

2001

# Information Systems Strategy and knowledge-based SMEs: Developing a framework for analysis of the Australian Biotechnology Industry

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## Recommended Citation

Clarke, Jayne and Turner, Paul, "Information Systems Strategy and knowledge-based SMEs: Developing a framework for analysis of the Australian Biotechnology Industry" (2001). *ACIS 2001 Proceedings*. 21.

<http://aisel.aisnet.org/acis2001/21>

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## **Information Systems Strategy and knowledge-based SMEs: Developing a framework for analysis of the Australian Biotechnology Industry**

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### **Abstract**

*A limitation of recent work in the analysis of information systems strategies (ISS) for small-to-medium enterprises (SMEs) is the tendency to focus exclusively on organisational resources as being the only source of competitive advantage. In some knowledge-based SMEs, ISS involves competitive advantage being obtained through a variety of mechanisms. These mechanisms include interfirm relationships and industry-structure as well as resources. This paper develops a framework for analysing ISS deployed by Australian biotechnology SMEs in one of the most knowledge-intensive industries. By making IS research conscious of the variety of ways SMEs source competitive advantage, at organisational, relational-based and industry structural levels, it is anticipated that the paper will contribute to the on-going debate on ISS and SMEs in the evolving knowledge economy.*

### **Keywords**

IS Strategic Planning; Knowledge Utilisation; Small Business; Strategic Alliances, Strategic IS

## **INTRODUCTION**

Research into information systems strategies (ISS) has primarily grown out of strategic management approaches emphasising resource-based sources of competitive advantage. Initially these strategic management approaches concentrated on large businesses and examined IS as one resource among many that could be managed to generate competitive advantage. However, as IS became increasingly pervasive within business, researchers began to focus on IS as the key strategic resource. In one sense therefore current models of ISS are resource focused strategic management models viewed from an IS/IT perspective (Duhan *et al*, 2001).

With the emergence of the internet and electronic commerce, a number of researchers recognised the potential for ISS development amongst small to medium sized enterprises (SMEs). Initially these approaches were relatively unsophisticated merely involving the application of ISS models developed for large business to the SME environment. The uniqueness of SMEs and in particular their tendency to be resource poor was quickly recognised and attempts were made to enhance frameworks for examining ISS amongst SMEs (Blili and Raymond, 1993). It was recognised that ISS approaches developed for large firms were problematic for SMEs (Martin, 2000). Subsequently a number of researchers adopted a resource based approach to develop an ISS model specifically for the SME context (Levy and Powell, 2000). This model has recently been further developed and applied to knowledge-based SMEs (Duhan *et al*, 2001).

This paper explores the application of resource-based ISS to Australian biotechnology SMEs and develops a framework for analysis of SMEs in this knowledge intensive context. It highlights that an overemphasis in ISS on resources has led to insensitivity towards other sources of competitive advantage. Biotechnology SMEs have some characteristics that are similar to large organisations. This indicates potential value in exploring the applicability of other sources of competitive advantage as identified in previous strategic management research on large organisations.

## **HISTORICAL DEVELOPMENT OF ISS FRAMEWORKS**

Since the 1960s, scholars in this field have been concerned with explaining differential firm performance (Dyer and Singh, 1998). Three prominent views on sources of competitive advantage have emerged, industry structure, resource and relational-based.

Industry structure competitive advantage was the dominant view in the 1980s and refers to an organisation's competitive advantage through membership of an industry with favourable characteristics. Associated with the work of Porter (1980), characteristics may include relative bargaining power, barriers to entry, lowering cost and tying in suppliers and customers (Duhan, 2001; Dyer and Singh, 1998). As a result, the focus for many researchers has primarily been the favourable industry structure. However, researchers began to recognise the

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importance of an organisation's resources as a source of competitive advantage and the resource-based perspective became the predominant view in the 1990s (Hoskisson *et al.*, 1999). The resource-based view refers to competitive advantage obtained through a firm's ability to "accumulate resources and capabilities that are rare, value, nonsubstitutable and difficult to imitate" (Dyer and Singh, 1998: 660). Therefore the research focus is the firm itself. Initially, the resource-based view focused on competitive advantage obtained through technology but more recently, the focus has turned to information being a competitive resource (Galliers, 1991).

During the same period a third view on the sources of competitive advantage referred to as the relational-based view emerged (Dyer and Singh, 1998). The focus is on interfirm linkages as sources of competitive advantage where individual firms can only leverage additional advantage through joint contributions in the form of strategic alliances. Substantial knowledge exchange and the combination of complementary resources or capabilities results in joint learning and the creation of unique products, services or technologies and lower transaction costs than competitor alliances due to a more effective governance mechanism (Dyer and Singh, 1998).

The emergence and development of ISS research and practice is intimately linked to developments outlined above. More specifically it is evident that most methods used in IS strategy planning are essentially derived from 1990s strategic models applied from an IS/IT perspective (Duhan *et al.*, 2001). Consequently, these ISS frameworks have been developed from a resource perspective reflecting the dominant view of the 1990s (Dyer and Singh, 1998; Hoskisson *et al.*, 1999). In this context, ISS emerges as a plan of how an organisation can deploy IS, IT, people, and knowledge, to maximise the effectiveness and efficiency of the corporation so it can achieve its objectives (Levy *et al.*, 1999; Min *et al.*, 1999).

Frameworks may be seen as outline models of how IS can potentially assist firms with their objectives of gaining competitive advantage (Levy *et al.*, 1999). Their purpose is to assist in analysis to take advantage of IS opportunities (Doyle, 1991). These frameworks have been developed from a resource-based perspective and have emphasised the firm's internal strengths and weaknesses relative to their external opportunities and threats (Hoskisson *et al.*, 1999). Some researchers have criticised these frameworks for codifying commonsense (Mintzberg, 1994; Davenport, 1997) or offering little value to an organisation that knows its business (Levy *et al.*, 1999). Despite these limitations, frameworks have proved to be useful. There are a plethora of frameworks available and the range can be overwhelming. Earl (1989) developed a framework of frameworks with the purpose of assisting managers in choosing the appropriate models to apply. Despite these criticisms, frameworks have proved to be useful. However the dominance of the organisational view that has permeated ISS frameworks (Walsham, 1993; Earl, 1996; Levy and Powell, 2000) has tended to inhibit sensitivity towards other sources of competitive advantage.

### **The unique characteristics of SMEs and implications on ISS**

As previously indicated, ISS frameworks have mainly been developed for large organisations in a North American context (Levy *et al.*, 1999). It is therefore important to identify those characteristics of SMEs, with respect to IS and strategy, which differentiate them from large organisations:

- SMEs tend to view the role of IS as to increase operational and transaction efficiencies internal to their organisation (Blili and Raymond, 1993; Hagman and McCahon, 1993; Riemenschneider and Mykytyn, 2000). Most SME owners do not think of IS as a strategic weapon (Levy and Powell, 2000) and seldomly use it to support management decisions (Levy *et al.*, 1998).
- SMEs tend to be resource poor therefore affecting investment in IT/IS and in training (Blili and Raymond, 1993). As a result, staff and owners have limited knowledge and skills in IS, which prevents them from taking advantage of strategic information (Levy *et al.*, 1998). A perception is that IT/IS is a drain on resources rather than opportunity for growth (Levy and Powell, 2000).
- SMEs tend not to have an explicit business strategy, which is a driver for ISS. SME owners have implicit strategy and strategic information tends to be held informally within the team (Levy and Powell, 2000). The absence of an explicit strategy makes ISS development difficult. Therefore the challenge of an ISS is to elicit this strategy from the SME managers.

These characteristics raise questions as to whether SMEs actually need an ISS, what affect they have on SMEs ability to develop an ISS effectively and the appropriateness of applying ISS frameworks designed for large organisations to SMEs. Levy *et al.* (1998) identified that some of the strategic IS opportunities available to large organisations were available to SMEs thereby highlighting the usefulness of ISS to SMEs. More recently, an application of Earl's framework of frameworks demonstrated that opportunity and awareness frameworks developed for large organisations, also have some applicability to SMEs (Levy *et al.*, 1999). Clearly however, SMEs have different ISS needs to large organisations. This implies that they may require their own ISS frameworks.

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## **ISS Frameworks and SMEs**

Based on their initial research on the applicability of Earl's work to SMEs (Levy *et al*, 1999), Levy and Powell (2000) developed an ISS for SMEs specifically addressing the issues raised above. The primary focus of their ISS framework is the alignment with business strategy, but it also encapsulates organisational culture and the role of information. To overcome issues on the limited use of IS currently in SMEs, Levy and Powell (2000) argue that it is more appropriate to focus on the information requirements rather than concentrating on IT requirements. Levy and Powell (2000) also note that industry sector differences may be significant. A subsequent paper by Duhan *et al* (2001) has identified that in sectors with knowledge based SMEs (KSMEs) a 'core competencies' approach (a key aspect of the resource based approach) is more appropriate for developing ISS. Duhan *et al* (2001) characterise KSMEs as organisations that have intangible resources, high information content and significant customisation to the needs of their clients, for example IT consulting and solicitors firms. These SMEs exist in environments where large organisations outsource their non-core capabilities. These non-core capabilities then become the core competencies of the KSMEs. Duhan *et al* (2001) articulate a convincing case for the application of core competencies in KSMEs but they also acknowledge that further work is required.

In the Australian biotechnology industry SMEs, one of the most knowledge-intensive industries, the core competencies approach to ISS emphasises the strategic importance of a firm's intellectual property (IP). However, because the Duhan *et al* (2001) core-competencies approach to ISS has been developed purely from resource based perspective other sources of competitive advantage being sourced from beyond the organisational boundary remain unexplored. The biotechnology industry provides a good example of where ISS has been applied beyond the organisational boundary and used to exploit other sources of competitive advantage. In the context of Australian biotechnology SMEs, a purely resource-based view neglects competitive advantage acquired by creating barriers to entry through patent blocking and interfirm relationships, including alliances and clustering.

## **BACKGROUND ON THE AUSTRALIAN BIOTECHNOLOGY INDUSTRY**

The 21<sup>st</sup> Century has been proclaimed as the 'biotechnology century' (Lilly, in Ernst and Young, 1999). The biotechnology industry is an example of a knowledge-based industry (Finkel, 1999; Osborne, 2000) with its main function being research and development (R&D) and its primary asset its IP. It is a relatively young industry, which has developed rapidly over the last 20 years especially in the areas of pharmaceuticals and agriculture.

Australia's involvement and development in biotechnology is considered vital for its competitiveness in the knowledge economy (Finkel, 1999) and the sustainability of the country's economic and export activity (Biotechnology Australia, 2000). Its importance stems from the potential biotechnology has to revolutionise primary industries, in areas including agriculture, mining, forestry and aquaculture, upon which the country's economy is so reliant.

The Australian biotechnology industry is small by international standards, consisting of a number of large companies, including subsidiaries of multinational corporations and a further 130 small companies. Internationally, the Australian industry is most similar to the Canadian biotechnology industry with many small and medium sized companies accounting for a large proportion of core biotechnology companies (Ernst and Young, 1999). However, in comparison, Canada industry has over 300 core biotechnology companies, and its success places it second only to the USA.

The main strengths of the Australian biotechnology industry include; substantial public investment in R&D, especially in medicine and agriculture; the relatively low cost of research; a developed research structure, comprising of universities, hospitals, medical research institutes, CSIRO, CRCs and Commonwealth and state funded R&D organisations; and internationally well-regarded research capabilities, all of which attract additional international investment. Despite these strengths, the relative small size and lack of capital investment has resulted in lost opportunities for commercialisation of Australian biotechnology research. Alliances with larger multinational companies continue to be a major platform for Australian companies to gain experience and reach international markets. Although these problems are not unique to the biotechnology industry, a heavy reliance on R&D and the long lead time between discovery and commercialisation, implies the need for IP protection to be greater in biotechnology than in other sectors (Biotechnology Australia, 2000).

## **DISCUSSION OF ISS AND KNOWLEDGE-BASED BIOTECHNOLOGY SMEs**

The work of Levy *et al* (1999), Levy and Powell (2000) and Duhan *et al* (2001), has provided significant development and insight into ISS frameworks for SMEs. In particular, their work has demonstrated to researchers that ISS frameworks developed for large organisations are not necessarily applicable to SMEs.

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Duhan's *et al* (2001) core-competencies approach also provides insights for ISS in biotechnology SMEs by emphasizing the strategic importance of IP. IP forms the core of any biotechnology start-up (Smith, 2000 from Rothschild Bioscience). Given that these firms have no product to market, IP is also the only basis upon which they are able to acquire further financing (Spruson and Ferguson, 2001). In biotechnology SMEs, R&D operations must be directed towards commercial outcomes. It therefore follows that an R&D strategy is heavily reliant and influenced by IP issues. Furthermore, as a firm's business plan must optimise its IP-asset potential (Bent, 2000). In this context the core competencies approach does help the development of a strategic direction for IP. However, the biotechnology industry also provides a context where competitive advantage derived through industry structure and relational based sources are equally as important.

### **Importance of Industry Structure Competitive Advantage**

A number of biotechnology firms use their IP, especially patents, to create blocks to further R&D in specific areas. Although patenting is necessary to ensure that companies are able to recoup substantial research and development expenditure, some trends in the IP management result in barriers to entry. Blocking patents arise where the excise of one patent would infringe claims of another (Nicol and Nielsen, 2001). Patent blocks prevent access to essential research tools and can inhibit patenting further downstream. Given that most Australian biotechnology firms are downstream companies, it is clear that blocking patents and stacking licences could well be a barrier to entry for the Australian biotechnology industry. It is estimated that over 90% of current US patents are never exploited suggesting many are used for blocking purposes (Nicol and Nielsen, 2001).

In Australia, this issue of patent blocking is a significant issue to SMEs, particularly as non-Australian companies and institutions hold most of the biotechnology patents granted in Australia (Nicol and Nielsen, 2001). It is suggested that many patents, held by foreign companies, are deployed for blocking purposes and lie dormant. Ernst and Young's (1999) report on the Australian biotechnology industry revealed that 21% of the companies surveyed had at some time abandoned at least one project from further work or commercialisation as innovation had been blocked by IP rights (IPR) owned by other parties.

Clearly, biotechnology firms use their IP, in particular their patents, to achieve an industry structure form of competitive advantage. By taking out patents for blocking purposes, these organisations are potentially hindering access to technology and preventing further basic research and commercial exploitation of gene related inventions, thus creating barriers to entry. As foreign companies own the majority of Australia's patents, it suggests patent blocking may be a major problem for Australian biotechnology SMEs and may affect their ability to compete internationally.

### **Importance of Relational Competitive Advantage**

Interfirm relationships are also an essential part of the biotechnology industry. Due to the prohibitive cost of R&D, patent blocks and the related financing and investment issues, strategic alliances, joint ventures and mergers are rife in the industry. These interfirm relationships enable companies to overcome barriers to entry through access to IP, capital and international markets. Although a major issue facing the Australian industry is that these alliances are resulting in innovation being taken offshore.

Another source of relational-based competitive advantage is industry clusters (Dyer and Singh, 1998) Clustering in the biotechnology industry is a trend occurring worldwide (Biotechnology Australia, 2000). Biotechnology research and commercialisation is characterised by its knowledge base and the intensity of collaboration between research organisations and industry. This has resulted in strong biotechnology clusters being developed particular in regions of USA, UK and Germany. These clusters include research organisations, companies involved in development and application of biotechnology, companies providing specialised inputs, equipment and services, and supporting legal, financial, business service organisations (Biotechnology Australia, 2000). Powell (1996) found that in the biotechnology industry innovation was the result of networks, not individual firms. Therefore Powell (1996) concluded biotechnology firms are competitively disadvantaged if they are unable to create or be positioned in these learning networks.

## **DISPARITY BETWEEN ACADEMIA AND PRACTICE**

The development of ISS is intimately related to dominant views articulated in strategic management discourses. Current ISS frameworks have predominantly been developed from a resource-based perspective. The operational nature of most SMEs and their focus on internal efficiencies (Hagman and McCohan, 1993) complement this organisational resource-based perspective. The resulting fit between SME characteristics and the resource-based premises underlying ISS has created a tendency to ignore a consideration of other sources of competitive advantage. In fact, it appears that academia has viewed the other sources of competitive advantage as mutually

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exclusive. However, as the discussion on KSME's avenues for sourcing competitive advantage indicates, there is a need to consider these issues in more depth.

### **Organisational Boundary Restrictions**

Another consequence of the dominance of the resource-based view in ISS has been the limited investigation of methods for exploiting a firm's resources beyond the firm's boundary. This does not imply current ISS frameworks have an insular view. It is clearly evident that these frameworks scan their environment and gain industry awareness by seeing what their competitors are doing. However there is little evidence in research to demonstrate how a firm's resources, particularly IS, can be applied outside the organisational boundary. Yet in practice, there are examples of how IS/IT can be exploited beyond the organisational boundary. For example, virtual organisations (Levy, 2000; VOnet, 2001) acquire relational competitive advantages. Similarly IBM's development of propriety software to lock-in supplier and customers enabled them to gain an industry structure advantage. Indeed, it can be argued that resource paucity can make small firms more reliant on boundary spanning activities as a source of innovation and development (Martin, 2000).

### **Biotechnology SMEs are not typical SMEs**

The final reason for this divergence is that the ISS frameworks suggested by Duhan *et al* (2001) and Levy and Powell (2000) have been developed according to the characteristics and nature of the SMEs they studied. However, biotechnology SMEs are not typical SMEs

- Australian small businesses unlike other SMEs in other studies (Blili and Raymond, 1993) tended to hold an optimistic view of IS/IT and see more benefits than problems (Burgess, 1998). Like most SMEs, Australians small businesses tend to operational efficiency but they diverge from other SMEs as they also see it as providing better access to information (Burgess, 1998). Furthermore, as technology is fundamental to their business processes, biotechnology SMEs tend to have a good understanding of how IS can be used effectively.
- Secondly, biotechnology SMEs can be described as innovative companies in accordance with Simmie's (1998) definition of innovation. Innovation is considered a form of advantage (Martin, 2000), which the biotechnology industry achieves through their network of strategic alliances (Powell, 1996). These networks provide SMEs with access to information, resources, market and technologies as well as advantages from learning and scale economies (Martin, 2000).
- Thirdly, biotechnology SMEs are generally not considered resource poor with their multi-million dollar R&D budgets. Furthermore, these SMEs have a highly specialised and skilled workforce, who have good level of skills and expertise lends them to having a good understanding of the importance IT and IP management.
- Finally, unlike SMEs in other sectors, biotechnology companies tend to possess an explicit strategy, with particular consideration of the strategic management of IP. The business plans are the only way these start-up SMEs gain access to financing. In fact, IP management is essential business practice to ensure the SME has freedom to operate, by not breaching other company's IPR.

The characteristics of the biotechnology SMEs in some circumstances assimilates to those of larger organisations. This may have implications on the relevancy and applicability of ISS models to these SMEs.

## **DEVELOPING A FRAMEWORK OF ANALYSIS**

Analysis of ISS for knowledge-based SMEs in the biotechnology industry requires multiple perspectives on sources of competitive advantage. From the literature review these sources are resource, relational and industry structure. Academia in dealing with strategic management is beginning to recognise that the knowledge economy is dictating that competitive advantage must also be sought outside the firm (Kim and Mauborgne, 1999), looking for a balance of both internal and external complex explanations in the new competitive landscape (Hoskisson *et al*, 1999) and thinking beyond a company's boundaries (Kim and Mauborgne, 1999). ISS research is yet to explore this complementary view of sources of competitive advantage.

In undertaking this research, an interpretive epistemological stance has adopted. In accordance with Hill and McGowan's (1999) suggestion that small company research may best be examined using a qualitative approach, this research will use qualitative analysis and future work will utilise multiple case studies.

From a preliminary investigation, a framework for analysis (refer to table1) has been developed and will form the basis of future work on ISS in knowledge-based biotechnology SMEs. The framework identifies various foci relevant to investigating sources of competitive advantage in biotechnology SMEs and indicates previous research which has either identified or used these foci in their investigation.

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The framework was developed mainly as a result of the literature review, drawing on the major themes, discussions and past research methodologies. It draws particularly on the work of Powell (1996), DeCarolis and Deeds (1999) and Calabrese *et al* (2000), whose research is derived from a variety of disciplines and each provides differing perspectives on the biotechnology industry. The work of Calabrese *et al* (2000) provided insight and awareness of limitations in a similar biotechnology industry, Canada. Thorburn's (2000) research on knowledge management in research spin-offs allowed the framework to be tuned to the particular characteristics of Australian R&D organisations. The framework was further refined based on reoccurring themes apparent in informal discussions with company managers, government representatives, IP lawyers who have worked in the biotechnology industry and researchers in other disciplines, predominantly law. These informal discussions have enabled the researchers to gain an overall understanding of the biotechnology industry and some of the issues facing companies, particularly from an Australian perspective. In addition, some documentation review of industry reports, company annual reports and websites have also assisted in the initial investigation and framework development.

Sources of Competitive Advantage Levels	Preliminary Identified IS Strategies	Foci for Future Data Collection/Analysis	
<b>Resource</b> (Wernerfelt, 1984) Organisational	Knowledge Creation (R&D)	<ul style="list-style-type: none"> <li>R&amp;D Strategy (Rivette and Kline, 2000; Bent, 2001; Spruson &amp; Ferguson, 2001)</li> <li>Corporate Strategy (Rivette and Kline, 2000; Bent, 2001; Spruson &amp; Ferguson, 2001)</li> <li>IP Strategy (Rivette and Kline, 2000; Bent, 2001; Spruson &amp; Ferguson, 2001)</li> <li>Relationships between IP, R&amp;D, Corporate Strategy (Rivette and Kline, 2000; Bent, 2001; Spruson &amp; Ferguson, 2001)</li> <li>Other resource management strategies and their relationships-people, technology (Thorburn, 2000)</li> <li>Types of IP (patents, trade secrets, Plant Breeder's Rights)</li> <li>IP Management (Bent, 2001)</li> <li>Patenting process (US differs from Australia and Canada)</li> </ul>	<ul style="list-style-type: none"> <li>Finance-Venture Capitalists (Spruson &amp; Ferguson, 2001)</li> <li>Awareness of the external environment and competitors (Rivette and Kline, 2000)</li> <li>Patents (DeCarolis and Deeds, 1999;)</li> <li>Firm Citations (DeCarolis and Deeds, 1999).</li> <li>Products in development and market (DeCarolis and Deeds, 1999).</li> <li>Government assistance programs-Biotechnology Australia, AusIndustry, each State govt. Dept of State Development –(Ernst and Young, 1999)</li> <li>Look at International trends (as the firms are part of the global knowledge economy)</li> </ul>
<b>Relational</b> (Dyer and Singh, 1998) Interfirm	Knowledge Sharing (Industry Clustering)	<ul style="list-style-type: none"> <li>Industry Associations (AusBiotech Association)</li> <li>Government Assistance programs (as above)</li> <li>Linkages with Govt. departments, research institutions, universities (Ernst and Young, 1999; Thorburn, 2000)</li> <li>Management and sharing of other resources (Thorburn, 2001)</li> <li>Geographic location (Decarolis and Deeds, 1999)</li> <li>Strategic alliances (Powell, 1996; Decarolis and Deeds, 1999; Calabrese et al, 2000)</li> </ul>	<ul style="list-style-type: none"> <li>Joint Ventures (Powell, 1996; Calabrese et al, 2000)</li> <li>Clusters (Powell, 1996; Calabrese et al, 2000)</li> <li>IP management strategies in IP sharing and licensing Agreements (Grindley and Teece, 1997)</li> <li>Ad hoc, temporary and informal links and networks (Decarolis and Deeds, 1999; Steen and Innes, 2000)</li> <li>Themes of discussion in these alliances</li> <li>Look at International trends (as above)</li> </ul>
<b>Industry Structure</b> (Porter, 1980) Industry	Knowledge Blocking (Patent Blocking)	<ul style="list-style-type: none"> <li>Laws on IP (Nicol and Nielsen, 2001; Spruson and Ferguson, 2001)</li> <li>Laws on anti-Competitiveness (Nicol and Nielsen, 2001)</li> <li>Value chain -upstream versus downstream biotechnology companies (Calabrese et al, 2000; Nicol and Nielsen, 2001)</li> <li>Strategies for overcoming patent blocking (Rivette and Kline, 2000)</li> </ul>	<ul style="list-style-type: none"> <li>Issues associated with blocking (Rivette and Kline, 2000)</li> <li>Patent practices and reasons for patenting (Cohen et al, 2000)</li> <li>Relationship like between firms, between larger and smaller companies (larger MNEs have access to more resources and markets)</li> <li>International trends (as above)</li> </ul>

Table 1: Developing a framework for analysis of ISS in Australian Biotechnology SMEs

The framework of analysis will form the basis of future research investigating ISS in biotechnology SMEs, when exploring these multiple cases. The nature of this research is firstly, to explore the development and use of ISS in the biotechnology industry, and secondly, to extend ISS strategy theory by developing an ISS framework relevant to biotechnology SMEs. This assimilates with Benbasat *et al* (1987) observations as to when multiple case studies are most useful. Furthermore, the paucity of research in ISS for SMEs (Blili and Raymond, 1993; Levy *et al*, 1999; Levy and Powell, 2000) and the embryonic nature of the biotechnology industry is indicative of this area being an emerging field in the IS discipline. This again lends the study to a multiple case study approach, which enables rich descriptions and replication logic of emergent research areas (Yin, 1994; Benbasat *et al*, 1987).

The primary data collection technique will be semi-structured interviews. The interviews will be conducted with the Australian biotechnology SME owner-managers and other people in the organisation involved in strategic IS management. These people are considered the appropriate persons to interview as:

- Although a large number of SMEs do not have an explicit strategy, many SME owners have an implicit strategy, which can be elicited. (Levy *et al*, 2000);
- An SME owners-manager's attitude and experience of IS will heavily impact the heavily role of IS (Duhan *et al*, 2001).

Analysis of the data collected will be done using grounded theory, which has been used extensively in a variety of social science disciplines.

## CONCLUSION AND FUTURE WORK

The dominance of the resource-based approach in IS strategic management research has proven to be an effective basis for developing ISS for SMEs. To Australian biotechnology SMEs, in of the most knowledge-intensive industries, their IP is an obvious source of competitive advantage demonstrating the need for seeking resource-sourced competitive advantage. However, closer examinations of biotechnology SMEs reveal that they seek other sources of competitive advantage, through industry structure, creating barriers to entry, and relational-based, through strategic alliances and clustering. For biotechnology SMEs to "play the game" of these large biotechnology firms, a more holistic view is required, encapsulating resource, industry and relational-based sources of competitive advantage.

The intention of this research is to examine and explore the assumptions upon which ISS frameworks have been based. Examination of current research in the context of biotechnology SMEs indicates the need for the development of an ISS framework, which incorporates IP and perceives the sources of competitive advantage as complementary rather than mutually exclusive. Further work will involve an in depth investigation into the sources of competitive advantage, in this knowledge-intensive industry, through the application of the framework for analysis. The aim of this research is to provide a better insight into ISS in knowledge-based SMEs and the development of an ISS framework relevant to the Australian biotechnology SME context. The similarity of the Canadian biotechnology industry structure and its enormous success in comparison to the Australian industry suggests a potential comparative study between the two countries. It is anticipated that differences in how Canadian SMEs use their ISS may provide valuable insights and identify critical success factors to improve the competitiveness of Australian SMEs.

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