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Intellectual Property Appropriation Strategy and its Impact on Innovation Performance

ABSTRACT

This study examines the impact of key determinants of IP appropriability, namely organizational resources, IP management practices and organizational learning culture, on innovation performance. The study uses quantitative survey data obtained from the Australian biotechnology, pharmaceutical and Information Communications Technology (ICT) industries in order to test several hypotheses. Our results show that IP appropriation is likely to be most successful when trade secrets and profits from innovation are applied simultaneously within an organizational learning culture. The implication for managers is that several factors would need to be implemented in order to facilitate the appropriation of IP.

INTRODUCTION

The nature of competition has changed due to the emergence of the knowledge economy, in which intellectual property (IP) has emerged as a critical factor for developing competitive advantage. IP encompasses intangible assets such as knowledge, inventions and designs. The IP value chain comprises several steps: generation, protection and utilisation activities (Reitzig and Puranum, 2009). The generation of IP can be either through R&D partnerships or from other external sources, such as patent publications. The protection of IP can be achieved via legal or alternative mechanisms, such as patents or secrecy, respectively. Finally, the utilisation of IP can mean undertaking business development activities to commercialise the IP via marketing and distribution channels or licensing it.

The owners of IP have exclusive rights to the property, allowing them to extract financial benefit (Reitzig and Puranam, 2009; Narayananan, 2001) such that around two-thirds of the value of large businesses in the U.S. can be traced to intangible assets (Shapiro and Pham, 2007).

Since IP is of value to the firm, it needs to be retained and protected from imitation, obsolescence, or infringement to allow for its appropriation. Appropriability refers to *"the ability of the owner of a resource to obtain a return equal to the value generated by that resource"* (Levin *et al.*, 1987). Expanding on this definition, scholars have used the term IP appropriability in the literature to describe the circumstances which allow value to be captured from the technological knowledge that is derived from innovation (Nieto and Perez-Cano, 2004; Ceccagnoli, 2009).

Competitors may choose to imitate an innovation as it saves them the time and expenses required for identifying and experimenting with new sources of innovation (McEvily and Chakravarthy, 2002; Nieto and Perez-Cano, 2004). The technical knowledge required by competitors to imitate can be acquired through reverse engineering by examining patent applications and publications, engaging in informal conversations with employees, hiring competitors' employees, and informal discussions with suppliers and customers (Mansfield, 1981; Levin *et al.*, 1987; Appleyard, 1996). Hence, the innovating firm incurs costs in protecting this knowledge from imitators.

Instead of simply protecting their IP, some firms may choose to share and exploit their intellectual assets in the market for profit and thus, competitive advantage. However, this exploitation exposes the firm's IP to the threat of imitation by competitors. Therefore, firms must *"find ways to balance the need for knowledge protection and the need to replicate and share their knowledge"* (Hurmelinna *et al.*, 2007, p137). Thus, this study aims to address the following key research question: *How should IP be managed to gain value for the firm?*

Other questions that are addressed in our stud include:

What are the most significant determinants of IP appropriation strategy for superior innovation performance?

Is a model based on IP appropriation strategy a reliable and valid instrument for predicting innovation performance?

Does company size, industry type and foreign ownership have an effect on the relationship between IP appropriation strategy and innovation performance?

In order to address the above research questions, the study examines the relationship between IP appropriation strategy and innovation performance. The research examines how the determinants of IP appropriability allow firms to derive value from IP. We also control for company size, industry type and foreign ownership.

A cross-sectional study was conducted across three industries within Australia: biotechnology, pharmaceutical and Information and Communications Technology (ICT) industries, which operate under different ownership patterns. The Australian context was chosen is because Australia is globally not perceived as an innovation leader[1]. For example, Australia continues to lag behind in the OECD rankings in some areas such as the share of high and medium-high level technology in manufacturing exports or gross value added, in which it ranks 25th in the OECD[2].

However, the Australian government recognises IP as a valuable asset that can facilitate competitive advantage. Hence, it is looking to nurture innovation, investment and international competitiveness through the establishment of several bodies for dealing with IP matters, such as the Advisory Council on Intellectual Property (ACIP), Commonwealth Copyright Administration

[1] Kate Mills (2012) Bottom of barometer for lacklustre Oz initiative. *Business Review Weekly* (online).
[2] http://www.industry.gov.au/science/Policy/AustralianInnovationSystemReport/AISR2011/wp-content/uploads/2011/07/Australian-Innovation-System-Report-2011.pdf p.25

(CCA), Government Information Licensing Framework (GILF) and IP Australia, which is an agency responsible for the registration of patents, trademarks and designs[3].

Despite these initiatives, there is a lack of literature resulting from empirical studies of innovation performance of Australian firms. Even the focus of the research output of the IPRIA seems to be on the legal aspects of IP administration, rather than the strategic management of IP appropriation and its impact on firm performance. Therefore, it is important to undertake this study in order to learn how Australian firms can improve their innovation performance through strategic management of its IP and other organizational resources and capabilities.

LITERATURE REVIEW & THEORETICAL MODEL

Innovation Performance

Innovations are playing a more important role in the appropriation of rents by firms (Shapiro and Pham, 2007). Innovation performance is the measure of the firm's output from innovation, which is the process that transforms ideas, or inventions, into commercial value (Utterback, 1971; Duncan, 1972). This leads to the development of new products, processes and services, which allow a firm to reduce its production costs, access new markets or develop new processes and routines.

Past literature has shown that R&D is positively correlated with innovative output (Rogers, 1998; Mansfield, 1964; Hall, 1998), and that R&D spending leads to increased profits and market value for the firm (Rogers, 1998; Greenhalgh and Rogers, 2006; Pakes, 1985; Greenhalgh and Longland, 2001). Therefore, innovation performance can be considered as a reasonable measure of firm performance, especially since it has been used in past studies (Srivastava and Gnyawali, 2011; Terziovski and Corbel, 2012; Subrammanian and Nilakanta, 1996).

The Resource-Based View and IP Appropriation

The resource-based view (RBV) perceives the firm as a bundle of resources (Penrose, 1959). The RBV stipulates that firms can generate and implement strategies leading to competitive advantage due to the presence of complementary resources (Williamson, 1975; Hitt and Ireland, 1986; Porter, 1996; Steiglitz and Heine, 2007; Pisano and Teece, 2007).

[3] http://australia.gov.au/topics/law-and-justice/intellectual-property.

The VRIO framework proposes that organizational resources, such as physical assets, knowledge, specialists and entrepreneurial management, are: valuable (V), if the firm is able to exploit an opportunity or neutralise an external threat with the resource or capability; inimitable (I), if they are difficult and costly to imitate; rare (R), if their control is in the hands of a relatively few; and can be organised (O) to allow them to be exploited (Barney 1991, 1995). Scholars have used this framework to argue that organizational resources enable appropriability and sustained innovation performance (Grindley and Teece, 1997; McEvily and Chakravarthy, 2002; Nieto and Perez-Cano, 2004; Steiglitz and Heine, 2007; Reitzig and Puranam, 2009).

Therefore, the VRIO framework enables an internal firm-level analysis and allows us to explain how the presence of these resources and capabilities can facilitate the firm's IP appropriation strategy by allowing the IP to be exploited and yet protected from imitation, in order to achieve superior innovation performance. Hence, in the context of this study, it can be said that the organization's resources are valuable, rare, inimitable and can be organised to enable IP appropriability and sustained innovation performance.

The Knowledge-Based View (KBV) and IP Appropriation

According to the knowledge-based view (KBV) of the firm, knowledge is the most strategically important resource of a firm. Supporters of the theory argue that sustained competitive advantage and firm performance arise from diverse knowledge bases and capabilities, since knowledge-based resources are usually difficult to imitate because they exist within organizational culture and identity, policies, routines, documents, systems and human capital (Grant, 1996; Spender, 1996).

The knowledge-based theory stems from the strategic management literature, building on the RBV of the firm. However, proponents of the KBV argue that the resource-based perspective does not distinguish between different types of knowledge-based capabilities, regarding knowledge as a general resource instead of one that has special characteristics. That is, the RBV assumes that any heterogeneity among firms in their competitiveness is due to their distinctive capabilities to build up, expand, and organize those resources and capabilities to create and apply value-enhancing strategies (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993). The KBV instead, suggests that knowledge can be integrated through efficiency, scope and flexibility, while it can

be coordinated through the use of rules and directives, sequencing, routines, and group problem solving and decision making.

Scholars have sought to develop a knowledge-based theory of the firm in order to answer the question of how to organise the firm to efficiently generate knowledge and capability (Conner, 1991; Demsetz, 1988; Conner and Prahalad, 1996; Kogut and Zander, 1992, 1996; Grant, 1996; Nickerson and Zenger, 2004). Within this line of literature, there are two conflicting arguments with regards to the existence of firms for the efficient transfer of knowledge. Some research suggests that firms exist to avoid knowledge transfer (Demsetz 1988, Conner 1991, Conner and Prahalad 1996), since the firm is able to exercise authority in directing others' actions, while other research suggests that firms exist instead to facilitate knowledge transfer (Arrow 1974; Kogut and Zander 1992, 1996; Nahapiet and Ghoshal 1998), since the firm is able to support the formation of shared language and identity. The lack of consensus on this issue implies that there is still no defined knowledge-based theory of the firm. Therefore, in this paper, we address this conflict in the literature and seek to explain the existence of firms in the context of knowledge transfer.

It is commonly assumed within the strategy literature that the firm already encompasses valuable knowledge and capabilities (Argyres, 1996; Prahalad and Hamel, 1990). Since knowledge is one type of IP and sustained competitive advantage stems from the ownership of IP, IP appropriability can be seen as "knowledge-based advantage" (McEvily and Chakravarthy, 2002). Furthermore, IP appropriation strategy is defined as one which is used to appropriate innovation rents (Ceccagnoli, 2009). Therefore, this study will examine how the determinants of the firm's IP appropriation strategy can facilitate knowledge transfer and thus, the generation of commercial value, leading to superior innovation performance.

Development of a Theoretical Model and Hypotheses

The following theoretical arguments presented fall in on line with Utterback's (1971) notion that the ability of firms to appropriate their innovations depends on the characteristics of their environment, their internal characteristics and the flows between the firms and their environments. With regards to technology transfer, Kogut and Zander (1992) describe the paradox firms are faced with, arguing that intra- and inter-firm technology exchange relies on the codification of knowledge. However, this codification increases the risk of imitation and hence,

they state that the problems of the growth of the firm stem from the issues of technology transfer and codification.

The relationship between Organizational Resources and Innovation Performance

Organizational resources are those attributes of a firm's physical, human and organizational capital which can lead to efficiency and effectiveness (Wernerfelt, 1984). Physical resources may include technology, plant and equipment, such as R&D facilities, geographic location and access to raw materials. Human capital resources can include the training, experience, judgement, intelligence, relationships and insight of workers. Organizational capital resources, also known as complementary assets (Barney, 1995) include formal reporting structure, explicit management control systems, compensation policies, regulatory knowledge, client lists, marketing capabilities and networks.

The firm's resources also include IP, which is usually solely owned by the firm. Hence, in line with the VRIO framework, it can be considered as rare since it is in short supply. Bundles of resources, such as knowledge and physical assets, complement each other and provide the firm with a sustained competitive advantage (Porter, 1996; Steiglitz and Heine, 2007). Thus, firm resources can be considered as strengths for enabling strategies to be generated and implemented (Porter, 1981).

Using the knowledge-based lens to centre the analysis of the firm as an institution for the coordination of knowledge, Grant (1996) argues that the competence of the firm depends on to what extent it could organize and coordinate its existing knowledge efficiently, making knowledge the most significant competitive asset that a firm possesses. Similarly, Wiklund and Shepherd (2003) argue that organizational knowledge is an important bundle of intangible resources that can provide a firm with sustainable competitive advantage. Their research provides a useful complement to earlier studies in the RBV and KBV, providing empirical support for the VRIO framework by highlighting that a firm's resources (VRI) and organization (O) considered together can better explain firm performance. They find that market knowledge and technology knowledge are two knowledge-based resources, which help firms to rapidly discover and exploit opportunities and respond quickly to competitors' moves, leading to superior firm performance.

It has also been demonstrated in the literature that the following practices involving resources and capabilities can lead to positive innovation performance: borrowing assets from

the core business (brands, sales relationships) to give new ventures a competitive advantage (Govindarajan and Trimble, 2005); appropriately allocating resources for commercialization (Christensen and Bower, 1996); or creating competence-enhancing discontinuities and consolidate their industry leadership (Anderson & Tushman, 1990). One example is the development of the DVD in 1995, which was the result of innovation by Toshiba and Matsushita to increase the data storage capacity of the CD, which was first introduced due to the presence of technological knowledge, an asset that the two firms leveraged on (Rosenkopf and Nerkar, 2001).

Thus, we argue that an IP appropriation strategy can enable the firm to be organised to undertake the preceding mentioned practices to take advantage of organizational resources, such as technological knowledge. In this way, we suggest that organizational resources, including knowledge and physical assets, can be exploited as part of the firm's IP appropriation strategy, thus enabling superior innovation performance. Therefore, the following hypothesis is proposed:

Hypothesis H1(i): The relationship between the exploitation of organizational resources as part of an IP appropriation strategy and innovation performance is positive and significant.

Furthermore, the internalisation of knowledge can occur when IP is acquired from both internal and external sources, including the development of resources internally through the firm's own R&D activities, R&D alliances with other firms, in-licensing agreements, acquisitions of other firms and imitation.

The literature suggests that the acquisition of IP via sources internal to the firm, such as internal R&D activities, involves intra-firm knowledge transfer. For example, Nonaka and Takeuchi (1995) define organizational knowledge as "the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services, and systems". They argue that it is the tacit knowledge that is held by the individuals of the firm that is converted in a spiral process from the individual to the group and then the organization in four modes of knowledge conversion: socialisation through field building; externalisation through dialogue or collective reflection; combination through networking or linkages of explicit knowledge; and internalisation though learning by doing.

Furthermore, with regards to innovation performance, past literature has also shown that R&D is positively correlated with innovative output (Rogers, 1998; Mansfield, 1964; Hall, 1998), and that R&D spending leads to increased profits and market value for the firm (Rogers,

1998; Greenhalgh & Rogers, 2006; Pakes, 1985; Greenhalgh and Longland, 2001). Therefore, the following hypothesis is proposed:

Hypothesis H1(ii): The relationship between the internal acquisition of IP via R&D and innovation performance is positive and significant.

Similarly, the external acquisition of IP, a form of inter-firm knowledge transfer, via alliances, in-licensing agreements, acquisitions and imitation, has also been argued to lead to sustained innovation performance, since it is more costly to discover and develop a new product internally than to imitate it or purchase it via partnerships agreements or acquisitions (Lanjouw, 2003). Acquisitions of IP from sources external to the firm are commonly used to facilitate the enhancement of technological capabilities, as in the example of Monsanto Chemical Company, primarily an integrated chemical manufacturer, which saw potential to develop its agricultural products further. The company invested in genetic engineering firm Genentech to facilitate its venture into biotechnology to produce genetically modified seeds for agriculture (Leonard-Barton and Pisano, 1990).

However, there are some findings in the literature, which suggest that the practices of acquiring IP from external sources may instead diminish innovation performance by encouraging competitors to expropriate a firm's IP through imitation. Since imitation saves firms the time and expenses required for identifying and experimenting with new sources of innovation it removes the incentive to spend on R&D and innovate internally and hence, it may have a negative effect on innovation performance (McEvily and Chakravarthy, 2002; Nieto and Perez-Cano, 2004). Furthermore, imitation from external sources may not lead to higher innovation performance because, as Choi (1998) and Gallini (1992) find, imitation is costly and after dedicating resources towards the imitation of IP, an organization may not have the resources to appropriate that IP, such as product development and marketing capabilities. Also, Hagedoorn & Duysters' (2002) find that certain alliance structures can result in appropriability hazards that enable imitation, and hence poor appropriability of the IP. This may also explain the increase in appropriability hazards in acquisitions, where differences in organizational fit may lead to appropriability hazards. Therefore, the following hypothesis is proposed:

Hypothesis H1(iii): The relationship between the acquisition of IP from sources external to the firm and innovation performance is negative and significant.

The relationship between IP Management Practices and Innovation Performance

The implementation of IP management practices also facilitate the firm's IP appropriation strategy. Since IP is a type of knowledge asset, some studies have applied the RBV to argue that the attributes of these knowledge resources themselves contain barriers to imitation making them inimitable and hence, influencing the choice of technological knowledge protection (e.g., McEvily & Chakravarthy, 2002; Nieto and Perez-Cano, 2004). However, even the KBV can be applied to explain this, since the inter-firm transfer of knowledge is affected by the nature of the firm's IP.

With regards to the attribute of codifiability, explicit knowledge can be imitated, and thus transferred out of the firm, more easily because it can be codified. Examples of explicit knowledge include: knowledge contained in documents, plans or databases; knowledge contained in production machinery and equipment; and knowledge contained in certain raw materials, such as chemicals and pharmaceutical products or special alloys (Badaracco, 1991). The higher the degree of codification of an item of knowledge, the more efficient the legal means of protecting it (Nieto and Perez-Cano, 2004).

These legal IP protection measures, IPRs, grant innovators legal protection of their innovations against imitators through assigning ownership rights (Nieto and Perez-Cano, 2004). When IPRs are available to the firm, IP based on explicit and highly codified knowledge can be effectively protected by the use of patents, copyrights, trademarks or secrecy agreements (Nieto and Perez-Cano, 2004). Thus, IPRs provide the firm with protection of its proprietary knowledge by warning competitors about possibility of litigation if infringed, thus deterring them from expropriating and transferring that knowledge out of the firm with the (Mansfield, 1990).

Patents, in particular, have been shown to have a significant impact on the valuation of innovation (Levin *et al.*, 1987). The overall benefits of patents include providing a proprietary market advantage (shorter time to market); improving financial performance (reducing R&D expenditure); and improving overall competitiveness (Rivette and Kline, 2000; Terziovski and Corbel, 2012).

Therefore, if we employ the knowledge-based lens, we can argue that in the context of our study, the use of IPRs to protect a firm's IP deter imitation, leading to superior innovation performance. Thus, we propose the following hypothesis:

Hypothesis H2(i): The relationship between the utilisation of formal IP protection methods and innovation performance is positive and significant.

However, firms may not be able to rely on IPRs for the protection of their IP, due to the nature of their proprietary knowledge. In contrast to explicit knowledge, tacit knowledge is that which cannot be articulated and cannot be codified because it contains all the procedures and principles that one knows how but cannot articulate in words or other means (Nelson and Winter, 1982; Nonaka and Takeuchi, 1995; Nieto and Perez-Cano, 2004). Since knowledge of organizational routines is acquired through experience within the firm (Nelson and Winter, 1982; Cohen and Levinthal, 1990), most technological knowledge has a significant tacit component (Nieto and Perez-Cano, 2004). These features of tacit knowledge mean that it has natural barriers to imitation, which for example, are more difficult for employees to communicate to external parties such as customers, suppliers or peers, who might share this information with the firm's competitors (Mansfield *et al.*, 1981; Teece, 1986). This makes it not only difficult or impossible to imitate, and thus transfer out to other firms, but also difficult to protect with IPRs. Therefore, when IP is based on tacit knowledge, informal IP protection mechanisms can be utilized. These include the exploitation of lead-time, moving rapidly down the learning curve, organizational knowledge such as complementary manufacturing capabilities, product complexity, customer lock-in and brand advertising (Cohen et al, 2000; Lanjouw, 2003). We exclude trade secrets from this category of tacit knowledge, since they can be legally protected with secrecy agreements.

Furthermore, in the absence of IPRs, for example in weak institutional environments (Shapiro and Pham, 2007), firms can only protect their IP, whether based on explicit or tacit knowledge, with alternative methods (Keupp *et al*., 2010). In fact, the implementation of informal protection measures may also remedy some of the failures of protection offered by IPRs (Keupp *et al.*, 2010). For example, since it is highly codified with its components visible to imitators, patented technology can be imitated through the use of reverse engineering to sometimes create non-violating substitutes at less cost (Davis, 2001; Pisano and Teece, 2007). Therefore, the following hypothesis is proposed:

Hypothesis H2(ii): The relationship between the utilisation of informal IP protection methods and innovation performance is positive and significant.

However, it is not sufficient for the firm's IP to be rare and be made inimitable with the implementation of protection measures. According to the VRIO framework, it must also be valuable and organised to enable superior competitive advantage (Barney 1991, 1995). Since the

IP value chain is comprised of the steps of generation, protection and utilisation activities (Reitzig and Puranam, 2009), the firm's management of IP via open or closed innovation practices renders it valuable and organised, as it allows the firm to appropriate its IP, while mitigating the threat of expropriation by competitors (Kelly and Kranzburg, 1978; Chesbrough, 2003, 2008; Pisano and Teece, 2007). Hence, IP management practices, such as open or closed innovation regimes are also determinants of IP appropriability.

Chesbrough (2003, 2008) categorises IP management strategies as either open or closed innovation regimes. In an open innovation business model, the firm uses its unused internal ideas to capture value in the market via external channels, while using ideas external to its own business to generate additional value (Chesbrough, 2003, 2008; Pisano and Teece, 2007). Examples of strategies for managing IP in an open innovation regime include obtaining IPRs, such as patents, which can be out-licensed, as well as publishing new discoveries, making them open to the public and encouraging standardization, which shapes the landscapes of industries.

In order to be successful in open collaborative innovation, firms need to share valuable knowledge, while they protect that same knowledge against unwanted spill-overs (Grindley and Teece, 1997; Gulati and Singh, 1998). However, since they provide articulated and codified information, patents are an easy target for competitors wishing to obtain information at less cost than if they were to conduct the R&D activities themselves. Grindley and Teece (1997) argue that currently an increase in R&D and manufacturing costs has led to the increased risk of infringement of IP. Therefore, the market response by firms has been to aggressively protect their IP with a dual strategy for capturing value from that IP, whereby the IP in question is out-licensed in R&D partnerships and in product manufacturing in manufacturing joint ventures.

Since many companies in high-tech industries have significantly large numbers of patented IP, in which it is difficult to monitor infringement of individual patents, they out-license whole portfolios of patents in a given field-of-use to partners, whereby each firm has the freedom to infringe the other's existing and future patents for a given period. Innovation performance is enhanced by such IP management practices because high-tech firms manufacture products, which include complex systems that involve different technologies. Since it is not possible for them to develop all the technologies that they require for their products, many of these technologies are developed by other firms (Grindley and Teece, 1997; Shapiro & Pham, 2007).

While several scholars have investigated the impact of open innovation practices on firm performance (e.g. Laursen and Salter, 2006; Enkel et al., 2009; Jarvenpaa and Wernick, 2012; Granstrand, 2004), there is a need to validate the arguments presented by Grindley and Teece (1997) with a quantitative study of the impact of patent portfolio management via out-licensing on innovation performance, an examination of the impact of the implementation of out-licensing on innovation performance is warranted. Therefore, the following hypothesis is proposed:

Hypothesis H2(iii): The relationship between the implementation of out-licensing and innovation performance is positive and significant.

Implementing a closed innovation regime means that although the IP is protected, the firm could be losing out on potential rents, especially when the firm must recoup its investments in R&D (Nieto & Perez-Cano, 2004). In their theoretical paper, Pisano and Teece (2007) examine appropriability regime and industry architecture, and how they can be shaped for successful IP appropriation. They find that greater levels of IP protection and stronger barriers around innovation are not necessarily conducive to capturing value from the firm's IP.

According to Chesbrough (2008) closed innovation regimes were common in the past, with firms keeping control of internally generated ideas and being self-reliant for the commercialisation of these ideas. Managing IP by maintaining industrial secrecy (trade-secrets) to exclude competitors from this proprietary knowledge is an example of a closed innovation model, where the innovator can appropriate returns indefinitely as long as the knowledge does not spill outside the firm (Levin et al., 1987; Cohen et al., 2000; Nieto and Perez-Cano, 2004; Hurmelinna *et al.*, 2007). Several studies that suggest that secrecy provides better protection of IP than patents (e.g., Cohen et al., 2000; Arundel, 2001). Therefore, the following hypothesis is proposed:

Hypothesis H2(iv): The relationship between the implementation of a policy of maintaining trade secrets and innovation performance is positive and significant.

Another key determinant of the firm's IP appropriation strategy is its motives for IP appropriation, as explained by Narayananan (2001). These include starting a new business; enhancing technological capability, or supporting the existing business. Firms make IP appropriation choices either "To create fundamentally new business; to alter the rules of rivalry; or to support – defend, maintain, and expand – existing businesses". These functions determine the type of technology appropriation projects pursued by the firm and the IP management

practices implemented by the firm. It can then be said that the motives for the firm's current IP management strategy impact innovation performance since they can facilitate intra- and inter-firm knowledge transfer and thus, the protection or exploitation of its IP, which can make it "inimitable" and/or "valuable". Therefore, the following hypothesis is proposed:

Hypothesis H2(v): The relationship between the motives for the organization's current IP management strategy and innovation performance is positive and significant.

Furthermore, the way in which the revenues from innovation are used can have an impact on innovation performance, thus making it a key determinant of IP appropriation strategy. Firms may choose to reinvest revenues into R&D activities, to acquire resources, pass them on to stakeholders, or keep them as retained earnings, etc.

When profits are used to increase the organization's IP assets, by means of reinvesting in R&D projects or acquiring IP via partnerships or acquisitions, the organization increases its ownership of "rare" resources. As mentioned earlier, R&D investment is expected to lead to increased innovation performance, as is the acquisition of resources. Therefore, we propose the following hypothesis:

Hypothesis H2(vi): The relationship between the use of profits from innovation and innovation performance is positive and significant.

The relationship between Organizational Learning and Innovation Performance

Another key determinant of IP appropriability which has been identified by the literature, organizational learning, facilitates the process by which firms can attain new knowledge (Tippins and Sohi, 2003). Learning by doing, where repeating an action leads to proficiency in performance in that activity, leads to a reduction in the costs of carrying out these activities because the firm can move quickly down the learning curve, so that the time required to manufacture a product becomes progressively shorter as the amount of units produced increases (Arrow, 1962).

Nelson and Winter (1982) describe the firm as learning by developing better routines, arguing that organizational routines can be both explicit and tacit in nature, with explicit knowledge being embedded in bureaucratic rules and tacit knowledge embedded in the organization's culture. Superior firm performance results when the quality of the interaction between the explicit and evolving tacit knowledge leads to improvements. However, they assume

that firm knowledge is independent of individual knowledge and do not explain how the firm facilitates the generation and application of its knowledge and learning.

A better explanation how organizational learning facilitates IP appropriation is given by Kogut and Zander (1992), who propose that organizational knowledge is either information or know-how based. Knowledge as information implies knowing what something means, while know-how is a description of knowing how to do something, describing what defines current practice inside a firm. Know-how is also an "accumulated practical skill or expertise that allows one to do something smoothly and efficiently" (Von Hippel, 1988), which implies that know-how must be learned and acquired.

Furthermore, knowledge increases with experience, which comes from localised search that is guided by know-how and information (Cyert and March 1963, Nelson and Winter 1982). Since, Schumpeter (1968) defines innovations "as new combinations of existing knowledge and incremental learning", Kogut and Zander (1992) argue, it is the recombination of information and know-how which leads to advances in knowledge, thus guiding innovation.

In their empirical study, Terziovski and Corbel (2012) found that a learning organization is characterized by high innovation performance, as it is able to quickly move down the learning curve. As a result, the firm can market its innovations before its competitors and maintain this leadership position for as long as the competitors are not able to obtain the proprietary knowledge (Garvin, 1993; Arundel, 2001; Nieto and Perez-Cano, 2004). Firms can also learn about how to better protect processes and products by imitating the strategies other firms in the same industry. The case study of Australian firm L&R Ashbolt, a specialised surface engineering company, demonstrates that firms can save time and capital by examining patents already registered by other firms to obtain useful information about innovation trends and directions. "*We don't copy patents that already exist – they just give us an idea of a direction we could follow and improve on. Examining competitors' patents also provides us with invaluable marketing knowledge*."[4]

Therefore, we can argue that the effectiveness of the firm's IP appropriation strategy depends on the recombination or know-how and information via intra- and inter-firm knowledge transfer, which leads to organizational learning. Hence, we propose the following hypothesis:

[4] http://www.ipaustralia.gov.au/strategies/case_ash.shtml

Hypothesis H3: The relationship between the implementation of an organizational learning culture and innovation performance is positive and significant.

The impact Firm Size as a control variable

Firm size is an important variable that can explain outcomes such as innovation performance. The differences between small and large firms can demonstrate the impact of firm-specific factors, such as resources and capabilities, on innovation appropriation. For example, as Arundel (2001) finds, small firms may not have the resources to bear the costs of applying for patents to protect their innovations or of law suits against infringements of intellectual property rights, and hence, may not find patents as valuable, but instead choose to protect their intellectual property with informal protection measures such as secrecy. On the other hand, large firms often have resources devoted to the protection of their intellectual property, such as a legal department, which leads to a higher propensity to patent innovations. Such patented IP can then be out-licensed by the firm to produce rents. The literature also demonstrates that larger firms enjoy economies of scale in the R&D function and the ability to collect sufficient funds to sustain large R&D programs, leading to increased innovation performance (Cohen *et al.*, 1987). Therefore, the following hypothesis is proposed:

Hypothesis H4(i): When the effect of company size is controlled for, the relationship between IP appropriation and innovation performance is stronger.

The impact of Industry type as a control variable

Industry-specific factors, such as life-cycle stages and the dominant paradigm, are highlighted in the innovation appropriation literature as impacting innovation appropriation strategies (Abernathy and Utterback, 1978; Porter, 1981; Williamson, 1993).

Since IP rights play an important role in appropriating innovation rents in technology-based industries (Cohen *et al.*, 2000), and open innovation regimes involve out-licensing of patented IP, firms in such industries are more likely to be continuously innovating. The development and achievements of the biotechnology industry, for example in the field of genetic research, have made the industry more dependent on IP rights protection (Eisenberg, 1987).

The pharmaceutical and chemical industries are also highly reliant on patent protection due to new advances in technology have made is easier to copy chemical compounds (Nogues 1990; Noonan, 1990; Besen and Raskind, 1991). However, there is evidence that the pharmaceutical

industry is becoming less innovative because, although there has been a rise in R&D expenditure, there is a decrease in the number of new drugs coming to market (Drews, 1998, Cohen *et al*., 2005). Therefore, the following hypothesis is proposed:

Hypothesis H4(ii): When the effect of industry type is controlled for, the relationship between IP appropriation and innovation performance is stronger.

The impact of Firm Ownership as a control variable

Firm ownership is another important variable that can explain outcomes such as innovation performance. Firm ownership refers to whether a business is owned publicly, privately, by a government body or a foreign owner, and can implications for the sharing of risks, allocation of resources, commitment of knowledge and organizational control (Gatignon and Anderson, 1988; Gomes-Casseres, 1990; Hennart, 1988).

According to Shleifer (1998) one characteristic of privately-owned firms compared to publicly-owned firms is their ability to enable cost reductions and quality innovation. On the other hand, the agency theory suggests that in publicly owned firms, shareholders can influence managerial decisions to ensure corporate entrepreneurship (Zahra, 1996).

Furthermore, Frost (2001) demonstrates that an important source of competitive advantage for the multinational organization is the capacity of its foreign subsidiaries to develop innovations based on stimuli and resources of the heterogeneous host country environments in which they operate. Foreign-owned companies, whose subsidiaries are based in the host country (Australia for the purpose of this study), may have an extra edge over local firms and thus achieve better innovation performance. Therefore, the following hypothesis is proposed:

Hypothesis H4(iii): When the effect of firm ownership is controlled for, the relationship between IP appropriation and innovation performance is stronger.

Theoretical Model

The literature review has identified some key factors that facilitate IP appropriation strategy, which impact innovation performance. These will be tested as independent variables in a model of the impact of IP appropriation strategy determinants on innovation performance.

Figure 1 presents this resulting theoretical model. Based on the VRIO framework and KBV, the model indicates that the firm's organizational resources, IP management practices and organizational learning culture are constructs that form the IP appropriation strategy of the firm,

which can facilitate the firm's appropriation of innovation rents. The model predicts that firm size, industry type and foreign ownership are also expected to have an effect on the relationship between these dimensions and innovation performance. These will be tested as control variables in Hypotheses H4(i) to H4(iii).

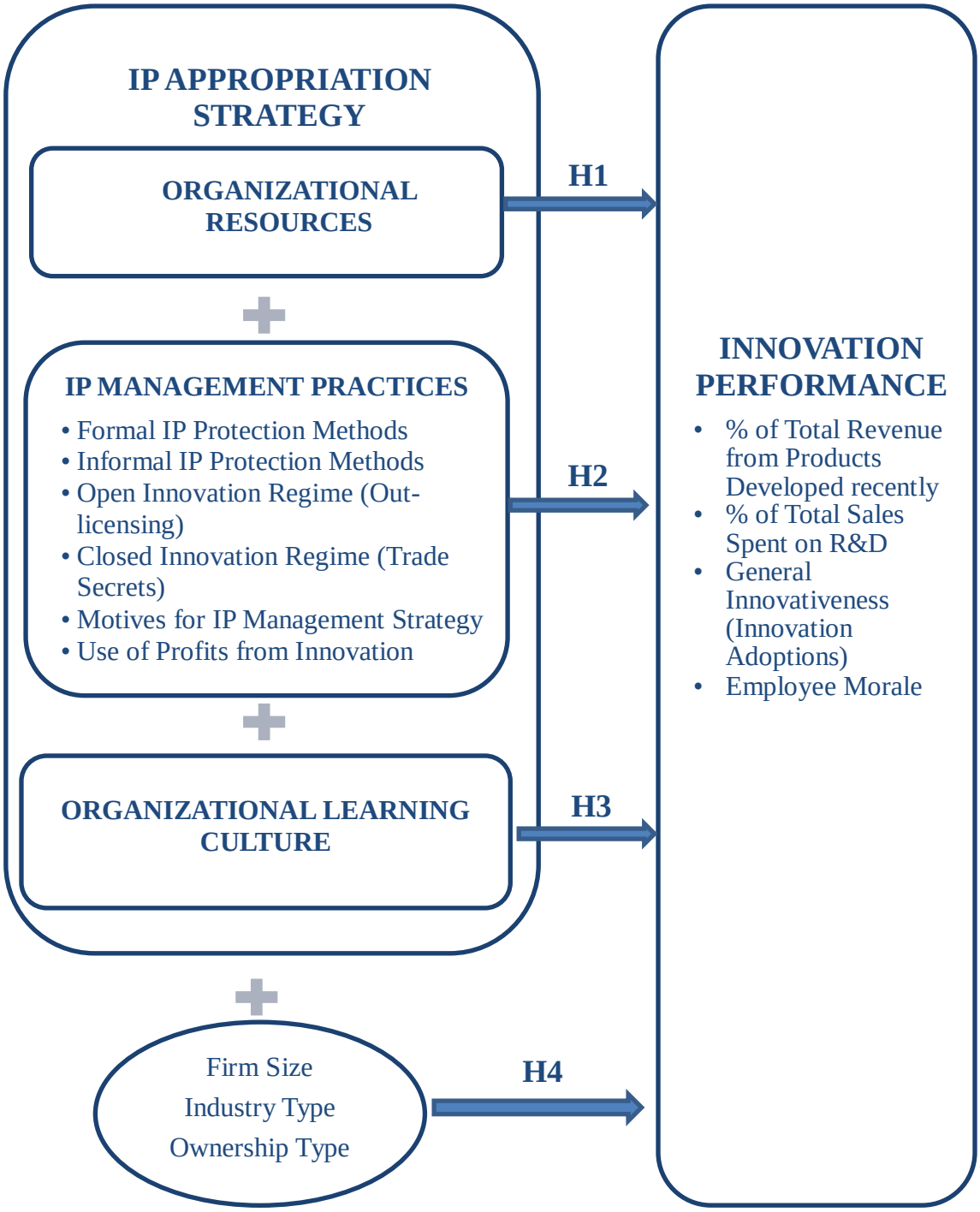

Figure 1. Theoretical Framework for IP Appropriation Strategy.

METHODOLOGY

Quantitative analysis is used to test the extent to which the model predicts the most significant IP appropriation dimensions of innovation, and whether the model is a reliable and valid instrument for predicting innovation performance.

Survey Instrument

A survey instrument was designed based on the theoretical framework and was used to obtain information on the following: (1) Basic company information, including the nature of the business, the level of sales in Australia and abroad, as well as the type of ownership; (2) IP Management Practices (3) Organizational Learning Culture; and (4) Innovation Performance.

The respondents targeted for the survey instrument included IP managers, commercialisation managers and general managers, generally due to their understanding of the firm's IP strategy.

The survey instrument was communicated via email and follow-up telephone calls were made for non-responses. The survey instrument was pilot-tested in approximately 30 organizations chosen at random. The final version of the survey instrument was developed with the relevant independent and dependent variables based on the feedback obtained from the pilot study.

Defining Target Population and Sample

The sample of firms was developed from two sources. Firstly, a sample of 300 companies was drawn from the Australian ICT industry, based on the Australian Standards Industry Classification (ASIC) system. Secondly, Ausbiotech's online database of biotechnology and pharmaceuticals companies was used to randomly select 600 biotechnology and pharmaceuticals companies based in Australia.

Context and Industries Studied

This study requires a sample that is representative of a cross-section of randomly selected companies in Australia, including small-to-medium enterprises (SMEs). The biotechnology, pharmaceuticals and ICT sectors were chosen because R&D and IPR strategy are important for rapid and continuous innovation (Cohen et al., 2000). In the ICT industry, formal structures and systems can enable cost savings for the firm (Terziovski, 2010; Wheelen and Hunger, 1999; Bessant and Tidd, 2007), and thus the innovation of process improvements can be a source of IP, which can lead to competitive advantage.

The pharmaceutical and biotechnology industries are the most IP-intensive and contribute to annual GDP growth in the U.S. and to a lesser extent in Australia (Shapiro and Pham, 2007). Hence, by focusing on these industries, this study aims to highlight IP appropriation strategy issues impacting innovation performance, which is expected to be high in Australian firms since they enjoy incentives provided by the Australian government, aimed at encouraging increased R&D spending.

However, low rates of patenting, suggests that instead of generating breakthrough innovations, Australian firms are adopting or modifying already existing innovations[5]. Therefore, innovation performance is unique in Australia because despite the presence of the legal framework supporting the enforcement of IP rights and also the Australian government's incentives to encourage R&D spending, Australia generates fewer first-to-market innovations compared to other OECD countries[6].

Defining Variables

Multiple Regression Analysis, was used to test the model. The variables used in the regression analyses to test the hypotheses were defined using Exploratory Factor Analysis. This is because the variables in our data set were developed from a survey, which was based on a series of questions relating to various aspects of IP appropriation. We needed to reduce the number of variables, but were not certain about which variables to combine in order to ensure the resulting unobserved variables would explain the maximum possible variance among the observed variables. Unlike confirmatory factor analysis, exploratory factor analysis, does not rely on prior assumptions about the relationships among the items.

The relevant variables in the data base were considered reliable indicators of the constructs if their composite reliabilities exceeded a Chronbach Alpha of greater than 0.7 (Nunnally, 1978), while a cutoff loading of 0.30 was used to screen out variables that were weak indicators of the construct.

[5] http://www.innovation.gov.au/Innovation/Policy/AustralianInnovationSystemReport/AISR2011/chapter-1-the-performance-of-the-australian-innovation-system/assessing-the-performance-of-the-innovation-system/index.html

[6] http://www.innovation.gov.au/Innovation/Policy/AustralianInnovationSystemReport/AISR2011/chapter-1-the-performance-of-the-australian-innovation-system/assessing-the-performance-of-the-innovation-system/index.html

Defining Independent Variables

The independent variables corresponding to the independent constructs were derived from the corresponding sections in the survey instrument titled "Organizational Resources", "IP Management Practices", and "Organizational Learning", which used a Likert scale (ranging from 1 through to 5). Table 1 provides the results of the Exploratory Factor Analyses for the independent variables.

Table 1. Exploratory Factor Analyses for independent constructs.

Construct	**ORGANIZATIONAL RESOURCES**	
Factor Loadings for Items:	Formal Reporting Structure	0.830
	Explicit management control systems	0.788
	Access to Raw Materials	0.663
	Experienced Managers	0.622
	Plant & Equipment	0.586
	Geographic Location	0.583
Eigen Value	**2.819**	
Cronbach's Alpha	**0.769**	
KMO Test of Sampling	**0.742**	
Bartlett's Test of Sphericity: Chi-Square	**179.985*** **	
Construct	**FORMAL IP PROTECTION MEASURES**	
Factor Loadings for Items:	Trademarks	0.798
	Copyrights	0.742
	Secrecy Agreements	0.693
	Patents	0.528
Eigen Value	**1.947**	
Cronbach's Alpha	**0.632**	
KMO Test of Sampling	**0.657**	
Bartlett's Test of Sphericity: Chi-Square	**60.551*** **	
Construct	**INFORMAL IP PROTECTION MEASURES**	
Factor Loadings for Items:	Lead-Time	0.797
	Moving Quickly Down the Learning Curve	0.795
	Organizational Knowledge	0.781
	Product Complexity	0.756
Eigen Value	**2.450**	
Cronbach's Alpha	**0.787**	
KMO Test of Sampling	**0.691**	

Bartlett's Test of Sphericity: Chi-Square	**139.763*** **	
Construct	**MOTIVES FOR CURRENT IP MANAGEMENT STRATEGY**	
Factor Loadings for Items:	To Establish Customer Lock-in	0.800
	To Establish Lead-Time Advantage	0.794
	To Establish Ownership Rights	0.629
	To Influence Technological Standards	0.471
Eigen Value	**1.888**	
Cronbach's Alpha	**0.614**	
KMO Test of Sampling	**0.647**	
Bartlett's Test of Sphericity: Chi-Square	**55.947*** **	
Construct	**USE OF PROFITS FROM INNOVATION**	
Factor Loadings for Items:	To Acquire Resources	0.772
	Reinvested in R&D Activities	0.750
	Kept as Retained Earnings	0.677
	Passed on to Stakeholders	0.533
Eigen Value	**1.901**	
Cronbach's Alpha	**0.623**	
KMO Test of Sampling	**0.639**	
Bartlett's Test of Sphericity: Chi-Square	**56.432*** **	
Construct	**ORGANIZATIONAL LEARNING**	
Factor Loadings for Items:	Inclusion of new aspects to processes, products and services compared to prior strategies	0.944
	Undertaking new approaches to processes, products and services that are different from those used in the past	0.765
	Continuous improvements to the firms processes, products and services	0.551
Eigen Value	**2.119**	
Cronbach's Alpha	**0.784**	
KMO Test of Sampling	**0.640**	
Bartlett's Test of Sphericity: Chi-Square	**113.520*** **	

*Note: N = 110, Significance Levels: *p<0.10, **p<0.01, ***p<0.001.*

Defining Control Variables

When estimating the effects of the independent variables on the dependent variable, the following control variables were included in the regression analyses. Firm size will be controlled for by using two proxy variables, which represent two different aspects of firm size. These are Number of Employees, which refers to firm size in terms of human capital resources, and Total Sales, which refers to market capitalisation. Firm industry type will be controlled for by using dummy variables to represent firms from the biotechnology, pharmaceuticals or ICT industries. Finally, in order to control for *Firm Ownership*, a dummy variable was created, where 1 is for privately-owned and 0 is for non-privately owned, since the majority of firms in the dataset (70.9%) were privately owned.

Defining Dependent Variable

This study makes use of the measure of the Innovation Performance construct, which was developed by Terziovski and Corbel (2012). Their measure is based on several dimensions of innovation performance developed by Subramanian and Nilakanta (1996) including: *Revenue from new products developed in the last three years; Number of Innovation Adoptions; Time of Innovation Adoption; Time to Market (TTM); Research and Development as a Percentage of Sales; and Employee Morale*.

These items were extracted from the "Innovation Performance" section of the survey instrument, in which they were measured on a Likert scale (ranging from 1 through to 5). An Exploratory Factor Analysis of the innovation performance items was conducted in order to extract some factors representing the dependent construct. Table 2 contains the Exploratory Factor Analysis results for the dependent variable *Innovation Performance*.

Table 2. Exploratory Factor Analysis for dependent construct.

Construct	**INNOVATION PERFORMANCE**	
Factor Loadings for Items:	Percentage of Total Revenue which is from products developed in the last 1-3 years	0.602
	General Innovativeness (stemming from no. of innovation adoptions or time of innovation adoption)	0.585
	Percentage of Total Sales spent on R&D	0.506

	Employee Morale	0.413
Eigen Value	**1.831**	
Cronbach's Alpha	**0.596**	
KMO Test of Sampling	**0.685**	
Bartlett's Test of Sphericity: Chi-Square	**40.271*** **	

*Note: N = 110, Significance Levels: *p<0.10, **p<0.01, ***p<0.001.*

Analysis Techniques

The formulated hypotheses were tested using bivariate correlations as well as multiple regression analyses, which enabled a comparison between each of the independent variables and the strength of their relationships with the dependent variable construct, *Innovation Performance*. The Ordinary Least Squares (OLS) method was used to conduct a multiple regression analysis to test the relationships between the independent and dependent variables.

DATA ANALYSIS

Survey Results

The survey yielded 110 responses, which is equivalent to a responses rate of 16%. The resulting sample comprised of 43% biotechnology companies, 25% pharmaceuticals companies, and 33% ICT companies. With this sample, 71% of companies were privately-owned, 24% were publicly-owned, 5% government-owned, and 1% foreign-owned. With regards to firm size the majority of respondents had between 20 and 99 employees (41%), and total annual sales within the range of AUD1-19 million (61%).

Respondent Profile

The respondent profile can be generally described as middle to senior managers, with 30% of the respondents in senior management positions, which included chief executive officers, directors and managing directors. The remaining 70% of the respondents were in middle management positions, which included IP commercialisation managers, business development managers and functional managers. This was expected, since upon administration of the survey,

it was difficult to contact senior managers directly, but often mid-level managers were available to participate in the survey.

Descriptive Statistics

An examination of the descriptive statistics of the sample of the dataset provides an overview of the sample and the observations within it. Table 3 provides a table of the descriptive statistics output.

Correlation Analysis

A bivariate correlation analysis was conducted to examine the correlations between the variables and to check for multi-collinearity. Table 4 illustrates these correlations in a correlation matrix. Despite the presence of some significant correlations, there is no threat of multi-collinearity since the inter-correlation coefficients between the independent variables are well below the recommended correlation coefficient value r = 0.9, as suggested by Hair et al. (2009). Therefore, multi-collinearity does not appear to be a problem (Qian and Li, 2003).

The results of the regression analysis of Model 2 in Table 5 can be used to either support or abandon the hypotheses. The results were found to be insignificant for the hypotheses relating to organizational resources (H1(i)), internal acquisition of resources (H1(ii)), external acquisition of resources H1(iii)), formal IP protection methods (H2(i)), informal IP protection methods (H2(ii)), out-licensing (H2(iii)), motives for IP management strategy (H2(v)), and organizational learning culture (H3).

Table 3. Descriptive Statistics.

	N	Minimum	Maximum	Mean	Std. Dev.	Skewness	Kurtosis
Organizational Resources	110	-2.526	2.994	0.000	1.000	0.014 (0.230)	1.078 (0.457)
Internal Acquisition of IP via R&D	110	-3.830	0.920	0.000	1.000	-1.298 (0.230)	2.044 (0.457)
External Acquisition of IP	110	-1.980	1.890	0.000	1.000	-0.193 (0.230)	-0.452 (0.457)
Formal IP Protection Measures	110	-3.551	1.812	0.000	1.000	-1.105 (0.230)	1.736 (0.457)
Informal IP Protection Measures	110	-3.375	1.643	0.000	1.000	-1.031 (0.230)	1.865 (0.457)
Out-Licensing	110	-1.420	1.850	0.002	1.001	0.093 (0.230)	-1.041 (0.457)
Maintaining Trade Secrets	110	-2.260	1.690	0.022	1.011	-0.460 (0.230)	-0.177 (0.457)
Motives for Current IP Management Strategy	110	-2.608	1.863	0.000	1.000	-0.157 (0.230)	-0.302 (0.457)
Use of Profits from Innovation	110	-2.580	2.216	0.000	1.000	-0.220 (0.230)	-0.358 (0.457)
Organizational Learning	110	-3.335	1.997	0.000	0.954	-0.561 (0.230)	0.671 (0.457)
Innovation Performance	110	-2.198	1.359	0.000	0.781	-0.422 (0.230)	0.124 (0.457)
Valid N (listwise)	110						

*Note: Significance Levels: *p<0.10, **p<0.01, ***p<0.001; Standard errors in parentheses.*

However, Table 5 indicates that the regression coefficient for *Maintaining Trade Secrets* is positive. The Beta coefficient is 0.222 and the result is significant ($p < 0.10$). In other words, the results indicate that the greater the use of trade secrets to protect the organization's IP, the higher the innovation performance of the organization. Therefore, the hypothesis H2(iv) is supported.

Furthermore, the regression coefficient for *Use of Profits from Innovation* is positive. The Beta coefficient is 0.288 and the result is significant ($p < 0.01$). These results indicate that the greater the more an organization makes use of its profits from innovation by acquiring new resources, reinvesting them into R&D, etc., the greater the innovation performance of the organization. Therefore, the hypothesis H2(vi) is supported.

Finally, the regression coefficient for *Organizational Learning* is positive. The Beta coefficient is 0.266 and the result is significant ($p < 0.01$). In other words, the results indicate that the greater the presence of an Organizational Learning within the organization, the higher its innovation performance. Therefore, the hypothesis H3 is supported. Overall, when the Beta coefficients are taken into consideration, it can be stated that the Use of Profits from Innovation has the greatest impact on Innovation Performance, followed by Organizational Learning, and then Maintaining Trade Secrets.

It can also be concluded that the impact of the independent variables relating to *Organizational Resources, IP Management Practices* and *Organizational Learning* on *Innovation Performance* are not affected by firm *Industry, Ownership* or *Size*.

Table 4. Bivariate Correlation Analysis.

	1	2	3	4	5	6	7	8	9	10	11
1.Organizational Resources	1	0.053	0.453**	0.108	0.025	0.138	0.269**	0.323**	-0.023	0.161	-0.065
2.Internal Acquisition of IP via R&D		1	-0.012	0.042	0.300**	0.026	0.278**	0.236*	0.092	0.094	0.022*
3.External Acquisition of IP			1	0.077	0.023	-0.155	0.121	0.140	0.022	0.093	-0.153
4.Formal IP Protection Measures				1	0.283**	0.331**	0.215*	0.166	0.063	0.046	0.096
5.Informal IP Protection Measures					1	0.069	0.428**	0.518**	0.173	0.337**	0.34**
6.Out-Licensing						1	0.131	0.122	-0.053	0.031	0.109
7.Maintaining Trade Secrets							1	0.439**	-0.125	0.320**	0.262**
8.Motives for Current IP Management Strategy								1	0.196*	0.434**	0.237*
9.Use of Profits from Innovation									1	0.009	0.297**
10.Organizational Learning										1	0.329**
11.Innovation Performance											1

*Note: N = 110, Significance Levels: *p<0.10, **p<0.01, ***p<0.001, All tests are two-tailed.*

Table 5. Results of multiple regression analysis on *INNOVATION PERFORMANCE*.

	Model 1		Model 2	
	B **t value**	**β**	**B** **t value**	**β**
Constant	-0.003 (0.065) -0.053		0.129 (0.202) 0.639	
Organizational Resources	-0.063 (0.080) -0.787	-0.081	-0.037 (0.083) -0.448	-0.048
Internal Acquisition of IP via R&D	0.076 (0.070) 1.084	0.097	0.070 (0.071) 0.978	0.089
External Acquisition of IP	-0.117 (0.076) -1.539	-0.150	-0.100 (0.077) -1.304	-0.128
Formal IP Protection Measures	-0.009 (0.073) -0.129	-0.012	-0.033 (0.075) -0.434	-0.042
Informal IP Protection Enablers	0.097 (0.085) 1.135	0.124	0.079 (0.092) 0.862	0.101
Out-Licensing	0.063 (0.072) 0.879	0.081	0.079 (0.075) 1.062	0.102
Maintaining Trade Secrets	0.155* (0.081) 1.922	0.201	0.171* (0.083) 2.062	0.222
Motives for Current IP Management Strategy	-0.061 (0.088) -0.686	-0.078	-0.085 (0.090) -0.937	-0.108
Use of Profits from Innovation	0.243** (0.070) 3.479	0.311	0.225** (0.077) 2.905	0.288
Organizational Learning	0.221** (0.078) 2.844	0.270	0.218** (0.079) 2.757	0.266
Biotechnology			-0.170 (0.178) -0.955	0.108
Pharmaceuticals			-0.108 (0.215) -0.503	-0.060
Ownership			0.007 (0.170) 0.041	0.004

Employees		-1.331E-005 (0.000) -1.464	-0.152
Total Sales		0.000 (0.000) 1.577	0.156
R-Squared	**0.315**	**0.347**	
Adjusted R-Square	**0.246**	**0.242**	
F Statistic	**4.556*** **	**3.323*** **	
No. Observations	**110**		

Notes:

a) All tests are two-tailed

*b) Significance Levels: *p<0.10, **p<0.01, ***p<0.001*

*c) Beta (***ß***) = Regression coefficient (standardised regression coefficient)*

d) B = Intercept

e) t =t-test-assesses whether the means of two groups are statistically significant from each other. The larger the t value the greater the difference.

DISCUSSION OF RESULTS

The impact of Organizational Resources on Innovation Performance

The relationship hypothesised in H1 between *Organizational Resources* and *Innovation Performance* did not receive support, despite the notion that organizational resources can lead to efficiency and effectiveness (Wernerfelt, 1984). This can be explained from the literature, for example, with regards to the factor *Experienced Managers,* Bettis and Hitt (1995) explain why the presence of experienced managers in a firm might be negatively correlated with innovation, suggesting that they need to have a new entrepreneurial mindset and unlearn what they already know. Given the large number of small to medium enterprises in the sample, one school of thought in the literature is that small and medium enterprises are good at creating new products but lack systems and processes to commercialise their products (Terziovski, 2010).

Hypothesis H1(ii) relating to *Internal Acquisition of IP via R&D* and *External Acquisition of IP* were also not supported. This can be explained from the literature, which on one hand agrees that greater internal R&D activities lead to higher innovation performance (Rogers, 1998;

Mansfield, 1964; Hall, 1998). However, Drews (1998) found, increased R&D expenditure does not necessarily lead to higher innovation outputs because the IP derived from the R&D may not be appropriated to its full potential. For example, the organization may believe there is little or no commercial value in the IP, and thus it may not have the motivation to legally protect its IP with IPRs. Therefore, it may choose not to spend the time and cost required to legally protect its IP, and thus the organization does not attain full profits from that innovation.

Hypothesis H2(iii) stated that the acquisition of IP from sources external to the firm could hinder innovation performance, and although the result was insignificant, it still suggests a negative relationship. This insignificance may be due to the rather small sample size.

The impact of IP Management Practices on Innovation Performance

The regression analyses in Table 5 show that Hypotheses H2(iv) and H2(vi) are supported, as the IP management practice variables, *Maintaining Trade Secrets* and *Use of Profits from Innovation*, demonstrated positive and significant relationships with the dependent variable *Innovation Performance*.

Hypotheses H2(i), (ii), (iii) and (v), relating to formal IP protection measures, informal IP protection measures, out-licensing, and the motives for the firm's current IP management strategy, respectively, were not supported. Formal IP protection measures, such as patents, trademarks, copyrights and secrecy agreements, may not be effective in protecting the firm's IP if these are not enforced due to a weak institutional environment (Shapiro and Pham, 2007), which is likely to impede the firm to effectively appropriate its IP and hence gain profits.

Also, we find that informal IP protection enablers, such as lead-time advantage, moving quickly down the learning curve, organizational knowledge and product complexity, may not be effective in protecting the firm's IP. This could be due to the fact that these are simply conditions which may be conducive to IP appropriation.

Out-Licensing activities, which generally make use of patented IP, have been recommended by Teece (1986) to be undertaken under conditions of strong patent protection and/or where the innovating firm does not possess complementary assets for the manufacture or marketing of its innovations. In the current study, the sample population is taken from the Australian biotechnology, pharmaceuticals and ICT industries, so IPRs are enforced and hence,

this is not an issue. On the other hand, although firms may be licensing their IP, they may not possess the capabilities to commercialise the IP. Therefore, if the innovating firm is out-licensing its IP to other firms which are in the market already, it may be losing out on potential market share and profits that it could gain if it possessed complementary assets to manufacture and market its innovations on its own, instead of out-licensing.

The motives for the organization's choice of IP management strategy, including establishing customer lock-in, establishing lead-time advantage, establishing ownership rights, and influencing technological standards, were also shown to have no significant effect on innovation performance. This could be due to the fact that they are simply motives, which may not be acted upon or may be difficult to achieve, given the organization's resources and IP management strategy.

The impact of Organizational Learning Culture on Innovation Performance

The study found support for the relationship hypothesised in H3 between *Organizational Learning* and *Innovation Performance*. This result indicates that the greater the presence of an organizational learning culture within the organization, the stronger is the relationship with innovation performance. This result could be due to the factors represented by the *Organizational Learning* variable (See Table 1 for Exploratory Factor Analysis). It is possible that these factors allow the firm to move quicker down the learning curve, which enables the appropriation of the organization's IP.

CONCLUSIONS & IMPLICATIONS

Following the quantitative analysis of the data, we can now answer the key research question of this study. The exploitation of organizational resources and capabilities, implementation of certain IP management practices and an organizational learning culture enable firms to appropriate their IP, through both protection and exploitation, for superior innovation performance. Several factors were found to facilitate the appropriation of IP: implementation of trade secrets, the way in which profits from innovation are used, and the development of an organizational learning culture.

The study makes a contribution to the literature by shedding new light on previous findings (Pisano and Teece, 2007; Chesbrough, 2008; Ceccagnoli, 2009; Terziovski and Corbel, 2012).

The implication for managers is that IP appropriation is likely to be most successful when trade secrets and profits from innovation are applied simultaneously within an organizational learning culture.

Furthermore, by examining the hypotheses in the Australian context, our paper reveals findings that add insight into what factors facilitate IP appropriation in Australian firms. Factors such as maintaining trade secrets and making use of profits from innovation, as well as implementing an organizational learning culture, would facilitate IP appropriation in Australian firms, which would lead to superior innovation performance.

Study Limitations

This study has some theoretical and empirical limitations. A conceptual problem is that our study does not test for the possibility that the IP protection measures that facilitate IP appropriation can also be used in combination for superior competitive advantage. For example, lead time can be used to maintain a leadership position in combination with other IP protection measures, such as patents and/or secrecy agreements, which act as a "safety net" and are more effective in sustaining a competitive advantage (Hall & Ziedonis, 2001; Terziovski & Corbel, 2012). Also, different protection mechanisms can also be implemented at various stages of the IP value chain. For example, firms might first depend on secrecy before the commercialisation of a new product, but follow this with patent protection, as well as marketing and lead-time strategies. Furthermore, the effectiveness of different protection mechanisms varies over time. For example, patents eventually expire or trade secrets may be exposed. Therefore, we suggest further research to examine the impact of combinations of IP management practices on innovation performance.

Empirical limitations of this study stem from the characteristics of our sample. Most of the companies in the sample were privately-owned (71%), implying limited generalizability of the results to mostly privately-owned companies with some applicability to publicly-owned companies, which made up 24% of the sample. Similarly, with regards to firm size, since the majority of respondents had between 20 and 99 employees (41%), and total annual sales within the range of AUD1-19 million (61%), it may be argued that the results are generalizable to small-to-medium-sized enterprises.

Another empirical limitation is that we gathered data from one respondent in each company. We suggest further studies seeking responses from multiple respondents in firms in order to determine if organizational resources do in fact play a role in the IP appropriation strategy of firms, together with IP management practices and organizational learning culture.

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