



Australian Government

Knowledge Intensive Service Activities

in the

Mining Technology Services Industry in Australia

A report prepared for the OECD KISA project

This report has been prepared by the Australian Government, using research conducted by Dr Lyndal Thorburn of Innovation Dynamics Pty Ltd.

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ABBREVIATIONS

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
CRC	Co-operative Research Centre
DITR	Department of Industry, Tourism and Resources
GDP	Gross domestic product
ICT	Information and communications technology
KIS	Knowledge intensive service
KISA	Knowledge intensive service activity
KIBS	Knowledge intensive business service
MNC	Multinational corporation
MTS	Mining technology services
R&D	Research and development
RTO	Research and technology organisation
SMEs	Small and medium enterprises

Summary

Note: all currency in this paper is expressed in Australian dollars. At time of writing, AU\$1 was equal to approximately US\$0.75.

This paper explores the knowledge intensive service activities (KISA) which firms in the Australian mining technology services (MTS) industry use in the process of innovation. It is part of an OECD project which is studying the role of KISA in the innovation systems of different industries. It looks at how mining technology services firms' make choices about providers of innovation expertise, and how firms combine and internalise the knowledge-intensive services used in order to develop innovation capability.

The study consists of an overview from secondary sources of the industry and six case studies of individual businesses. The study has significant limitations. The case study firms are not representative of the industry, as they were selected partly on the basis that they were innovative. Nevertheless the analysis provides valuable information for understanding the role of KISA in terms of innovation in mining technology services.

The MTS industry includes firms providing technology based services to the mining industry (which excludes petroleum). In Australia, it comprises about 500 firms, some of which could define themselves in terms of their activity as, for example, information and communications technology. The biggest sectors of the industry are Exploration and other mining services and Scientific, electronic and other machinery and equipment. Technical services also employs a significant proportion of the work force.

The economic importance of MTS is greater than its turnover figures suggest because of its contribution to the productivity of the mining industry, which (on 2001-02 figures) constitutes 29 per cent of Australia's total exports of goods and services. Its revenue is approximately \$3 billion a year, of which about 20 per cent is export sales. Like other Australian high technology industries the MTS industry is dominated by small firms: half of the businesses have revenue of less than \$500 000 a year; and half employ five or fewer people. Its work force is predominantly university educated, in science, engineering and/or technology.

Government policies identified by industry leaders as most important to the industry are those related to higher education, and those dealing with public sector research, including the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Cooperative Research Centres (CRC) program. In addition, firms in the industry have access to tax concessions for research and development, and to the Government's industry and innovation programs, which focus on assisting small and medium enterprises to become established and to commercialise new technology.

In 2001 the Australian Government announced an industry Action Agenda for the MTS industry. An Action Agenda provides a collaborative framework for the industry to set out a strategy for the future. The Action Agenda has identified strengths, opportunities and weaknesses and ways of addressing them, and, most importantly, has promoted dialogue and begun to overcome the fragmentation which was identified as an important problem of the industry.

All of the case study firms were selected because of their undertaking innovative activities. They saw their competitive position as dependent on continuously improving their products in response to changes in technology and customer needs.

All believed that the deep technical knowledge and the problem solving ability of the people who worked for them were their main comparative advantage. Many had developed new products such as packaged software based on solving problems within the firm or for a particular customer.

The firms spent only a few per cent of turnover on external services. They most commonly outsourced legal, accounting and financial services, and capital raising and information technology networking. When they outsourced services, they did so either because they were too small to hold the expertise within the firm, or for compliance reasons. They did not identify any difficulty with access to external services, but it is possible that one reason for little outsourcing is that many are located away from major cities.

The firms used personal networks of managers and of technical staff to find the services they need and to help them to internalise the expertise they embodied. Most networks were at a national level, even exporting being conducted largely through partnerships with Australian customers.

The survey indicated good access to public R&D, but the case study firms had few links with R&D institutions, in some cases seeing them as competitors. The firms do much R&D in-house, especially in relation to the development of existing technologies.

Firms built their innovation knowledge capabilities largely by working with their customers. Some had formal feedback mechanisms, but all valued the collaborative problem solving activity. Occasionally they identified wider markets for software or skills which they had developed to solve a particular problem and packaged them for wider sale.

In conclusion, the MTS sector is innovative in terms of both new products and new ways of doing things, and forward looking. It does suffer from fragmentation [need more about this – first time mentioned], which the Action Agenda and subsequent work is addressing. It relies heavily on public education and research for its knowledge intensive activities. Future expansion is likely to be in exports, and for this collaboration and branding as a sector may be even more important.

1 Introduction

1.1 *Innovation and the Importance of KISA*

Early research on innovation systems focused on the role of a nation's institutions in creating a climate for innovation, and on detailed study of conditions such as access to finance, technology transfer and the commercialisation of publicly funded academic science. One theme was how all of those factors contributed to building capabilities at the firm level.

As knowledge of innovation systems broadened and deepened, the importance of access to a number of services became apparent. There have been a number of studies of knowledge intensive business services or KIBS (see for example Webb [2002]).

In 2002, the OECD launched a set of case studies in innovation. The study was initiated to examine what was occurring at the level of the industry sector compared to the national innovation system level of analysis. Two of the OECD studies are sector based – energy and pharmaceutical biotechnology – and the third focuses at the firm level – that is, what firms do with the inputs of knowledge intensive services, and firm knowledge intensive service activities (KISA). In particular, the current study is examining how firms use these services to supplement their competitive advantage in their industry, how they use them to build capabilities, how they incorporate them to create a dynamic of continuous innovation, and how they use them to increase their absorptive capacity for further new ideas. Central to discussion of knowledge intensive service activities are the questions of what causes a firm to develop knowledge internally versus getting it from outside, and how the firm manages knowledge once it has acquired it.

This paper, based on work by Dr Lyndal Thorburn of Innovation Dynamics Pty Ltd, presents six case studies and analyses them according to two separate classifications to explore how firms use knowledge intensive services to manage change (Thorburn 2005). The first is a classification of services. The second is a classification of kinds of innovation.

For purposes of innovation, not all knowledge intensive services work in the same way. Some services are routine, like accounting. They are essential to successful implementation of innovation, but are not drivers of further innovation activities. A simple purchase of a service from an established provider, or application of skills learned in an established, accredited course may be all that is required. Some services are engaged in for 'compliance', but can be a vehicle for bringing in important new knowledge. For example, advice on a specific issue of intellectual property protection might change the whole way a firm looks at its new ideas and values its routines. Some services are 'tailored' to the firm, and may be the source of new ideas about products or about implementation. A design service which suggests certain features for one product could lead to a new way of appraising all products.

There are many kinds of innovation. The innovation most studied in the literature is the development of new goods and services; but new methods of management – procedural, personnel related, and structural – are just as important in ensuring a firm's competitiveness and building a lasting culture of innovation (Koberg *et al* 2003).

The importance of organisational innovation and change has been recognised in the analysis of innovations. The Oslo Manual (OECD 2005), for example, views innovation in terms of the interaction between market opportunities and the firm's knowledge base and capabilities. It recognises the role of organisational innovation in terms both of increasing output by its direct effect (p 37) and of facilitating and being part of technological product and process innovation (p 31-2). Organisational factors are particularly important here in the KISA study because the project is, at least in part, about building firm – and system – capabilities. That is, it is not concerned just with analysing how current innovations take place. Its emphasis is on how KISA contribute to building the capacity for future innovation.

1.2 The Mining Technology Services Study

The first element of the study of the MTS industry is an overview from secondary sources. General data on the industry are presented in Chapter 2 of this report. A description of government programs and policies directed to the sector makes up Chapter 3. Case studies of six MTS firms were used to explore KISA and innovation at the firm level. They are reported in chapter 4. Finally, in Chapter 5 some conclusions are drawn about the role of KISA in innovation in the MTS industry.

There are limitations to the analysis presented in this report. The number of case studies is very small, and companies were chosen because of their innovativeness and are not representative of the whole industry; so it is not possible to draw conclusions about innovation across the MTS industry as a whole. Nevertheless the analysis of the firms participating in the study provides useful information for understanding the role of KISA in Australian MTS firms.

Australia's mining technology services industry is important to the Australian economy as an industry in its own right as well as for its contribution to the mining industry. MTS is an emerging technology based industry. It is currently seen as a global leader in several specialist areas, such as software applications for the mining and minerals industries.

Innovation in Australia's MTS industry supports the productivity and international competitiveness of the Australian minerals industry. Its function is to maximise returns from mineral exploration, extraction and processing. Indeed, much of the increase in minerals industry productivity over the past 20 years can be directly attributed to the implementation of MTS innovation. The importance of this to the Australian economy is indicated by the fact that in 2001-02 Australia's mineral resource exports (excluding petroleum) represented 29 per cent of Australia's total exports of goods and services (ABARE 2002).

While the MTS industry has not been much recognised or discussed as an industry, it is of vital importance that the innovation system within the industry works well. Important aspects of this are the extent to which knowledge intensive services are available to it, and how it builds capacity by engaging in knowledge intensive service activities.

2 Mining Technology Services in Australia

The analysis presented here is drawn largely from a study by the Australian Bureau of Agricultural and Resource Economics (ABARE) which was commissioned by the Australian Department of Industry Tourism and Resources to support the Mining Technology Services Action Agenda (ABARE 2002). The Action Agenda is discussed in Chapter 3 of this report. Figures are for the financial year 2000-01 except where otherwise stated.

2.1 Defining the industry

For the purposes of this study, the mining technology services sector comprises technology based firms that service the mining industry. MTS includes products that may be based on information and communications technologies, products that incorporate other scientific, technical or engineering based technologies, and services that provide expertise within these technology areas on a fee or contract basis.

The MTS does not include regular business services such as accounting and legal advice, nor maintenance services like accommodation and catering, nor heavy plant and equipment; and the mining industry which these firms service includes mineral exploration, production and basic processing activities, but excludes those functions connected with the petroleum industry.

The large number of firms and the variety of activities have produced a fragmented sector, one where firms often do not identify their common interests and which does not speak as an entity in communicating with government or with customers. (MTSAA 2003). There is little statistical material available for the industry as a coherent whole. It is important to note that the activities within MTS arise from other industries such as information and communications technologies and engineering. There had been little regular data collection on the sector as an entity before the ABARE survey in 2002.

2.2 Overview of the industry

The MTS sector in Australia comprises over 500 companies and 10 or more are public research organisations. A number of firms which provide technology services to the mining industry identify themselves first by their activity, for example information and communications technology, so it is difficult to be precise about the size of the sector.

The main customers for the firms are the major Australian-headquartered mining firms, which have operations world-wide, and the so-called junior firms which are exploring and developing smaller deposits, mostly in Australia. Like many service firms, MTS firms rely strongly on word-of-mouth for expansion of the customer base. They tend to be located in the major mining states of Queensland, Western Australia, and to a lesser extent New South Wales. Most mining firms are headquartered in the major cities of Melbourne, Perth and Brisbane, but their operational sites are sometimes located in very remote areas of Australia and overseas – particularly in emerging mining operations in Africa, Eastern Europe and Asia. Thus MTS firms are more likely than businesses in other industries to be located in regional and remote areas, close to their main customers, the explorers and miners, and/or to have a capacity to travel to remote areas.

2.2.1 Activities

The ABARE survey identifies six categories of activity in the MTS industry:

1. exploration and mining services: for example total exploration management, prospect exploration, supply of registered mine surveyors on contract, co-ordination of exploration and drilling data
2. scientific, electronic and other machinery and equipment: for example electronic drill guidance systems for surface and underground drilling applications, vertical multistage borehole pumps (this category was included in the ABARE survey but is excluded from much discussion of the sector and from the case studies that follow)
3. construction services: for example construction management, surveys of the layout of critical machinery, alignment surveys for conveyors, commercial explosives and blasting systems
4. scientific research services: for example increasing recovery rates of valuable metals and decreasing levels of impurities, decreasing the environmental impact of base metal production, management of sulfidic wastes, flotation research
5. technical services: for example geotechnical modelling for stress analysis, seismicity, pillar closure and backfill exposures, geochemical and metallurgical laboratory analysis of samples from ore deposits, design of measurement and data collection processes for survey design.
6. computer services: for example data processing and analysis software for geochemical and environmental applications, system design for the acquisition of field data using remote telemetry, multimedia based training programs for the mining industry.

Table 1: The MTS industry by type of business 2000-01

	Sales \$m	Exports \$m	Employment person years
Exploration and other mining services	1 140	6	3 460
Scientific, electronic & other machinery & equipment	1 120	338	5 480
Construction services	44	38	59
Scientific research services	208	80	2 890
Technical services	456	84	4 440
Computer services	150	64	1 000

Source: ABARE (2002)

Of these activities, the first two categories are by far the biggest in terms of revenue, each accounting for more than one-third of the revenue of the industry. Technical services is also a big employer. And it is said that over 60 percent of the world's mining operations now utilise software developed by Australian companies (MTSAA 2002). For the purposes of the KISA study, firms producing heavy machinery and equipment for the mining industry were omitted from the case studies.

2.2.2 Production and exports

The gross sales revenue of the MTS industry in 2000-01 was over \$3.1 billion. Of this, approximately 80 per cent was sales direct to exploration or mining companies; and the remainder was sales to contractors or to the trade. Exports sales were about 20 per cent of the gross sales revenue.

Table 2: Estimated gross sales revenue and exports of Australian MTS production

	Gross sales revenue	Export sales revenue

	\$m	\$m
1995-96	1 240	467
2000-01	3 120	611
2001-02 e	3 740	713
2005-06 e	5 600	1900

e estimate by firms surveyed

Source: ABARE (2002)

Table 2 provides sector estimates for gross sales revenue and for exports for the stated financial years. From 1995-96 to 2000-01, total revenues increased from \$1240 million to \$3120 million, which translates to an annual growth rate of 20 per cent. For the five year period from 2000-01 to 2005-06, the forecast increase was from \$3120 million to \$5600 million, which translates to an annual growth rate of 13 per cent. Exports grew at an annual rate of 6 per cent from 1995-96 to 2000-01, and were projected to grow at 25 per cent a year from 2000-01. Thus while the growth rate of the sector as a whole is expected to decrease (while remaining high), the growth rate of exports is expected to increase.

2.2.3 The firms in the industry

Like other Australian high technology industries, the MTS industry is dominated by small firms¹. In terms of sales, 20 per cent of businesses had less than \$100 000 a year; 30 per cent had sales between \$100 000 and \$500 000; 13 per cent had sales of over \$10 million. Small and medium firms are expected to grow faster in coming years than large firms.

Table 3: Size of business: revenue and export sales 2000-01 a

	By sales revenue %	By export sales revenue %
\$0	1.9	34.9
\$1 - \$100 000	17.8	22.0
\$100 001 - \$500 000	29.6	14.4
\$500 001 - \$1 million	11.7	12.0
\$1 000 001 - \$2 million	8.5	5.3
\$2 000 001 - \$5 million	12.2	6.2
\$5 000 001 - \$10 million	5.6	1.9
Over \$10 million	12.7	3.3
Total	100.0	100.0

a Results are percentage distribution of responses of firms surveyed

Source: ABARE (2002)

In 2000-01, about two-thirds of firms in the industry exported MTS products. This was expected to rise to three-quarters by 2005-06. There is a clustering of companies with exports under \$500 000 in 200-01, but by 2005-06 it is projected that 36 per cent will have more than \$1 million in export sales. Small and large firms are expected to increase their rates of exporting most.

The industry employed approximately 17 300 people in Australia in 2000-01. Of the firms, 53 per cent employed 5 or fewer people; another 26 per cent employed 25 or fewer. Only 1 per cent employed over 500 people. Large businesses (here defined as

¹ The Australian Bureau of Statistics generally defines firm size thus: very small firms, employing 0-4 persons; small firms, employing 5-19 persons; medium firms, employing 20-99 persons; large firms, employing 100 or more persons. Data were not available to apply these definitions, and firm size is discussed in terms of proportions of firms having particular levels of employment and turnover.

those with more than 50 employees) employed 11 500 people, or two-thirds of the work force.

Although no formal research into MTS sector educational requirements has been conducted, anecdotal evidence suggests that the majority of employees in the sector have university-based science, engineering and technology qualifications (MTSAA 2002a). This is often complemented by 5-10 years experience in the mining industry. As a result, the MTS sector is reliant not only on a steady supply of graduates from universities but also on the level of graduate awareness about the sector and its professional development requirements.

All three discipline areas are necessary for innovation in the sector: science in the new discovery, technology in the process and machinery to put it into production, and engineering in the design work that makes it happen. As such, access to a pool of university trained science, engineering and technology graduates is essential to the sustainability of the industry.

Table 4: Size of business: employment a

Employment	% of firms
1 – 5 people	53.1
6 – 10 people	10.0
11 – 25 people	15.8
25 – 50 people	7.7
51 – 100 people	4.3
> 100 people	9.1
Total	100.0

a Results are percentage distribution of responses of firms surveyed
Source: Adapted from ABARE (2002)

The most important occupations in the industry are engineers (including metallurgists), geologists and other earth scientists, and managers and administrators. In terms of area of activity, science electronic and other machinery and equipment was the biggest employer, followed by technical services and exploration and other mining services.

2.2.4 Research and development

Firms in the MTS industry on average spent 12 per cent of their sales revenue on research and development, according to the ABARE survey. Consistent with the large proportion of small companies in the industry, 41 per cent of companies did not spend funds on R&D. Nearly 16 per cent spent over \$500 000. Medium sized enterprises (those employing 11 to 50 staff) spent 43 per cent of sales revenue on R&D. Over 60 per cent of all firms did not engage in R&D collaborations. Of the 40 per cent who did engage in collaboration, their most important collaborators were exploration and mining companies, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and universities.

The ABARE survey indicated that collaboration with exploration and mining companies, the primary buyers of MTS products, is considered by the industry to be of great importance. Key in the facilitation of collaboration between the MTS sector and the mining industry is AMIRA International, an industry association which manages collaborative research for members by taking a partnership approach to research and development. AMIRA operates by developing and managing jointly funded research projects on a fee-for-service basis on behalf of members. Currently,

AMIRA is managing 60 projects attracting some \$40-45 million of industry funds. New funding of approximately \$10-13 million is received each year.

2.2.5 Intellectual property

The MTS industry includes many small and medium enterprises producing both incremental innovation and collaborative research. Intellectual property protection can work not only as protection but also to signal expertise and attract investment. The ABARE survey found that most firms relied on secrecy, keeping ahead of the game, and quality of service to protect their competitive edge. Sixty per cent of firms thought that patents were of little or no importance.

3 Government Policies and Programs for the Industry

3.1 Seeing mining technology services as an industry

It is easy *not* to think of mining technology services as a coherent entity. The 500 or so firms involved are engaged in a great variety of activities, from scientific research to construction. There are vastly different organisations, with a large number of tiny businesses and some companies that are large by Australian standards. Some are entirely concentrated on mining technology; others serve other markets as well. They are geographically dispersed, which adds to the difficulty of seeing them as a unit.

Perhaps most importantly, as an industry it is characterised by its demand side, rather than by what it produces. That is, what makes it an industry is that the firms in it produce services for the mining industry. The services themselves could be classified in other ways: the software industry, contract research, and construction. In analysing and predicting the economic fortunes of the industry it is important to note that the customer, the mining industry, is responsive to the cycles of world wide economic growth.

Defining the industry in terms of demand also influences the factors that will be important to the industry as an entity. When an industry is focused on supplying a given set of customers, cluster effects, supply chain issues, synergies in design, and the profile or branding of the industry will be important. When an industry is focused on producing a certain set of goods from a certain set of inputs, it is more likely to be concerned with, say, regulatory issues or access to raw materials. The possibility of transferring technology developed for mining into other sectors is also something which requires more exploration, as the Action Agenda suggested that it does not happen as much as it could; but if it did, it might affect the definition of the industry.

3.2 The Mining Technology Services Action Agenda

The Australian Government announced an Action Agenda for the industry in 2001, noting:

- the importance of the mining technology services industry to Australian mining,
- the special issues created by the industry's complex interaction with the mining industry, and
- its growing importance as an industry and an exporter in its own right,

An Industry Action Agenda is a whole-of-Government initiative to provide a collaborative framework within which government and the industry can develop initiatives to address market impediments and allow industry to fulfil its potential.

The Action Agenda provides a framework within which MTS companies can work with governments, research agencies, educational bodies and the minerals industry more broadly to develop, and implement, a vision for a sustainable and internationally competitive Australian MTS sector over the coming decade and beyond.

Among the issues identified as central to a strategy for growth by the Action Agenda were:

- access to R&D services and commercialisation mechanisms
- access to venture capital, and building awareness about investment capital in the industry

- the need to use electronic commerce in response to globalisation
- the need to maintain the supply of specialist staff
- awareness and understanding of intellectual property

It is noted that each of these concerns involves some element of knowledge intensive service activities.

The Government endorsed the Action Agenda report - MTSAA Strategic Leaders Group (SLG) report *Mining Technology Services: Australia Leading the World* - on 12 May 2003. The report was the culmination of extensive consultations with all stakeholders, including relevant Commonwealth agencies, the States and Territories and the mining technology services sector.

There have already been achievements as a result of the Action Agenda. Workshops have been conducted on intellectual property services (provided by IP Australia) and on technology diffusion (provided by the Commonwealth Scientific and Industrial Research Organisation). There have been moves to improve the profile of the industry with students through a series of Minerals Council of Australia initiatives. Access to the APEC business card facilitates entry to a number of countries which are export markets for the industry, and entry for skilled migrants intending to work in the industry has been made easier. In addition, there is now a generally more vigorous dialogue within the industry.

3.3 Government programs

Australia's industry policy is relatively non-interventionist and rests first and foremost on providing general economic settings which foster efficiency. Recent policy has emphasised innovation as the basis for continuing competitive advantage, including a focus on commercialisation of Australian research.

In addition to the impetus and services provided by the Action Agenda process, firms in the MTS industry have access to the range of industry programs offered by the Department of Industry, Tourism and Resources. Many are tailored to small and medium enterprises, recognising that SMEs are important for the commercialisation of new ideas in MTS, and that significant risks are involved. SMEs in the industry generally need assistance in building management skills and funding R&D in their early stages; they also need patient early stage capital, access to markets, and access to government and big business contracts.

The programs that can provide services to the industry are:

- The **Small Business Assistance Program** is a competitive grants program made up of three components: Small Business Incubators, Small Business Enterprise Culture and Small Business Answers. These initiatives are available to fund projects that help small businesses grow and develop.
- **Commercial Ready** is a competitive merit-based program offering industry a single entry point to grants for early stage commercialisation activities, R&D with high commercial potential, and proof-of-concept activities.
- **Commercialising Emerging Technologies (COMET)** is a grants program that targets management skills of businesses and individuals to increase the commercialisation of innovative products, processes and services (COMET is particularly relevant to KISA and is discussed further in later sections of this report.)

- The **Pooled Development Fund (PDF) Program** is designed to increase the supply of equity capital for growing Australian small and medium-sized enterprises (SMEs). PDFs raise capital from investors and use it to invest in Australian companies.
- The **Innovation Investment Fund (IIF) Program** is designed to promote the commercialisation of Australian R&D, through the provision of venture capital to small, high-tech companies at the seed, start up or early expansion stages of their development.
- **Industry Techlink** gives companies looking for technology solutions access to technology consultants who can help them diagnose their problem and provide a suggested way forward.
- **Invest Australia**, in the course of attracting direct foreign investment, builds capacity by creating leading edge customers for the industry.

A number of programs aim to assist the Information and Communications (ICT) sector, which is an important component of MTS. These include The **ICT Incubator Program** which aims to improve the rate of commercialisation of ICT ideas and R&D by establishing incubators to increase the success rate of new business information in the Australian ICT sector. The incubators have varied business models, but all incorporate a structured business growth program which includes access to early stage finance, access to a management team and advisory panels, coaching and mentoring, and channels to markets and to international partnerships.

The **InnovationXchange**, which is a joint effort between government and industry, is a web based data exchange between business, government and research organisations designed to provide a trusted intermediary to assist businesses, especially SMEs, to gain access to new technologies, research and patents, education and training, financial and business services, government programs and networks.

State Governments provide a variety of programs to assist SMEs. Most States are involved with the Australian Government in the co-operative **Australian Technology Showcase** program, which is designed to promote innovative Australian technologies nationally and internationally, and to attract foreign and local capital for technology development and commercialisation. Most also have a range of **business mentoring and advice** services, and subsidies designed to **attract high technology businesses**.

It is difficult to know to what extent MTS firms take advantage of government programs, because of the way the industry crosses over a number of conventionally defined sectors.

Skills development is provided by Australia's system of universities and Vocational Education and Training colleges. Traditionally they had offered degree and diploma courses, but there is now pressure for more flexible courses, often directed to specific competences, and for more involvement of industry in curriculum development. The Resources and Infrastructure Industry Skills Council (and before it the National Mining Industry Training Advisory Board) provides the mining and extractive industry with a vocational education and training program. However, the ABARE survey suggested that the Industry Training Advisory Board was not much used by the MTS industry. Only a quarter of respondents had heard of it, and only 4 per cent had used its program – though 24 per cent said they would consider using it in future. Sixty-two per cent believed there was a role for industry sponsorship of courses.

The continued productivity of R&D and the maintenance of links between research institutions and industry are crucial to the continued growth and export competitiveness of the industry. The Government's main generic program to stimulate private sector investment in R&D is the R&D tax concession which enables companies to deduct up to 125 per cent of R&D expenditures from taxable income. There is also a 175% Premium Tax Concession and a Tax Offset. The new Commercial Ready program, which commenced on 1 October 2004, will provide competitive matched grants for R&D, proof of concept and early stage commercialisation.

Collaboration with Government funded research organisations on targeted projects and access to the pre-competitive research that they conduct provides the industry with an attractive mechanism to increase leverage on R&D investments by sharing costs with Government (MTSAA 2002b). The Commonwealth Scientific and Industry Research Organisation (CSIRO) is a large integrated research body that includes MTS in its portfolio of strategic, collaborative and contract research aimed at enhancing the competitive advantage of the mineral resources sector in the global market place. According to the ABARE survey, MTS companies rate the CSIRO as the most important provider of collaborative research and development projects. The scope of R&D undertaken by CSIRO spans the range of MTS sector products from exploration through to extraction, processing, energy conservation, mine site rehabilitation and safety.

The CSIRO is also closely linked with other research organisations including (but not limited to) the Julius Kruttschnitt Mineral Research Centre, the Ian Wark Institute and the Australian Nuclear Science and Technology Organisation, University of New South Wales and the Western Australian School of Mines. All these organisations contribute significantly to the research capability of the mining related Cooperative Research Centres (CRCs) and form alliances with MTS companies, universities and with other research organisations.

The CRC program, a mechanism for collaborative research between industry and the public sector has also provided an excellent platform for MTS research. Many companies prefer to conduct their collaborative research through a CRC due to the increased funding that they receive on their research dollar through Government's contribution to funding these centres. There are eight mining related CRCs: Mining; Predictive Mineral Discovery; Clean Power from Lignite; Coal in Sustainable Development; Hydrometallurgy; Landscape Environments and Mineral Exploration; Sustainable Resource Processing; and Renewable Energy.

4 Key Findings from the Case Studies

4.1 Theoretical framework

4.1.1 Innovation

Governments seeking to support and encourage innovation by firms need to have an understanding of what happens inside the firm – in particular, how the firm organises itself to obtain ideas, and put these into practice in a way that adds to its profitability. Any changes in products or processes are likely to be gradual, or incremental. A deeper understanding of how and why changes occur in innovative firms will provide a better understanding of the basis of innovation and how governments can encourage and support it.

A useful framework for the analysis of innovation in and by firms has been developed by Koberg, drawing on earlier work by Herbig:

‘... procedural (management-determined innovations in rules and procedures); personnel-related (innovations in selection and training policies, and in human resource management practices); process (new methods of production or manufacturing); and structural (modifications to equipment and facilities and new ways in which work units are structured).’ Koberg *et al.* (2003: 24), following Herbig (1994)

Koberg’s definition gives a way of looking broadly at innovation. It provides a framework for categorising those internal processes within firms that lead to the changed products or services perceived by the consumer. Koberg’s review of the differences between these two types of innovation highlights four key types of incremental innovation:

- innovations in manufacturing or production processes,
- innovations in personnel management,
- innovations in company procedures and structures, and
- innovations in equipment, facilities and work units.

While Koberg’s published model is limited to manufacturing, Thorburn and Langdale (2003) have extended it to encompass service industries. The current study has relied on this framework in the context of innovation within and by firms, but has added new considerations of the role of knowledge-intensive services in the economy.

4.1.2 Methodology

Six case studies were conducted in 2004 and 2005. Each company was interviewed using a prepared interview guide (Attachment A). This interview guide was developed following a review of the methodologies and issues covered by KISA studies in partner countries and uses some questions common to these studies. It was framed to gather data around innovative activity within the business, focusing on the generation and utilisation of knowledge, but collecting a range of information about the firms. The Australian interview guide was also structured to accommodate the particular circumstances of Australian firms and the Australian R&D support system.

Names of potential MTS firms for interview had been generated by preliminary work for the ABARE survey and the MTS Action Agenda, and were supplemented by

internet searching of firms that had won awards for export, customer and employee service as well as innovation.

The characteristics of the firms studied are summarised in Table 5.

Table 5: Characteristics of Mining Case Study Firms

Name	Location	Type of Firm	Size a	Age (Yrs)
Ausenco Limited	Queensland	Engineering and project management services	Large	13
RSG Global Pty Ltd	Western Australia	Mineral exploration and resource consulting		4
SoftRock Solutions Pty Ltd	Western Australia	Computer Services	Small	15
Runge Limited	Queensland	Technical Services and Scientific Research	Large	23
Lakefield Orestest Pty Ltd	Western Australia	Technical Services and Scientific Research	Large	11
Advitech Pty Ltd	NSW	Technical Services and Scientific Research		18

a Very small firms, employing 0-4 persons; small firms, employing 5-19 persons; medium firms, employing 20-99 persons; large firms, employing 100 or more persons.

Source: Thorburn, L.J., Sectoral Case Studies in Innovation

Despite the segmentation of the mining technologies sector in the ABARE report (ABARE 2002), the companies in the case studies delivered a very broad range of services. A number of firms sold software, either as stand alone packages or bundled with part of their services. Several firms offered a range of exploration and other mining services, often related to determining the value of the ore body so that customers can obtain bank financing for further exploration, extraction and processing.

Table 6: Coverage of Mining Technology Sub-Sectors by Case Study Firms

Name	Exploration and other Services	Construction Services	Technical and Scientific Services	Computer Services
Advitech	No	No	Yes	Yes
Ausenco	Yes	Yes	Yes	No
Lakefield Orestest	No	No	Yes	Yes
RSG Global	Yes	No	Yes	Yes
Runge	Yes	No	No	Yes
Softrock Solutions	No	No	Yes	Yes

Source: Thorburn, L.J., Sectoral Case Studies in Innovation

Because the firms offer tailored services, and many of them gain their competitive advantage from the skills of the people who work for them, they rely on staff with deep technical knowledge and who can effectively determine a solution for the customer and can deliver it in the time and for the cost specified. The case study firms are also quite opportunistic – many of those that have developed software have commercialised software first developed in house to meet internal needs.

Interviews were conducted face-to-face with the Chief Executive Officer or a member of senior management from the companies. Each interview was written up as a case study (Attachment B) and was cleared by the company prior to inclusion in this report.

4.1.3 Services dealt with in the study

Firms were asked about the following knowledge intensive services:

- Business Planning
- Legal services
- Accounting and Financial Services
- Capital Raising Services
- Technology awareness (of technologies potentially of use to the firm)
- Technology trends (interpreted as emerging technologies which may displace the firm's current framework or base technology platform)
- Formal research and development
- Market research (formal customer surveys as well as broad market analysis)
- Product development
- Project management
- Operations
- Marketing (including advertising)
- Sales
- Export strategy
- Establishing overseas offices
- Performance Benchmarking
- IT/Networking setup or operations
- Staff Recruitment
- Quality Accreditation
- Compliance with Standards
- Staff Training

Although all services in the list above are 'knowledge-intensive', the interviews identified differences in the type of service delivery. The remainder of this report uses the following definitions for the three types of service level:

- Compliance, where firms use external service providers to ensure that they comply with regulatory or taxation regimes – in Australia, this usually relates to:
 - accountants' completion of annual company tax returns and Business Activity Statements related to the Goods and Services Tax'
 - advice from lawyers regarding corporate governance and the corporations law, and
 - auditing and accreditation of quality management systems by quality consultants.
- Routine, where standardised services are purchased for routine matters – these included:
 - some types of market research (for example, purchase of reports on markets),
 - legal services (review of standard contracts),
 - sales (relationships with ITOs or resellers),
 - ICT (maintenance of computer systems and networks), and
 - accreditation (quality assessors for ISO accreditation).
- Tailored, where the service was modified to suit the needs of the client. For example:
 - tailored surveys of customers,

- design of new equipment or installations that are one-off in nature, and
- legal advice on specialised contracts.

4.2 Innovation in the firms studied

4.2.1 Kinds of innovation

Most case study firms reported that their incremental change spanned all four areas identified by Koberg et al (Table 7). However, **most firms' innovation was concentrated on enhancement of service delivery**, that is, it was based on development of new products and services and the procedures required to ensure that these were delivered effectively.

Table 7: Incremental Innovation in Mining Technology Case Studies

Name	Product/Service	Procedural	Personnel related	Structural
Advitech	Risk management software, Environmental noise services	Quality management system (ISO 9001 accredited)	All personnel trained in new products`	Computer based project assessment system.
Ausenco	New technological processes	Formal quality management system	Formal positions in health and safety, environment, business development	Internet based presentations to clients
Lakefield Orestest	Hydrometallurgical testing processes	Standardisation of testing procedures in house	Incentives for meeting budget	Online tracking of projects by clients
RSG Global	Introduction of metallurgical services	Development of induction manual and formal timesheets	Change in Divisional structure	Customers can download time limited demonstration versions of software
Runge	Range of software packages	Work to a very formal strategic planning framework	Employee share options program	Remote delivery of training programs
Softrock Solutions	Automatic slope monitoring equipment	Standardisation of information collection to build database	Appointment of training manager	Remote monitoring of mine site slopes via internet, new equipment

Source: Thorburn, L.J., Sectoral Case Studies in Innovation

4.2.2 Use of External Knowledge-Intensive Services

Use of external knowledge intensive services was limited – firms outsourced from 24 to 57 per cent of knowledge intensive services discussed during the interview (Table 8). Only a few per cent of turnover was usually spent on these services. Those of high importance ranged from 11 to 50 per cent of the services outsourced. Services that were tailored ranged from 20 to 60per cent of those outsourced.

The most commonly outsourced services included legal, accounting and financial services (largely compliance), capital raising and IT/networking. Several firms had

outsourced various aspects of business planning. Several also outsourced recruitment to some extent, although not always successfully.

Table 8: Use of External Services by Mining Case Studies

	Advitech	Ausenco	Lakefield Orestest	Softrock	RSG Global	Runge
Planning	tailored	tailored		tailored	tailored	ROUTINE
Legal	ROUTINE	routine	tailored	tailored	TAILORED	tailored
Acctg/Financial	compliance	compliance		compliance	compliance	compliance
Capital Raising		TAILORED				TAILORED
Tech Awareness						
Tech Trends				routine	ROUTINE	
Formal R&D						
Market Research		tailored				tailored
Product devt.				TAILORED	ROUTINE	
Project manag't						
Operations	tailored	tailored			TAILORED	
Marketing	routine				TAILORED	
Sales						
Export Strategy					tailored	
Establishing o/s offices		routine			routine	compliance
Benchmarking						
IT/Networking			routine		TAILORED	
Recruitment	routine	tailored	routine		routine	tailored
Accreditation	compliance		COMPLIANCE			
Standards						
Training	routine	routine	routine		routine	routine
Total outsourced	8	9	5	5	12	8
% Outsourced	38%	43%	24%	24%	57%	38%
Of those:						
% High	13%	11%	20%	20%	50%	25%
% Tailored	25%	56%	20%	60%	50%	50%

Notes: Words in CAPITALS indicate outsourcing was of high importance; words in lower case indicate outsourcing of medium importance; blanks indicate no outsourcing. N/A indicates not relevant to that firm

Source: Thorburn, L.J., Sectoral Case Studies in Innovation

4.3 Partners in KISA

4.3.1 Personal networks

The senior management in all case study firms had a significant role in identifying potential new areas for innovation and the decision to respond to new opportunities.

All CEOs relied heavily on their personal networks to assess market trends, to confirm or test the results of formal market surveys or other sources of quantitative market data and to find people to deliver services when these were not available inside the firm.

The managers of mining technology services firms had excellent personal networks and used an informal approach to seeking advice and ideas from their peers. These firms were largely reliant on national scale networks although those firms which did export also had a range of international links (often also through technical staff). In all case study firms management also drove innovation in the softer areas of innovation relating to staff development and training, company structure and upgrading of equipment.

Word of mouth was very important to all firms in order to acquire customers and to identify emerging technical trends. These networks were based around the technical staff who were expected to maintain them through attending technical and trade conferences and through review of technical literature. The networks operated mainly at the national level. Those case study firms which did export significant amounts of services also had international links. However, most firms obtained their export projects through links with major Australian miners (customers) who were operating in these regions. Board members of the MTS firms often maintained international-scale networks.

The MTS firms have relatively high proportions of tertiary-qualified technical staff. As professionals, they are expected to use their professional networks to obtain information from outside the firm. This usually related to information on technology awareness and technology trends, both of which were important to these firms in fast-moving markets.

These firms are supplying custom-made services to large firms, and it is possible that the variable nature of their service delivery, and the importance of word of mouth referrals, plays a larger role than in other industries. In order to communicate with customers and to benefit from such referrals, the firms tend to locate near their customers; then this co-location in turn increases the possibility of communication and its importance.

4.3.2 Role of R&D institutions

Links with R&D institutions were surprisingly limited given the technical nature of the case study firms. Ausenco develops a range of its own technologies in-house and through contract research with external research organisations. It has staff dedicated to developing and cultivating these linkages.

Lakefield Oretest is a research agency in its own right. It sees major research organisations as a competitor and so does not have any formal links with external R&D institutions. It is also aware of the Australian Minerals Industry Research Association but does not work with it. The remaining case study firms do their own R&D work in-house, relying on their own technically qualified staff. Softrock does contract some development work to suppliers through purchasing custom-made equipment which it integrates into its own product/service offering. Advitech has, to date, carried out all its R&D in-house, but it is now looking for an appropriate R&D partner for a particular project.

Thus MTS firms, while relying heavily on R&D, contained it largely in-house. This was partly for commercial reasons (keeping ahead of competitors) and partly because some saw R&D institutions as competitors. Further, with the exception of software development, the R&D performed by mining technology firms was probably more 'D' in nature and relied on the skills of staff to develop existing technologies, rather than develop new technologies from basic research. None of the case study firms was a spin-off from an R&D institution, so the longstanding industry – research links observed in other high technology industries were not present.

4.3.3 Role of industry associations

There were no significant linkages with or involvement in industry associations. Most case study firms reported that these associations were not relevant to their innovation. Advitech, where the senior staff are actively involved in local Hunter valley industry groups, was the only exception to the rule. These industry groups are, however, seen to play a major role in broader knowledge acquisition.

4.3.4 Role of government

Firms had limited links with governments, but Advitech did have government customers. Ausenco and Advitech also had found that their State industry development departments and federal Austrade staff were extremely helpful. Lakefield has also used Austrade to some extent for export assistance. Several of Advitech's innovations grew from its close working relationship with regulatory agencies in NSW.

In general, the firms seemed to have limited awareness of government grant programs.

4.4 Firm capabilities

4.4.1 Learning by firms

4.4.1.1 Marketing

All case study firms had websites and were active users of online technologies to promote their firms. However, marketing was largely by word of mouth so these sites were more general promotional tools, with the exception of companies like RSG Global whose website was used to promote software packages through trial downloads. Formal market research seemed to play a relatively minor role.

4.4.1.2 Customer feedback

Case study firms reported that the main driver for innovation was a combination of new technologies and customer feedback. New technologies were identified in house and then implemented through technical staff. Customers provided feedback not only on the content of services but on the manner of their delivery,

The processes in place to obtain feedback from customers were largely informal. Runge had completed formal customer surveys but these were not regular. The other case study firms had tried a variety of ways to obtain feedback but these were not always successful. Several firms reported that feedback from customers had led them to launch new services, mainly software, which had been developed to solve in-house problems and were later marketed.

Case study firms were tailoring a set of services according to customer needs and in some sense every project required innovation. These firms also innovated by identifying an external market for internally developed software and project management skills so that in-house innovations eventually were packaged as a saleable good or service. These events were highly driven by customer demand.

4.4.1.3 Quality Systems, Customer Service and Intellectual Property

Smaller firms often had less formal quality systems in place but three of the larger firms (Ausenco, Lakefield Orestest and Advitech) had well developed quality systems and highly structured internal procedures. Ausenco was the most structured and had also introduced new staff positions that were designed not only to improve internal systems and structures but were aimed at raising awareness amongst customers of its quality system. Advitech has an extensive quality management system and has been accredited for the most recent version of the ISO 9001 standard.

Although all the mining firms have considerable intellectual property in the form of in-house developed software, scientific know-how, project processes etc, there has been little patenting of this IP because of concerns about revealing in-house secrets

Intellectual property was largely held through the skills of staff and only one firm had any patents. The competitive advantage of these firms was centred on their ability to bring together teams of experts to solve particular problems, which varied from customer to customer.

4.4.1.4 Staff

All case study firms employed expert technical staff who acted as the main gatekeepers for new information coming into the firm and were responsible for much of the environmental scanning. Ausenco had the most formal of these arrangements but all firms relied on technically qualified engineers, geologists and/or surveyors for these roles.

The firms were in direct contact with customers and had largely informal systems for obtaining customer feedback. All case study firms also have mechanisms in place to capture ideas suggested by staff and to ensure that customer feedback heard by staff is passed on to management.

4.4.2 Knowledge management

The main reasons that mining technology firms outsourced services were lack of internal capacity and a complementary need to obtain particular skills for their ongoing operations and innovation. As firms relied on their technical staff for bringing in many new ideas, the main system for managing this knowledge was through management meetings. Runge had the most formal knowledge management system but this was driven by its formalised business planning methodology, which had been brought into the firm from outside. Ausenco was moving toward a much more formalised system, through changes to its internal staff structure and information flows.

5 Conclusion

5.1 Awareness of KISA

Mining technology services firms are very conscious of the need to use knowledge intensive services to build their capabilities. They are service providers themselves, so they have a good understanding of how interaction with the provider of a knowledge intensive service can enhance business operations. Their work force is highly educated, so they understand how to learn and to build on their existing skills and knowledge.

The firm level case studies present several examples of innovative knowledge management: of firms which have developed tools for particular tasks and then packaged them to sell as stand alone units, or realised that the way they do something in-house has value which can be packaged and sold. At least one firm was quite explicit that it employed outside expertise only because it was small, and, as time went on, it would develop those areas of expertise in-house, either by internal skills development or by recruitment.

The culture of the firms is innovative, and it comes naturally to staff to integrate the knowledge of others into their own operations. Several firms had formal knowledge diffusion arrangements, for example, seminars for sharing the knowledge gained by staff who had been to outside conferences.

On the other hand, the Mining Technology Services Action Agenda identified a fragmentation of the sector which might mean that there are gains to be made from better communication between firms. Collaborations have long been considered to be a mechanism for the development of competitive advantage in business, but they are not common in the MTS sector, perhaps because firms fear that in collaborating they would risk their competitive edge (DITR 2002). There are two few case studies to generalise, but in the interviews there were very few references to learning from other firms – whereas in other sectors there appears to be a good deal of learning from peers, even from competitors (Australian Government 2004a, 2004b; Martinez-Fernandez *et al* 2004). This suggests that, while individual firms are engaging in useful KISA, the sector's performance could be improved by inter-firm co-operation in sharing knowledge and services.

5.2 Sources and availability of KIBS

Few of the firms noted any difficulty in getting access to the services they needed. This is impressive, given that some operate in remote locations. This may be simply because most firms find most services in-house (or the remoteness may force them to do this). The detailed case study responses suggest that the more important the service, the more keen the firm is to internalise it. Only human resources functions and information technology networking functions were consistently outsourced. Even when firms use external services, it is often in conjunction with some internal competence. These factors are reflected in the low expenditure (as a proportion of turnover) on external services.

In general, there is a link between small size and greater use of external services. This has appeared in studies of other industries. In the MTS cases, it was apparent that firms aspired to internalise the services when they grew big enough. This could improve their innovative capability, but retaining linkages with other firms would

remain important. Networks are, in almost all industries, an important source of information and assistance in building competences.

Many of the services the MTS firms used have been developed over time and in many cases are formalised into products such as software. They used their staff and customers to keep them abreast with developments and new information.

One theme that was clear in the ABARE survey was the importance of close contact with R&D institutions; access appeared to be satisfactory for most respondents. There was little information on this from the case study firms, which generally performed their own R&D and occasionally distrusted the R&D institutions as competitors.

The most common issue for the firms in this industry is the difficulty of finding skilled staff.

5.3 Policy implications

The Mining Technology Services Action Agenda which began in 2000 has stimulated a dialogue among the firms in the industry. This could be important in overcoming the fragmentation mentioned above and in generating the spillover benefits associated with collaborations and clusters. In this regard, facilitation of the Action Agenda amounted to both the provision by the Government of a knowledge intensive service, and the stimulation of further KISA. Implementation of the Action Agenda is the responsibility of an industry led Implementation Group, and it is likely that work to unify the sector will continue now that the initial step has been taken.

The Australian mining industry has experienced a period of prosperity, and the mining technology services industry has grown as a result. Further expansion will depend to a great extent on export sales. At present most firms that export significantly are assisted by the large mining firms who are their Australian customers. Government can contribute here by assisting individual firms, consortiums and industry groupings with access to foreign markets, and by helping to project a national brand image. This marketing perspective is particularly important because the industry is defined by its customers rather than by what firms do. Several case study firms reported that they had been assisted by Austrade, the Australian Government Trade Commission. Initially governments could assist by directly providing services, noting that few firms appear to use external sales and marketing services, but the objective would be for firms to develop their own skills in operating abroad.

It is not clear just how much firms in the MTS industry benefit from government programs, but usage may be quite low. If so, there may be a cost in good technology not being sufficiently commercialised, and also in technology which is being used in mining not being diffused to other sectors. Access to R&D institutions has been good, and the prospects for this industry are a strong motivation for maintaining Australia's research lead in a number of the relevant sectors. Again, better communication within the sector could assist with adoption and diffusion of research and new technology.

Finally, the continued supply of graduates in science, engineering, and technology will be crucial to continued innovation. This is being addressed in the context of the Action Agenda, and is also a more general policy concern of the Australian Government.

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Attachment: Interview Guide

BACKGROUND

This is an interview guide which contains some set questions and some starting points for discussion of issues. The depth of discussion on the issues raised in the guide will depend to some extent on the company that is being surveyed. However, during the interview it is expected that the majority of factual questions will be answered. The first section of the guide seeks answers to factual questions about the company while the next section analyses use of knowledge intensive business services in a range of areas within the firm.

BACKGROUND INFORMATION ON THE FIRM (MOSTLY OBTAINED PRE-INTERVIEW)

1. Date firm established/registered
2. Ownership (name of parent)
3. Location of owner
4. No. staff (FTE)
5. Describe the most recent product/service launched in the past 2 years

6. Describe any management-determined changes in rules/procedures or business processes intended to improve production systems or service delivery in the past 2 years?

7. Describe and changes in selection and training policies or HR management practices intended to improve production systems or service delivery in the past 2 years?

8. Describe any modifications to equipment/facilities or work units which have been intended to improve production/service delivery in the past 2 years

9. In general, what barriers were faced in implementing these changes?

10. What is the firm's primary competitive strategy? (for example...)
 - a) Introduce new products/services ahead of competitors
 - b) Offer higher quality products/services than competitors
 - c) Offer customised products/services for customers
 - d) Offer quick service/turn-around
 - e) Offer lower prices on comparable products/services of competitors
 - f) Stick to a small market where there is little competition
 - g) Other

USE OF KNOWLEDGE INTENSIVE BUSINESS SERVICES

11. From where does the firm obtain its services on each of the following items? (Identify High medium and low importance, or N/A)

Activity	External firm	R&D Instn	Other Extnl orgn**	In-house (staff)	Board	Is service tailored, routine, compliance or other?
Business planning						
Legal services						
Acctg/Financial services						
Capital Raising						
Technology awareness						
Technology trends						
Formal R&D						
Market research						
Product/service development services						
Project management						
Outsourced operations						
Marketing/promotion*						
Sales & distribution						
Export strategy						
Establishing offices overseas						
Performance benchmarking						
Networking services						
Recruitment services						
Accreditation/quality management						
Standards						
Training services						

* incl. e-commerce

** incl. government organisations such as business enterprise centres, government grants

For each of those above that are outsourced (KIBS, R&D, other), why is this? Discuss

Impediments to use of outside providers

Importance of outsourced providers

Impact of external providers on learning

Types of providers

Impact on innovation capacity

Impact on innovation performance

Is the service simply outsourced or is it a collaborative arrangement?

How is the knowledge shared?

DRIVERS FOR INNOVATION

12. How frequently do you need to bring out new products/services? What determines the timing?
13. What are the main drivers for innovation (for example, customers, suppliers, new regulations, competitors, staff, management...)
14. Of those listed in Q13, which is the most sophisticated innovation driver and what demands does it make on the firm?
15. If the main innovation driver is within the firm, what is the reason for this?
16. Describe the main customer base for the firm (e.g. large number of end-consumers, mix of firms and consumers, small number of government clients)
17. What proportion of your customers are
 - From your local region?
 - From other areas within your State?
 - From other areas of Australia?
 - From overseas?
18. Do customers from different regions have different needs/characteristics which require you to modify your products/services for these groups? (if yes, how do you meet this challenge)?
19. What other stakeholders do you need to work with (or at least be aware of) to ensure your business is successful? (e.g. govt for regulatory issues)
20. What is the balance of small (incremental) and step-change (radical) innovations in the firm?
21. Have small (minor) business changes led to significant competitive advantages over competitors? (if yes, expand)

KNOWLEDGE ACQUISITION

22. What continuing arrangements or procedures are there for seeking new ideas or business improvement information from external sources?
23. How does the firm develop a balance between choosing to acquire new technologies to support innovation and choosing to introduce new management practices or training to support innovation?
24. How has the firm structured itself to be able to respond to external opportunities?
25. What is the balance (by value) of all services sourced from outside the firm vs internal costs? (is easily available)

TRANSFORMING INTERNAL PROCESSES

26. How have the changes identified in affected the business? (e.g. productivity improvements, new markets, exports, lower costs)
27. What management practices help to support the process of innovation within the firm?
28. How important are existing vs new personal contacts in deciding to implement an innovation?
29. How does the firm establish internal procedures to ensure that knowledge brought in from external service providers is maintained within the firm?

IMPACTS ON STAFF OF INNOVATION

30. Where do you look to find employees that you most rely on for business changes and improvements (vs KISA)?

31. How do you ensure employees are trained to deliver new innovations in product and services to your customers?

32. Do you maintain company practices or procedures that enable you to benefit from ideas brought forward by other employees?

33. What are the relative roles of staff skills and knowledge, and formal procedures in each of the above questions?