flows are a crucial condition for the generation of novel products, processes and technologies. For such knowledge flows to occur, firms need to be involved in networks or innovation systems. This is where the term 'systems theories' arises (knowledge flows within the whole system, rather than in one direction only from the non-commercial sector to the commercial sector).

The uncertainty associated with knowledge-related investment, and the need for effective networks which enable knowledge to flow easily, point to the importance of high levels of trust both at organisational levels and in macro-level systems. Trust lowers transaction costs and increases certainty. In organisations, trust facilitates teamwork (and hence productivity, innovation and growth) and reduces the need for expensive monitoring. Correspondingly high levels of trust between players in

Evolutionary economic theories — *continued*

higher level systems will reduce the need for regulatory effort and the imposition of sanctions — productive cooperation and beneficial change will be facilitated.

Bryant and Wells (1998) provide a good overview of some of the different streams of thought in evolutionary economics theories.

SOCIAL PERSPECTIVES

As discussed in the Introduction, the proposed ABS framework includes Society. It does so because of the presumed importance of social factors to economic change and the positive and negative impacts of that change on society.

Social elements considered relevant to the framework include:

- a wide range of general societal characteristics and structures which form part of the context which influences economic growth; they include age structure, health status, income levels and distribution;
- the direct 'social' effect on knowledge processes which affect the economy; education levels are an obvious example, another example is the presumed impact of social capital because of its importance in facilitating knowledge flows (more information on the relationship of social capital to economic growth can be found in OECD 2000c); and,
- the effects on society of an increased emphasis on, and use of, knowledge; these can be both positive, for instance, the overall benefits to society of economic growth and easier access to information, and negative, for example, poorer employment prospects for low-skilled workers (a useful analysis of such effects can be found in Lee *et al.* 2002).

EMPIRICAL EVIDENCE: THE OECD GROWTH PROJECT

At the completion of its two year Growth Project, the OECD concluded that '...to enhance long-term growth, more emphasis should be given to policies focusing on ICT, human capital, innovation and firm creation' (OECD 2001a). Empirical evidence indicated that divergence in growth between OECD countries could be attributed to:

- investment in ICT
- increased use of labour
- rising quality of labour
- greater efficiency in how labour and capital are combined (multifactor productivity).

The findings of this project have had a significant influence on the framework proposed in Chapter 4. For this reason, some details are provided below.

Genesis of the Growth Project

The OECD Growth Project began in 1999 with a Ministerial Council request to analyse the causes underlying differing economic growth of member nations during the 1990s. There was a particular interest in why the US economy had experienced increased non-inflationary growth relative to most other OECD economies, whilst maintaining low unemployment. The importance of information and communication technology (ICT) had increased in the US and there was evidence of restructuring of enterprises and markets. Levels of economic growth experienced by Australia, Ireland and the Netherlands had also been higher in the 1990s — in contrast to other OECD member nations (OECD 2000a).

Fundamentals

Research indicated that, in successful economies, entrepreneurial behaviour was aided by a competitive environment, an efficient labour market and a legal and financial environment which protected intellectual property and supported start-up firms (OECD 2000a).

ICT

Productivity in the ICT sector improved economic productivity overall while use of ICT facilitated innovation and increased labour productivity (OECD 2000a). Deregulation of ICT industries encouraged competition and greater access across industries and across regions because of increased investment in infrastructure. Successful economies were more likely to have rapid diffusion of ICT, particularly in service industries where the effects are still being gauged (OECD 2000b).

Human capital

The importance of human capital in the innovation process underlies the demand for increased skills, including teamwork and cognitive skills, and lifelong learning in order to adapt to continuous change (OECD 2000b). The impact of knowledge accumulation on productivity underscores the importance of adequate education systems which also provide spillover effects to society. It may require investment in the knowledge base of economies, by supporting the science sector and research and development (R&D) for example, to take full advantage of technologies (OECD 2000a).

Productivity

The first Growth Project report indicated that multifactor productivity (MFP) growth had accelerated in the high growth economies as capital and labour inputs improved (OECD 2000a). Although US growth was modest, trend growth rose throughout the decade and MFP strengthened in the second half of the 1990s combined with a rapid rise in capital stock. The convergence by OECD economies to US levels of gross domestic product (GDP) per capita was reversed despite a slow convergence of labour productivity, and with higher labour productivity experienced by some OECD economies. Labour productivity gains, in many cases, represented shedding low skilled labour and rapid substitution of capital for labour (OECD 2000a).

In respect of labour productivity, research suggested that higher growth rates in output were accompanied by improvements in the utilisation of labour in the United States of America, Ireland, Netherlands, Norway and Australia. 'Traditional' factors, such as the ability of countries to employ their labour force, may lie behind the disparities in growth patterns across the OECD as well as some new factors, largely related to the diffusion of ICT. New ICT equipment used in many sectors has had an impact on human capital formation. Data suggest that the first wave of adoption of this technology in the US was accompanied by a significant shift towards more skilled workers (OECD 2000e).

Innovation and knowledge flows

Innovation of products, processes and organisational structure has been assessed as a critical component in the success of firms. Related to this is the increased importance of fluidity of knowledge flow between individuals, firms, organisations and also between national economies. Knowledge networks reduce the cost of R&D and speed up the innovation process. Empirical studies have shown the success of collaboration in the discovery, application and diffusion of technologies. Foreign direct investment (FDI) has been recognised as a means of importing innovation (OECD 2000b).

Conclusions arising from the Growth Project

The final Growth Project report *The New Economy: Beyond the Hype* (OECD 2001b), contains the major conclusions from the two year project. They are as follows:

1 'ICT is an enabling technology. Governments should: focus policy efforts on increasing the use of new technology; increase competition and continue with regulatory reform in the telecommunications industry to enhance the uptake of ICT; ensure sufficient competition in hardware and software to lower costs; build confidence in the use of ICT for business and consumers; and, make e-government a priority.'

2 'Foster an innovative environment: give greater priority to basic research; improve the effectiveness of government funding of innovation; make greater use of competitive funding and evaluation in supporting public research; tackle new challenges in intellectual property regimes; and, remove barriers and regulations that limit effective interaction between universities, firms and public laboratories.'

3 'Prioritise policies to enhance human capital (the skills and competencies embodied in labour): invest in high-quality early education and child care; raise completion of basic and vocational education and improve the quality of the system; improve school-to-work transition; strengthen the links between higher education and the labour market in a cost-effective way; provide wider training opportunities; and, reduce obstacles to workplace changes and give workers a greater voice.'

4 'Foster an entrepreneurial climate: promote access to financing; facilitate firm entry and exit; review and assess the relevance and effectiveness of government support programmes; and, encourage an entrepreneurial spirit in society.'

5 'Assure that economic and social fundamentals are in place: preserve macro-economic stability; encourage openness; make financial systems more supportive of innovation; mobilise labour resources; and, address the redistributive implications of structural change.'

OBSERVATIONS ON THE IMPORTANCE OF KNOWLEDGE

Changes which have highlighted the increasing importance of knowledge have been observed in several economies (Gera *et al*. 1998; Houghton and Sheehan 2000; Lamberton and Neutze 1999; OECD 2001a; Gera and Weir 2001). A number of these changes are described below:

- growth in demand for high-skilled workers, with an increased emphasis on cognitive skills, the development of ideas and life-long learning;
- prevalence of information and communications technologies resulting in:
    - emergence of new arrangements of work, production, shopping and education;
    - increased codification of knowledge; and
    - decreased costs of knowledge dissemination.
- increased openness of the world economy, leading to increases in trade (especially in knowledge-intensive exports), foreign direct investment (FDI) and knowledge transfer;
- internationalisation of production requiring increased knowledge to control and integrate business units;
- changing composition of production in more advanced economies, with movements towards services and away from manufacturing, and a movement towards higher value-added services;
- increased participation in international and domestic networks (and/or geographic or industry clusters) for the exchange of products, capital and knowledge, e.g. joint ventures, non-equity agreements and less formal inter-firm collaborations; and
- increased interest in R&D and other aspects of innovation.

CHAPTER 3 APPROACHES TO THE MEASUREMENT OF A KNOWLEDGE-BASED ECONOMY/SOCIETY

NEED FOR A MEASUREMENT FRAMEWORK

There seems to be a growing acceptance that it is important to try and measure the knowledge-based economy (and perhaps to a lesser extent society). The ABS believes that in order to present a coherent statistical picture of knowledge in an economic and social context, relevant statistics should be shown within a framework which is:

- structured in a logical and understandable manner
- developed in the light of relevant theory and empirical evidence
- widely accepted by policy makers and other users
- unbiased in its choice of statistical indicators so that, for instance, it does not show a group of indicators selected to suit a particular purpose or argument
- comprehensive whether or not relevant statistics exist for all framework elements (thus enabling any gaps in available statistics to be readily identified).

TYPE OF FRAMEWORK

A traditional statistical (or conceptual) framework can perhaps be viewed as a conceptual map which allows statistics to be organised and logically grouped. A statistical framework would typically deal with a particular topic and would include a range of rules and conceptual information such as classifications, standards, definitions and actors. The framework presented in this paper differs from a traditional statistical framework in two ways. The first, and most obvious, is that its scope is very wide so that component parts would themselves be the subject of statistical frameworks (some of which already exist). A second difference is that the proposed framework does not deal with concepts, such as classifications, standards or definitions, leaving these to be dealt with by statistical frameworks on component topics (for example, a statistical framework for education and training statistics or information technology and telecommunication statistics).

For these reasons, the proposed framework presented here could perhaps be better viewed as a 'descriptive' or 'presentation' framework (its defining characteristic being that it attempts to describe a subject using statistics rather than trying to view those statistics within the context of a statistical or conceptual framework).

Suite-of-indicators

In the approach adopted here, a suite of indicators which collectively describe the subject (i.e. the KBE/S) have been assembled and grouped according to particular aspects of the subject. This could be referred to as a 'suite-of-indicators' approach and is the one chosen by most agencies which have presented data on the KBE.

A SINGLE INDEX?

Once a set of indicators has been decided upon, it is theoretically possible to create an index to reflect the intensity with which an economy and society is knowledge-based. The use of a single figure index, if valid, would facilitate comparative analyses and could become an important indicator of economic performance. However, before an index can be developed, each indicator would require an appropriate weight to be assigned to it. This in turn relies on the existence of a sound and generally agreed model which defines and prioritises key elements of a KBE/S. As Mohnen & Dagenais (1998) noted, a major obstacle to constructing an index from a compilation of survey data is how to combine various measures of the same concept. This problem is compounded when the index is used over time, as the framework on which it is based needs to change in order to remain relevant. The ABS does not intend to pursue this approach, arguing that a single index would present an over-simplified and possibly misleading representation of the extent to which an economy or society is knowledge-based.

DIRECT MEASUREMENT APPROACH

Measuring knowledge in accordance with the economy wide input/output framework has also been suggested as an area for consideration. Such an approach, while quite distinct from that proposed here, could also aid analysis of economic growth. Statistics for the traditional sectors for inputs and outputs of knowledge would need to be developed. Linkages between these sectors could then be analysed for the degree of knowledge transfer and dependence. A number of conceptual and methodological challenges would need to be overcome if this approach were to be pursued.

EXISTING FRAMEWORKS

Various compilations of KBE statistics have been developed, many of which are based on the 1996 OECD definition of a KBE. Some are more heavily focused on ICT as the main driver of growth in a KBE. Others acknowledge ICT as an enabling technology of a KBE, but also encompass other factors as contributing to economic growth (e.g. employee skill levels, knowledge creation in the form of R&D and innovation, knowledge and technology transfer).

While most of these compilations could probably be described as 'descriptive frameworks', the majority are implicit rather than explicit frameworks. That is, the framework is defined in terms of the statistics which it presents rather than being derived on the basis of theory or empirical evidence. A notable exception to this is the APEC Economic Committee's 2000 KBE framework which is described in more detail later in this Chapter. It is based on empirical evidence.

Listed below are examples of existing KBE compilations. References for these can be found in the Bibliography.

- *Australia as a Modern Economy: Some Statistical Indicators 2002*, Department of Industry, Tourism and Resources (2002)
- *The 2002 State New Economy Index*, Progressive Policy Institute (2002)
- *Science, Technology and Industry Scoreboard: Towards a Knowledge-based Economy*, OECD (2001)

EXISTING FRAMEWORKS — *continued*

- *Knowledge Assessment Scorecard*, World Bank Institute (2002)
- *On the Road to the Finnish Information Society III*, Statistics Finland (2001)
- *UK Competitiveness Indicators*: Second Edition, UK Department of Trade and Industry (2001)
- *The New Economy and APEC*, APEC Economic Committee (2001)
- *Towards Knowledge-based Economies in APEC*, APEC Economic Committee (2000)
- *Knowledge-Based Activities: Selected Indicators*, Department of Industry, Science and Resources (2000)
- *Towards a European Research Area: Science, Technology and Innovation: Key Figures 2000*, Eurostat (2000)
- *European Innovation Scoreboard*, European Commission (2000)
- Porter's *index of innovative capacity* (1999)
- *The Knowledge-Based Economy: A Set of Facts and Figures*, OECD (1999)
- *Our Competitive Future: UK Competitiveness Indicators 1999* UK Department of Trade and Industry (1999)
- *Measuring the Knowledge-Based Economy: How does Australia compare?* Department of Industry, Science and Resources (1999)
- *Index of the Massachusetts Innovation Economy*, Massachusetts Technology Collaborative (1999)
- *The New Economy Index: Understanding America's Economic Transformation*, Progressive Policy Institute (1998).

APEC FRAMEWORK

The APEC framework was developed as part of a project commissioned by the APEC Economic Committee in mid–1999. The title of the project was *Towards Knowledge-based Economies in APEC* and was progressed by a specially created KBE Task Force, members of which included Australia, Canada and Korea. The aim of the project was to 'provide the analytical basis useful for promoting the effective use of knowledge, and the creation and dissemination of knowledge among APEC economies' (APEC Economic Committee 2000). A brief summary of the methodology used to develop the framework is presented here. For more information, the full report should be examined.

The project entailed the examination of empirical evidence and concluded that economic growth is most sustainable for those economies which are strong in all of the following four dimensions (findings of the OECD Growth Project, analysed and cited in the APEC Economic Committee report):

- 'Innovation and technological change are pervasive, and are supported by an effective national innovation system.'

APEC FRAMEWORK *continued*

- 'Human resource development is pervasive: education and training are of a high standard, widespread and continue throughout a person's working life.'
- 'An efficient infrastructure operates, particularly in information and communications technology (ICT), which allows citizens and businesses to readily and affordably access pertinent information from around the world.'
- 'The business environment is supportive of enterprise and innovation.'

These four dimensions form the basis of the APEC KBE framework:

- Innovation System
- Human Resource Development
- ICT Infrastructure
- Business Environment.

Drawing on the literature, in particular on a paper by Gera *et al*. (1998), the KBE Task Force developed the concept of a fully developed KBE and described the characteristics of such an economy. Once the characteristics of a KBE were described, quantitative measures (or indicators) of these characteristics could then be selected to incorporate objective measures into the framework. For the purposes of the APEC report (APEC Economic Committee 2000), it was important that the chosen indicators were available for all the case study economies. This tended to limit the choice of indicators.

OECD CONTRIBUTION

The OECD has made a significant contribution to research on the Knowledge-based economy. Its work has evolved from a long history of developing and publishing science and technology indicators. In 1996, the OECD published *The Knowledge-based Economy* (OECD 1996), an early attempt to compile statistical indicators on the KBE. It published another compilation in 1999 (OECD 1999) and in 2000 started releasing results from the two-year Growth Project. The impetus for the project was to discover the causes underlying differing economic growth of member nations during the 1990s.

The final Growth Project report, *The New Economy: Beyond the Hype* (OECD 2001b), was released in mid 2001. Even though its findings have been described in some detail in the previous chapter, it is worth summarising the policy conclusions which flowed from the project. The report emphasised:

- the importance of a stable and open macro-economic environment with effectively functioning markets
- the diffusion of ICT
- fostering innovation
- investing in human capital, and
- stimulating firm creation.

Those policy conclusions, based on empirical evidence, suggest the broad elements of a descriptive KBE framework. The ABS proposal described in this paper and the APEC framework have used those elements in their respective frameworks.

CHAPTER 4 OVERVIEW OF FRAMEWORK AND PROPOSED DIMENSIONS AND CHARACTERISTICS

GENERAL DESCRIPTION

The proposed ABS framework draws on work done by a number of organisations and individuals. In particular, it builds on work of the APEC Economic Committee and the OECD Growth Project.
See Chapters 2 and 3 for more information.

The ABS proposes a framework model with five dimensions. There are three core dimensions as follows:

- Innovation and entrepreneurship
- Human capital
- Information and communications technology.

In addition there are two supporting dimensions: a Context dimension and an Economic and social impacts dimension.

Within each dimension are characteristics; indicators are chosen to provide measures of the characteristics.

Dimensions

The contextual dimension is very broad and incorporates a number of background elements and preconditions, such as business environment and effectively functioning markets as discussed in the APEC and OECD reports.

The three core KBE/S dimensions: Innovation and entrepreneurship, Human capital and Information and communications technology provide the focus of the framework. They define the key characteristics of a KBE/S.

Finally, there is a dimension on economic and social impacts. It is included on the presumption that a KBE/S has an impact on the economy and society. A small number of indicators which reflect this impact are proposed for inclusion in the framework.

There are multiple relations and some overlaps between the dimensions. In particular, the economic and social impacts dimension has relations with all the other dimensions and, in turn, affects the other dimensions. Some of those relations will be simple causal links (but maybe not demonstrably); most will be far more complex.

A highly simplified diagrammatic representation of the dimension structure of the framework is shown in figure 1. It shows the context dimension as being pervasive, the three core dimensions as overlapping and the economic and social impacts dimension as being affected by both the context and the three core dimensions. In reality, there are many more relationships than those shown.

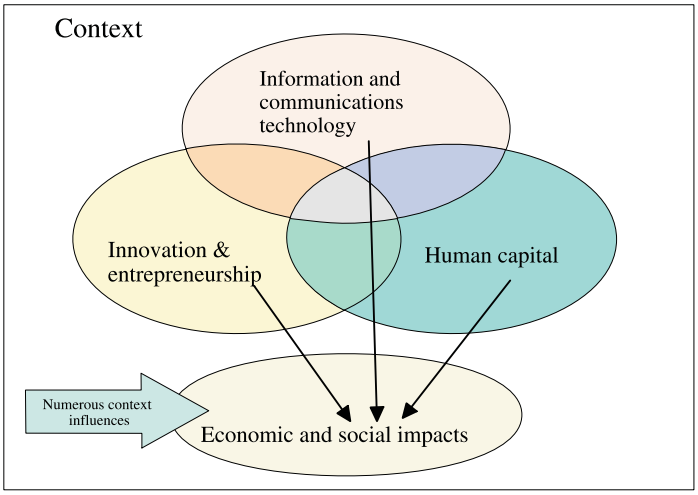

Figure 1: Simplified dimension structure of the proposed ABS Knowledge-based Economy/Society Framework

Characteristics

Each of the dimensions is described in terms of a number of characteristics. A characteristic is an aspect of a dimension which has been used to both further describe the dimension and to give it some structure by splitting it into more understandable elements. The characteristics are neither mutually exclusive nor intended to provide a comprehensive description of each dimension.

Characteristics are dimension specific but, as far as possible, have been based on familiar concepts. For instance, the ICT dimension has six characteristics which are broadly split into infrastructure and access (one characteristic), ICT demand (three characteristics) and ICT supply (two characteristics). Most characteristics are populated by one or more statistical indicators.

Indicators

An indicator provides a quantitative measure of a characteristic. In the proposed framework, an indicator is defined as a single figure or a small data set showing a broad dissection (for instance by broad industry, age group etc.). A list of possible indicators for each dimension is presented in Chapter 5.

FRAMEWORK LIMITATIONS

The framework presented in this paper does not attempt to cover all knowledge in the economy and society. Not only would such a task be overly ambitious but would be misleading if it implied that all knowledge were measurable.

In particular, the proposed framework does not offer a comprehensive treatment of a knowledge-based society athough it does address those social elements which potentially affect economic change or are affected by it.

THE CONTEXT DIMENSION

It is impossible to ignore the importance of a diverse range of contextual factors on a knowledge-based economy and society. We have grouped those into a context dimension, which incorporates the 'Business environment' dimension of the APEC framework and the 'Economic and social fundamentals' dimension of the OECD Growth Project.

The Department of Industry, Tourism and Resources (2002) states that a stable and competitive business environment is an essential component of a modern economy. It cites effective competition policy, stable and credible regulatory and legal frameworks and an open environment for trade and investment as important factors in:

- alleviating business uncertainty
- increasing investment in knowledge
- developing knowledge-based industries and their exports and
- promoting growth in labour and multifactor productivity.

The *Global Competitiveness Report* produced by the World Economic Forum (WEF) also emphasises the importance of policies and institutions to knowledge-based economies. The 2001 report discusses the changing context of business, legal and political systems as nations move from resource-based to knowledge-based economies (WEF 2001). The *World Competitiveness Year Book* produced by the International Institute of Management Development (IMD) considers government efficiency, business efficiency and infrastructure as well as economic performance when assessing overall competitiveness (IMD 2001).

The context dimension in the current proposal is broad and includes a number of economic, social, cultural, legal, political, environmental and global factors which may stimulate, or act as preconditions for, a successful KBE/S.

The proposed characteristics of this dimension include:

- Macro-economic factors (such as economic performance including monetary and fiscal macro-economic management to encourage stability of output growth, short-term interest rates and prices).
- Social and cultural factors. These include a wide range of societal characteristics and structures, for example, social capital, age structure of the population, health status, crime levels and income distribution.
- Product, financial and labour markets.
- Openness (an economy's openness and international orientation).
- Legal and regulatory frameworks.
- Political institutions and transparency.

There are relatively few indicators for this dimension. However, as work on the framework and indicators progresses, it is likely that other indicators can be included to improve the statistical description of this dimension.

THREE CORE DIMENSIONS

The three KBE/S core dimensions are described below. They could alternatively be described as the core components of a KBE/S.

INNOVATION AND ENTREPRENEURSHIP

This dimension includes the support for, and performance of, innovative and entrepreneurial activities within the economy.

Proposed characteristics of the dimension are:

- Research base and potential for knowledge creation. This characteristic deals mainly with the performance of basic research, research in relatively new fields and research by small and medium enterprises.
- Knowledge creation with commercial potential (this includes invention and patenting activity).
- Other knowledge creation.
- Knowledge networks and flows. This refers to sharing and dissemination of knowledge within firms, and between firms and other organisations (other firms, government and education organisations). It includes cross border flows of knowledge.
- Innovation. This characteristic covers the introduction of new or improved products or processes by businesses and non-technological innovation.
- Entrepreneurial activity. This characteristic refers to the creation of new, fast growing businesses.
- Support for innovation (support for R&D and provision of venture capital funding).

HUMAN CAPITAL

The skills and knowledge of people living in a society are clearly of central importance to its development as a knowledge-based economy and society.

The stock of human capital is reflected in the level of skills, competencies and knowledge of members of society. The stock is built up over time mainly through investment in education (public and private expenditure on education and training). A KBE/S framework is therefore concerned with education and training inputs, both formal and informal, as well as outputs in terms of the resulting skills and abilities of the population.

Proposed characteristics of the dimension are:

- Stock of skilled people (information about the education and skill levels of the population and the potential stock of qualified people)
- Flow of skilled people (this characteristic looks at knowledge workers, the level of educational attainment of the labour force, the extent of employer training and human capital loss/gain from the economy)
- Investment in human capital (refers to expenditure on education and training by government and business)
- Lifelong learning and access to education and training.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Information and communications technologies (ICTs) are enabling technologies of a KBE/S. They are vital tools for knowledge workers, allowing them to take full advantage of technology's capacity to access, manipulate and process information. ICTs are also an integral part of education, offering students access to information as well as a range of IT based learning tools.

Some commentators have argued that a strong ICT production sector is essential for a KBE/S. However work by the OECD suggests that the pervasiveness of ICT use within an economy and society is more important than the production of ICT goods and services (OECD 2000b).

Proposed characteristics of the dimension are:

- ICT infrastructure and access. This characteristic considers the ICT infrastructure in place and its availability and cost to members of society
- Household and individual use of ICT (looks at the extent of use of ICT and the ways it is being used by members of society for particular purposes and activities)
- Business and government use of ICT (examines the penetration of ICT into business and government processes)
- Prevalence of electronic commerce. This characteristic looks at business and individual use of the Internet, and other computer mediated networks, for buying and selling goods and services
- ICT skill base (refers to the share of ICT workers in the labour force as well as covering skill shortage issues)
- Strength of the ICT industry. This characteristic describes aspects of ICT industries in Australia. In particular, it looks at revenue growth, contribution to value added and employment, R&D expenditure and trade in ICT goods and services.

ECONOMIC AND SOCIAL IMPACTS DIMENSION

This dimension deals with the effects on the economy and society of an increased emphasis on, and use of, knowledge. As such, the dimension seeks to inform how 'intermediate' KBE/S outcomes impact on broader measures of economic and social progress (The 'intermediate' KBE/S outcomes are reflected under each of the three core dimensions.).

It is acknowledged that a cause and effect relationship between impacts and knowledge cannot necessarily be proven. Even when these relationships exist, there could be long lead times between a particular factor and the associated impact. It is also clear that other factors are likely to be involved in some of the impacts we are seeing. For instance, micro-economic and labour market reforms as well as 'knowledge' are likely to be factors in labour productivity improvement and economic growth. In respect of Australia, Parham *et al*. (2001) have suggested that recent productivity gains have come from both increased ICT use and non-ICT factors such as policy reforms.

ECONOMIC AND SOCIAL IMPACTS DIMENSION
— *continued*

The indicators chosen are those measures of economic and social progress that commentators have suggested should be impacted to some extent by a KBE/S. However, some of these indicators (e.g. GDP per capita) are quite broad in nature and, as discussed above, are likely to be also influenced by many other factors. The ABS would welcome particular comment on the types of indicators that should be shown in this dimension. Only a small set of statistical indicators is initially proposed. The set of indicators may grow over time as relationships between dimensions become clearer and views develop on the implications of a KBE/S.

Proposed characteristics for this dimension are:

- Economic and structural change (change in productivity, industry structure and trade)
- Social change.

CHAPTER 5 POSSIBLE INDICATORS

This chapter presents possible indicators for the framework. Each indicator is described in the context of the dimension and characteristic for which it is intended to be a measure. Source information about indicators can be found in the web version of this paper. See Chapter 6 for details.

The number of indicators

The number of indicators has been left deliberately large but it is unlikely that the ABS would attempt to publish information in respect of all the indicators which are included in this version of the framework. Users are therefore encouraged to make suggestions as to which are the most important indicators within each dimension. Suggestions about the importance of indicators not proposed here are also welcomed.

For some characteristics, there are inadequate or no indicators. In this situation, the characteristic is included but the lack of an appropriate indicator has been highlighted.

For most of the indicators, data presented will include comparisons over time and/or with other countries.

CHOOSING INDICATORS

The following list describes the characteristics of a good indicator. It should:

- be relevant to the characteristic it is intended to describe (including policy relevant);
- be supported by reliable and timely data;
- be sensitive to the underlying phenomenon which it purports to measure;
- be intelligible and easily interpreted;
- preferably be available for several time periods including recent periods; and
- for the purposes of international comparison, preferably be available for other countries.

For some characteristics, the most appropriate indicators will change over time. For example, in Australia, access to mobile phones is currently of interest as an indicator of household use of ICTs. However, mobile phone penetration is increasing fairly rapidly and within a relatively short time this indicator could show that the proportion of households with mobile phone access has stabilised. At that point, the mobile phone indicator will become less relevant in terms of providing useful information. However, by then we might expect that new ICTs will be emerging so it would be logical to replace it with other indicators to track the change in household use of ICTs.

Equally, for some indicators a long time series will prove useful in telling a meaningful story about a KBE/S. For example, an important indicator of innovation is expenditure on basic research by sector of performance as a percentage of GDP. Given that basic research is a key means of generating new knowledge, and this is unlikely to change in the near future, it is likely that this indicator would remain in the framework for much longer than an indicator of mobile phone coverage.

ABS criteria

ABS has included indicators based on a judgment of their performance against the criteria listed above. A framework indicator should comply with most or all of the criteria for a good indicator. Ideally, therefore, it should be relevant, reliable, timely, sensitive, intelligible, available for several time periods and available for other countries as well as Australia. There are a number of possible indicators which have not been included in the framework. Some of these have been rejected on the basis that they will generally not satisfy most of the above criteria. In other cases, indicators have been rejected because there are several better indicators of a particular characteristic.

Where possible, the indicator figure or data set will be considered in the context of a historical or international data series.

THE CONTEXT DIMENSION

Possible indicators for this dimension are:

Characteristic:	Indicators:
Macro-economic factors	• GDP • Exchange rates • Interest rates • Inflation
Social and cultural factors	• Age structure of the population • Income levels and distribution of the population • Participation in community activities
Product, financial and labour markets	• GDP Market Sector • Australian Stock Exchange(ASX) All ordinaries index • Labour market participation by age and sex • Industrial action, working days lost
Openness	• Foreign direct investment flows as a proportion of GDP • Trade openness: imports plus exports as a proportion of GDP
Legal and regulatory frameworks	*No indicators are proposed at this stage*
Political institutions and transparency	*No indicators are proposed at this stage*

INNOVATION AND ENTREPRENEURSHIP DIMENSION

Possible indicators for this dimension are:

Characteristic:	Indicators:
Research base and potential for knowledge creation	• Total R&D expenditure by sector of performance (business, government, private non-profit, higher education), as a proportion of GDP • Total R&D expenditure by sector of performance. • Expenditure on basic research by sector of performance (business, government, private non-profit, higher education), as a proportion of GDP • Expenditure on basic research by broad discipline, as a proportion of GDP • Business R&D expenditure by business size • Number of scientific and technical publications, per capita
Knowledge creation with commercial potential	• Expenditure on applied research and experimental development by sector of performance, as a proportion of GDP • Business R&D expenditure by broad industry and by technology intensity of industry • Number of Australian resident patents in 'triadic' patent families (European Patent Office, US Patent and trademark Office and the Japanese Patent Office) per million population • Number of international patent applications filed with the World Intellectual Property Organisation (WIPO) by country of origin • Inventiveness co-efficient: number of resident patent applications per capita • Patent applications filed in Australia in particular fields
Other knowledge creation	• *No indicators proposed at this stage*
Knowledge networks and flows	• Business funding of R&D performed by other sectors as a proportion of total R&D expenditure • Proportion of Australian business R&D funded from overseas • Proportion of business R&D performed overseas but funded locally • Number of international strategic alliances between firms • Cross-border ownership of inventions, proportion of patent applications • Citation of scientific inventions in United States patents • International co-operation in science and technology: proportion of scientific publications with foreign co-authors • International co-operation in science and technology: proportion of patents with foreign co-inventors • International mobility of human capital: non national human resources in science and technology • International mobility of students: enrolled tertiary students who are not Australian citizens, proportion of total enrolment

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INNOVATION AND ENTREPRENEURSHIP DIMENSION — *continued*

Characteristic:	Indicators:
Innovation	• Proportion of manufacturing businesses which are innovative by business size, industry and broad type of innovation (product, process or organisational) • Expenditure on technological innovation by manufacturing businesses by business size, industry and type of innovation (R&D, acquisition of technology etc)
Entrepreneurial activity	• Number of business startups (by Australian adults per capita) • Proportion of small and medium enterprises by industry (in growth industries defined in terms of both employment and output)
Support for innovation	• Government funded expenditure on R&D, as a proportion of GDP, by level of government • Government budget appropriations or outlays for R&D, as a proportion of GDP • Federal government financial support for science and innovation, by type of activity and theme • Value of venture capital provided as a proportion of GDP

Apparent gaps in available statistics for this dimension include:

- General lack of data on the value of intangible assets
- Lack of direct information on knowledge networks and business alliances and business clusters
- Data on business spin-offs from higher education institutions
- Innovation indicators from 1996–97 are restricted to the manufacturing and mining industries
- Recent data on the proportion of firms which are innovative, by age and size of firm, and industry (latest data are in respect of 1996–97)
- Lack of indicators for 'other' knowledge creation.

Relevant indicators are also shown under other dimensions. They include:

- Education system indicators (Human capital)
- Researchers as a proportion of the labour force (Human capital)
- Human resources devoted to science & technology (Human capital)
- Immigration and emigration of skilled people (Human capital).

HUMAN CAPITAL DIMENSION

Possible indicators for this dimension are:

Characteristic:	Indicators:
Stock of skilled people	• Highest completed level of educational attainment of the population, by age and sex • Educational attainment of the labour force, by occupation and highest educational attainment • Knowledge workers as a proportion of the labour force • Researchers as a proportion of the labour force • Labour force status of those with science and technology qualifications • Stock of human resources in science and technology, proportion of population
Flow of skilled people	• Literacy and numeracy rates for children under 15 years • Participation in secondary and tertiary education, proportion of relevant age group • Graduates in science, IT and engineering as a proportion of total graduates • Graduate outcomes by qualification, employment status, field of study and occupation • Proportion of labour force in vocational training and apprenticeships • Immigration and emigration of skilled adults • Net change in stock of skilled workers
Investment in human capital	• Total expenditure on education, as a proportion of GDP, by source of funding • Expenditure on education by government, as a proportion of GDP, by education sector • Government expenditure per capita on government schools, by level of education and government • Income and expenditure of non-government schools, by level of education • Business expenditure on training and vocational education • Private expenditure on education
Lifelong learning and access to education and training	• Adult literacy levels: proportion of the population at International Adult Literacy level 3 or above • Proportion of population aged 15–64 in formal education, by field of study and age • Proportion of population aged 15–64 undertaking work-related training • Expected number of years spent in education and training • Proportion of undergraduate university applicants not receiving an offer through state admission centres • Unmet demand for education, by labour force characteristics • Visits to public library facilities, per capita

HUMAN CAPITAL DIMENSION — *continued*

Apparent gaps in available statistics for this dimension include:

- Lack of currency of some indicators, for example, statistics on adult literacy are in respect of 1996.
- Number and type of tertiary courses offered by distance education.
- Information on ICT facilities in educational institutions.
- Indicators on the quality of the education system (for instance, recognition of Australian qualifications overseas).
- Indicators of skill shortages in particular fields.

Relevant indicators are also shown under other dimensions. They include:

- International mobility of human capital (Innovation and entrepreneurship).
- International mobility of students (Innovation and entrepreneurship).
- Federal government financial support for science and innovation (Innovation and entrepreneurship).
- Use of ICT by children at school (ICT).
- Use of ICT by teachers (ICT).
- Use of ICT for an education purpose (ICT).
- Relative earnings of employees by level of educational attainment (Economic and social impacts).
- Unemployment rates and duration by level of educational attainment (Economic and social impacts).

INFORMATION AND COMMUNICATIONS TECHNOLOGY DIMENSION

Possible indicators for this dimension are:

Characteristic:	Indicators:
ICT infrastructure and access	• Internet services: number of Internet Service Providers, POPs and access lines by broad region • Number of Internet hosts (computers connected to the Internet) per capita • Broadband penetration rates (number of DSL and cable modem lines) per capita • Proportion of subscribers with broadband access (DSL and cable modem) • The price of Internet access and use, compared to other countries • Proportion of households reporting particular barriers to access to computers and the Internet • Access to the Internet via public libraries, proportion of individuals accessing the Internet • Public libraries offering technology facilities • Number of telecommunication access paths (total fixed access lines and mobile subscribers) per capita • Household expenditure on ICT goods and services
Household and individual use of ICT	• Proportion of households with access to a computer by type of household, income, broad region (metropolitan/non-metropolitan) • Proportion of households with access to a mobile phone by type of household, income, broad region (metropolitan/non-metropolitan) • Proportion of households with access to the Internet by type of household, income, broad region (metropolitan/non-metropolitan) • Number of household ISP subscribers by broad region • Volume of data downloaded by household ISP subscribers • Proportion of individuals accessing a computer by age, sex, occupation, level of education and broad region • Proportion of individuals accessing the Internet by age, sex, occupation, level of education and broad region • Proportion of individuals using the Internet for particular activities and purposes, including accessing government services • Proportion of children using a computer or the Internet at school, by age, sex and broad region • Proportion of teachers using a computer or the Internet, by age, sex and broad region

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INFORMATION AND COMMUNICATIONS TECHNOLOGY DIMENSION — continued

Characteristic:	Indicators:
Business and government use of ICT	• Proportion of businesses and farms with computers, web sites, Internet access, by business/farm size • Proportion of businesses with Internet access, by broad industry group • Barriers to Internet use by businesses • Number of non-household (includes business and government) ISP subscribers • Government expenditure on ICT, as a proportion of total expenditure, by government type • Business expenditure on ICT
Prevalence of electronic commerce	• Proportion of businesses purchasing or selling via the Internet, by broad industry group • Proportion of business income attributable to selling goods or services over the Internet, by business size • Business perceptions of the impact of Internet selling on the business • Business perceptions of the benefits of Internet purchasing to the business • Proportion of individuals using the Internet to purchase goods and services, by value of purchases • Barriers to Internet purchasing by individuals • Number of secure web servers (those encrypted for the security of on-line transactions) per capita
ICT skill base	• ICT workers as a changing proportion of the labour force • Lack of skills as a constraint to business and individual use of computers and the Internet
Strength of the ICT industry	• ICT sector revenue by broad industry group • ICT sector proportion of total business value added • ICT sector proportion of total business employment • R&D performed by the ICT sector as a proportion of total business R&D • R&D expenditure on ICT, by sector. • ICT patents, proportion of total resident patent applications • Capital expenditure by the ICT sector as a proportion of total business capital expenditure • Production of ICT goods and services by broad commodity group • Trade in ICT goods and services by broad commodity group

INFORMATION AND COMMUNICATIONS TECHNOLOGY DIMENSION — continued

Apparent gaps in available statistics for this dimension include:

- Limited data available on business ICT expenditure, including software
- Lack of data on use of ICT and electronic services offered by government organisations
- Lack of data on ICT expenditure and use by the education sector
- Insufficient data on ICT skill levels and shortages
- Lack of data on networks other than the Internet.

Relevant indicators are also shown under other dimensions. They include:

- Various indicators on education standards and expenditure (Human capital).

ECONOMIC AND SOCIAL IMPACTS DIMENSION

Possible indicators for this dimension are:

Characteristic:	Indicators:
Economic and structural change:	• GDP per capita
	• Labour productivity
	• Multifactor productivity
	• Correlation between ICT use and financial performance at firm level
	• Contribution of technology- and knowledge-intensive industries to Gross Value added (GVA)
	• Contribution of high technology imports and exports to total trade
	• Contribution of trade in business services to total trade
	• Exports of education and training services
Social change	• Relative earnings of employees by level of educational attainment
	• Relative earnings of the self-employed by level of educational attainment
	• Unemployment rates and duration of unemployment by highest level of educational attainment
	• Changes in patterns of work: teleworking trends among Australian workers

As discussed in chapter 4, the indicators chosen are those measures of economic and social progress that some commentators have suggested should be impacted to some extent by a KBE/S. However, because of the difficulty in establishing 'cause and effect' relationships, and because factors other than a KBE/S impact upon broader economic measures, the choice of these indicators is not straightforward. This is an area where the ABS would particularly welcome comment.

ECONOMIC AND SOCIAL IMPACTS DIMENSION — *continued*

Apparent gaps in available statistics for this dimension include:

- Information on the link between knowledge and firm performance (though note that a number of countries are addressing this gap through data matching exercises and longitudinal studies). An indicator arising from current Australian work in relation to ICT is proposed for inclusion in this framework
- Direct information on the social impacts (for example the impact of ICT).

Note: Indicators of the so-called *digital divide* (or *digital opportunity*) can be found in the ICT dimension. The digital divide refers to inequality in access to ICT, especially the Internet. Important digital divide indicators are household and individual use of ICTs (and barriers to use) by socio-demographic and region characteristics. It has been argued that households and individuals without access to ICTs will become increasingly marginalised as ICTs, especially the Internet, are used instead of (or more effectively than) other means of communicating and conducting transactions (see Lee *et al.* (2002) for a more in-depth discussion on this topic).

CHAPTER 6 CONSULTATION AND FURTHER WORK

CONSULTATION

The release of this Discussion Paper is intended to stimulate discussion and provoke feedback about the proposed KBE/S framework and statistical indicators. Readers are invited to provide comment on the theoretical or empirical basis of the framework, the dimensions and characteristics chosen, and the range of indicators outlined. Please note that the number of indicators in the proposed framework is deliberately large. It is unlikely that the ABS would attempt to publish information in respect of all the indicators presented, therefore users are asked to suggest which indicators are the most important.

The gaps highlighted in the list of indicators are areas to be considered for further work. Developing statistics for entrepreneurship and innovation could be an initial approach to improving indicators for the KBE/S framework. However, users have also identified new statistics regarding knowledge in ICT, education and science as subjects to be considered. Suggestions regarding the subject matter priority of possible new statistics are encouraged.

Please provide comments to

Tony Weir, New Economy National Statistical Centre (email <tony.weir@abs.gov.au>; phone 02 6252 6709; mail: Locked Bag 10, Belconnen ACT 2616).

Further releases on the framework

ABS will release an updated version of the framework following the consultation and feedback process.

Receiving updates

Readers who are interested in receiving information on ABS work in this field are invited to subscribe to the free *Science and Technology Statistics Update*. This newsletter is emailed twice a year and provides updates on many aspects of Science and Technology Statistics including the KBE/S project and statistics on: Information Technology Use & Production, Research & Experimental Development, Innovation and Biotechnology. If you would like to receive the *Update* please visit the Science and Innovation Theme Page on the ABS web site (accessed via <http://www.abs.gov.au> — select 'Themes' from the home page menu).

INFORMATION ABOUT DATA SOURCES

The Web version of this paper contains links to information about each of the indicators shown in Chapter 5. The links will include a range of information such as:

- Organisation responsible for the collection (or publication)
- Description of the collection or publication
- Data details including classifications and output items
- Collection or publication frequency and history
- Geographic coverage.

The Web version is available on the ABS web site <http://www.abs.gov.au>.

DATA DISSEMINATION POSSIBILITIES

There are a number of alternative dissemination options. The final dissemination strategy that is chosen may combine more than one of the components described below. For example, updates of indicators could be produced each quarter, six months or year, supplemented with occasional releases on particular aspects of the framework. The ABS would be interested in user views on possible approaches.

Compendium publications

One way to present measures of the KBE/S is in a compendium of statistical indicators. This approach has to date been attempted by the OECD as a whole (OECD 2001d) and by a small number of OECD countries, including the United Kingdom and the USA (Department of Trade and Industry 1999, Massachusetts Technology Collaborative 1999). Godin (1996) concluded that 'if science and technology indicators were brought together in a single document, this would serve to give the indicators greater visibility and ensure better use was made of them by those concerned.' A compendium could take many forms. For instance, it could be a smaller work consisting of a subset of indicators and little commentary or it could be a more significant body of work, with a larger set of indicators and accompanied by commentary and analysis such as that by the Australian Department of Industry Tourism and Resources(2002). The first approach has the advantage that it could be produced more frequently (possibly even quarterly) and would be relatively timely. The second approach would be less frequent and timely, but contain more information. Such a publication could be released by the ABS only occasionally, if at all.

Thematic publications

Separate publications could be produced for dimensions or sets of characteristics within the framework. This would allow a more extensive treatment of those components of the framework than a compendium approach. Given that such releases would not cover the whole framework, it is likely that this approach would be used in conjunction with a regular compendium release of some kind.

Means of release

Information may be released as hardcopy publications or as electronic releases on the ABS web site. There are advantages and disadvantages of each.

RELATED ABS WORK

Measuring Australia's Progress

The ABS published the first edition of *Measuring Australia's Progress,* (cat. no. 1370.0) in April 2002. *Measuring Australia's Progress* (MAP) presents a set of indicators depicting economic, social and environmental aspects of national progress (including the importance of knowledge and innovation to progress).

The first issue of MAP is described as 'experimental' and the ABS will be undertaking consultation with users on the publication. It is expected that MAP will be updated periodically. For more information, contact Jon Hall (Analysis Branch, email <jon.hall@abs.gov.au>).

ICT and firm level performance

The ABS is collaborating with the Productivity Commission and the Department of Industry, Tourism and Resources on a project to systematically analyse the relationship in Australia between the use of ICTs and performance at the firm level. The project is part of an international effort being coordinated by the OECD. A report from the OECD work is expected in early 2003. For further information, contact Sheridan Roberts (New Economy National Statistical Centre, email <sheridan.roberts@abs.gov.au>).

Science and technology statistics

The ABS makes available a range of data in the following areas:

- research and experimental development — human resources and expenditure devoted to R&D;
- human resources dedicated to science and technology;
- information and communication technology: use and production; and,
- innovation (1996–97 data).

For more information, contact Sheridan Roberts (New Economy National Statistical Centre, email <sheridan.roberts@abs.gov.au>).

ICT satellite account

The ABS is currently scoping an ICT satellite account. Such an account would provide consistent monetary information on both the demand and supply of ICT within the context of a 'whole of economy' supply use framework. This would allow better measurement of the impact of ICT on the economy. For more information, contact Tony Johnson (National Accounts National Statistical Centre, email <tony.johnson@abs.gov.au>).

Social statistics frameworks

ABS released the first edition of *Measuring Wellbeing: Frameworks for Australian Social Statistics* (cat. no. 4160.0), in October 2001. This publication presents a system of social statistics and discusses conceptual frameworks for each of the nine main areas of concern which comprise ABS social statistics.

Education and training statistics

An Information Paper *Measuring learning in Australia: A framework for education and training statistics* is due for release in September 2002. For more information, contact Jenny Dean (National Centre for Education and Training Statistics, email <jenny.dean@abs.gov.au>).

Education and Training Indicators, Australia (cat. no. 4230.0) is a new publication due for release in late November 2002. It will present summary statistics and commentary covering the spectrum of education and training activities in Australia. A wide range of both ABS and non-ABS statistics are used, including data from the National Centre for Vocational Education Research and the Department of Education, Science and Training, covering schools, higher education and vocational education and training. Many of the indicators listed under the human capital and context dimensions in this discussion paper will be included within the Education and Training Indicators publication. For more information, contact Kirsty Leslie (National Centre for Education and Training Statistics, email <kirsty.leslie@abs.gov.au>).

Social capital

ABS work on social capital includes:

- understanding the key social issues and policy questions that might benefit from information on social capital;
- assessing the suitability of current ABS and other data and survey collections for obtaining information on social capital;
- identifying important information gaps on social capital;
- developing a framework for social capital statistics; and
- progressively developing indicators for the elements identified in the framework.

For more information, contact Joanne Hillermann (Family and Community Statistics Section, email <joanne.hillermann@abs.gov.au>).

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