

KNOWLEDGE PROTECTION AND KNOWLEDGE SHARING – BENEFITS AND PROBLEMS IN NETWORKED INNOVATION

ABSTRACT

In prior research, it has been stated that the strength of protection that a firm has against imitation of its core intangibles influences its performance. However, there are various mechanisms through which this can happen, as the availability and use of barriers to imitation offers quite different, even opposing, opportunities to utilize the intangibles belonging to an individual organization. Especially the increasing tendencies to collaborate in innovation activities have opened up new possibilities, although new challenges have also emerged as a result of increasing networking.

This study examines especially knowledge sharing and protection as two elements strongly present in networked innovation. The empirical evidence from 291 companies suggests that the strong appropriability regime (i.e. “protective fence” improving controllability of intangibles) contributes to both lengthening the imitation lag and facilitating knowledge exchange between organizations. The findings further illustrate that of these two, knowledge sharing is the one yielding better innovation performance, whereas imitation lags contribute to firm success in terms of profitability and increased turnover. It can be thus concluded that an integrative perspective, rather than simply choosing between two (seemingly) opposing strategies enables a firm to perform better, especially in the networked environment.

Keywords : innovation; networking; knowledge sharing; knowledge protection;
appropriability

INTRODUCTION

Innovation activities play a central role in present day markets. Continuous development is needed to meet with customer demands, and to benefit from emerging opportunities and react to threats posed by hypercompetitive, ever-changing business environments. Therefore, academics and practitioners have put notable efforts on finding the best ways of organizing for these activities and managing innovation efficiently. Especially the increasing networking tendencies and inter-firm dependencies have changed the name of the game in a way that has called for further examination. Thus, researchers have considered such areas as buying, procurement, internationalization, and innovation in terms of networking (e.g., Håkansson and Johanson 1992, Harrison and Håkansson 2006, Möller and Rajala 2007, Mazzarol and Reboud 2008). Subsequently, many strategies and approaches improving innovativeness have been developed and identified. However, looking at these strategies and perspectives, it seems that performance improvements are accessible through following very different, even quite opposing strategies. Considering that firms do not have unlimited resources for following a wide range of alternative approaches, it usually is necessary choose one or two and then follow those. Path-dependency easily strengthens this tendency. Thus, managers make decisions that may have far reaching consequences as they consider, for example, whether it is more beneficial to allocate the limited resources of a firm to exploration or to exploitation (e.g., March 1991), whether the incentive systems of the firm serve better when they are directed to encourage radical or incremental innovation (e.g., Anderson and Tushman 1990, Koberg et al. 2003, Nickerson et al. 2007), and whether the firm can reach best results from innovation by protecting know-how or through sharing it with others (e.g., Heiman and Nickerson 2004, Chesbrough 2003, Blomqvist et al. 2004).

In this study, the last mentioned question, the dilemma of knowledge protection and knowledge sharing is of particular interest. The conflicts between the two are easy to pinpoint: if certain intangibles are protected against copying and imitation, the firm is typically not willing to let others use those assets freely, and certainly not without compensation. Moreover, many protection mechanisms inherently make knowledge exchange impossible or highly difficult, and firms relying on those mechanisms are often bound to keep the knowledge within the firm – whether they want it or not. On the other hand, the firm can choose to provide other firms with an access to its knowledge assets, in which case it typically needs to put keeping secrets aside. Networking and collaboration for innovation presents one area, where knowledge exchange is imperative for reaching the wanted outcomes.

In some cases choosing the path for the company to follow is relatively easy. Certain factors, such as regulations, actions of competitors, existing resources and path-dependency, presence of (valuable) networks, or shifts in demand may push or pull the firm to some particular direction (e.g., independent vs. collaborative R&D and innovation). However, there also exist situations in which the firm has a relatively extensive freedom of choice and operation. In such situations it may not be rational to close other alternatives at the expense of going for one. While the contradictions related to knowledge protection and sharing are obvious (e.g., in networked and collaborative innovation, it is necessary to share information and knowledge to produce genuinely new combinations of knowledge, but at the same time, knowledge and innovations need to be protected so as to preserve the incentives to innovate in the first place), they also illustrate chances to integrate different approaches: For example, prior research has suggested that companies that are able to protect their intellectual assets are more likely to engage in collaborative activities (e.g., Kuivalainen et al. 2003), and that protection mechanisms are increasingly used as bargaining chips instead of protective fences

as such (e.g., Rivette and Kline 2003, Pisano 2006). Thus also complementarities exist between the two, and these complementarities can be more than relevant in networked innovation. In fact, it is possible that an individual firm can reach the best results not by choosing between contradicting strategies, but by creating a combination of them. Integrating both knowledge sharing and knowledge protection into a new strategy can be a form of new kind of management that understands and accepts the logic of “both- and” rather than “either-or”. Such an approach may be viable – and even imperative – in relation to inter-organizational innovation activities in particular.

In line with the discussion above, this study examines the effects of knowledge sharing (both in terms of acquiring and receiving knowledge) and knowledge protection (i.e., copy prevention) on the performance of a firm, and aims at finding out, how the strength of the appropriability regime of a firm – the set of different mechanisms that enable taking control over intellectual assets and exploiting them (see, e.g. Teece 1986, Hurmelinna-Laukkanen 2009) – contributes to the two. The aim is thus to find out, what kind of benefits and problems there are related to knowledge sharing and protection, and how the benefits can be promoted in relation to increasingly typical networked innovation. Theoretical considerations precede empirical evidence that is provided by studying knowledge sharing and protection among 291 companies engaged in R&D. Discussion, concluding remarks, evaluation of limitations and implications finish the study.

MULTIPLE DIMENSIONS OF APPROPRIABILITY

Intellectual property rights (IPRs) are by definition designed to protect intellectual creations. While there is a lot of debate going on whether the IPR-system actually achieves its two aims of granting the creator the rights that provide certain ownership over the intangibles and of fostering diffusion of ideas and further innovative creations, IPRs are a well recognized and widely used form of creating barriers against harmful imitation. However, as Teece (2006) notes, intellectual property protection is only one amongst many barriers to imitation. Indeed, prior research has shown that appropriability (i.e., the extent to which innovators can profit from their innovations based on their ability to prevent imitation) is not just about patents or other IPRs, but that it is a multi-dimensional concept (Pisano 2006). This multi-dimensional nature of appropriability is manifested on many levels, starting from the identification of appropriability mechanisms.

CONSTRUCTING AN APPROPRIABILITY REGIME

Considering the chances of an enterprise to reap profits from its know-how, the first thought is that it should reach the position of the sole beneficiary of the knowledge assets – or at least being the one to control the use of these assets. In other words, appropriability mechanisms should enable keeping certain technological or operational advances secured from the use of anyone else. This idea indeed is a right one in the sense that without the power to keep the intellectual assets to itself, the firm really has nothing to start from. Thus, the first condition that the appropriability mechanisms need to meet is *generating exclusivity*. However, while this condition may be a necessary one, it is not sufficient. The mechanisms also need to protect the investments put into creation of knowledge, and thus they need to *protect the profits* gained from it.

In prior studies, various mechanisms have been identified that enhance innovators' possibilities to appropriate rents from innovation. For example, quite a few researchers have considered mechanisms such as patents (and other IPRs), secrecy, and lead time, important in

this respect (see, e.g., Levin et al. 1987, Arundel 2001, Cohen et al. 2002). Other research has brought up the tacit nature of knowledge (e.g., Teece 1986), human resource management (HRM) (e.g., Baughn et al., 1997), and labor legislation and contracts (Hurmelinna-Laukkanen and Puumalainen, 2007). Thus, appropriability regime of a firm holds within it both formal (IPRs, contracts, labor legislation) and informal (tacitness, secrecy, lead-time, and HRM) means to protect knowledge. Formal and informal appropriability mechanisms enable keeping rivals from utilizing the protected knowledge assets, and they foster appropriation of profits; both by creating (temporary) monopoly position, and formal mechanisms (IPRs and contracts most notably) additionally by providing a chance to generate ancillary revenues (e.g., licensing or franchising revenues) and benefits (e.g. higher profit margins allowed by enhanced bargaining power) through their various uses. However, the protection mechanisms – or overemphasis on protection, to be more precise – create also challenges.

FEATURES OF THE APPROPRIABILITY MECHANISMS – FEATURES OF THE APPROPRIABILITY REGIME

The identification of appropriability mechanisms through evaluating their protective qualities reveals further dimensions of appropriability. First of all, it is fairly difficult to see a mechanism providing protection if it is not available. For instance, the firm may not be able to meet the requirements for patent or copyright protection (Cohen et al. 2000), or it may have to choose between IPR protection and secrecy¹. Moreover, the mechanisms can remain quite insignificant, if they are not strong enough to actually prevent abuse of intangibles. For example, a firm may be granted with patent, copyright, utility model, or some other presumably exclusive right, but if the rights cannot be executed, due to poor or corrupted court system, for instance, those rights may be quite useless.

Availability and *strength* are the features of appropriability mechanisms – and the regime composed of them – that clearly relate to protecting knowledge assets (especially in networked innovation endeavours). Yet, just like individual appropriability mechanisms need to carry the potential to be used not only for protection of knowledge assets, but also for protection of profits from them, the appropriability regime needs to have that potential also. Furthermore, realizing the potential needs to be separated from the underlying potential. Therefore, one more dimension, the *efficiency* of the appropriability mechanisms (and regime), needs to be added into the equation. The idea, that the existence (or even strength) of knowledge protection mechanisms as such does not really tell all about the (potential) competitive advantage of a firm, is not a new one. For instance, Levin et al. (1987) noted this when they stated that mere existence of legal protection tells nothing about its usefulness and efficiency in competition context. For example, in networked business environment even a strong patent may be useless if it prevents the company to engaging in relevant business relationships. Indeed, strong protection may turn quite harmful, especially in relation to networked innovation where both knowledge protection and sharing are needed. Therefore, firms need not only pay attention to obtaining protection, but to using it strategically as well.

¹ Indeed, many of the appropriability mechanisms are intertwined. They can enable or enhance the use of other mechanisms (e.g., using patent protection may foster lead time) or they can prevent use of them (e.g., the tacit nature of knowledge may make it impossible to utilize contracting or IPRs to fully cover some piece of knowledge). These linkages are important to acknowledge when an innovation is protected, yet it also needs to be remembered, that several mechanisms can be used to cover one innovation, especially if it can be broken down to smaller entities; for example, some features can be covered with IPRs, while others are protected with secrecy.

It is quite convenient to consider the *appropriability regime* as the framework within which knowledge and profits from it *can* be protected, while *appropriability strategy*, for its part, covers the different uses through which the firm can *realize the potential* that the appropriability regime provides. Naturally, the appropriability strategy as a part of business strategy guides the composition of the appropriability regime, and finally determines the efficiency of the appropriability regime. Indeed, the appropriability regime of a firm is not an exogenous factor, but a firm can direct its composition and efficiency with careful strategic planning and direction (Pisano 2006). This feature is well utilized, if the firm can take it into account when the dilemma of knowledge sharing and protection is at hand.

CHOOSING THE USES OF APPROPRIABILITY MECHANISMS

Prior to 1980s, most innovation related activities were carried out within firms (Pisano 2006), which meant that appropriability was mostly concerned about creating barriers to imitation and about securing profits from investments through the temporary monopoly position. However, with the emergence of alternative organizational approaches to innovation, such as networking, alliances, and contractual collaboration (see, e.g., Blomqvist et al. 2004, Möller and Rajala, 2007), the role of appropriability regime started to change. Coming to the new millennium, the business environment has changed notably even onto the level where open innovation paradigm has emerged (Chesbrough et al 2006). As a consequence, it has become evident that firms need to develop a more balanced attitude to appropriability. Protecting knowledge just for the protections sake may not only be useless, but actually create barriers to new innovation and improvement of a firm's financial success.

The beauty of the appropriability regime is in the fact that it holds a potential to protect profits from investing in innovation and creation of knowledge assets through following two main paths. The starting point is always in its ability to protect know-how and create exclusivity around it. This exclusivity enables the firm either to use the know-how without interference of others, i.e., *prevent* others from using the knowledge assets and thus create a unique competitive position for itself, or to *control* the use of proprietary know-how by others (see Hurmelinna-Laukkanen, 2009). This control can be exercised in different forms varying from very tight licensing arrangements to practically giving complete freedom of usage to others (consider, e.g., the copyleft-phenomenon where the copyright owner makes sure that the code is used the way (s)he wants it to be used, that is, relatively freely; Mustonen 2003).

Indeed, the competitive efficiency of the appropriability regime can be changed by manipulating the presence (that results from availability), strength, and uses of the appropriability mechanisms. Availability and strength are more challenging to adjust, as many requirements for gaining (strong) protection are not set by the firm itself but by outside actors², and sometimes getting rid of a mechanism may be challenging. For example, some tacit knowledge assets may be quite impossible to transform into codified form (Hurmelinna-Laukkanen and Puumalainen, 2007). However, efficiency depends to a large extent on the firm's own actions. Opportunities and threats present themselves in the marketplace and they may have their origins outside the company, but it is up to the firm to sense and then to seize these opportunities and react to threats.

² Consider, e.g., requirements related to obtaining patent, copyright, trademark or trade secret protection, the effectiveness of legal systems in executing rights, cultural differences in terms of honouring others' rights, and the speed of diffusion in the markets. In these cases external factors have a great saying in whether some form of protection is at the firm's disposal and whether imitation can actually be hindered.

HYBRID FORMS OF APPROPRIABILITY STRATEGY

Depending on the opportunities and risks on the markets, firms may very well be able to improve their competitive situation and innovation performance by following either the *strategy emphasizing knowledge protection* or the *strategy that relies on knowledge sharing*. However, in many cases knowledge exchange and protection are not symmetrical, meaning that knowledge sharing is inherently more essential in intra-firm operations while knowledge protection has a marginal role, and knowledge protection becomes more important when controlling knowledge transfer to external organizations is of concern – even if knowledge sharing would be a goal as well (Leiponen 2002, Heiman and Nickerson 2004, Hoecht and Trott 2006). Therefore, companies often need to incorporate both strategies into one hybrid appropriability strategy.

Combining knowledge protection and sharing can be started by evaluating the features of different appropriability mechanisms in the company's (existing) appropriability regime. For example, tacit nature of knowledge, like lead time, makes knowledge transfer inherently difficult, which may make it more attractive for knowledge protection. Similarly, when knowledge protection is seen as the goal of appropriability strategy, intellectual property rights, and technical means of concealment may be needed: all the mechanisms that foster the (fully proof) proprietary nature of knowledge assets are used. On the other hand, when knowledge sharing is targeted, mechanisms that allow safe transfer become more important. Intellectual property rights can be used for these purposes also, but also contracting and human resource management become more significant: the ground rules for allocation of knowledge assets are needed, and systems for operating according to them need to be put in place (Forrest 1992, Littler and Leverick 1995, Mouzas and Ford 2007).

The fact that different mechanisms are more relevant for different strategies does not mean that the firm should give up the ones that are left aside in an individual situation requiring knowledge protection or sharing. While certain mechanisms are more biased towards knowledge sharing and others are more easily applicable to knowledge protection, it is their combination that really counts. In a similar vein, it can be assumed that firms that are able to integrate both knowledge sharing and protection into their strategy perform better than companies that concentrate on just more one-sided strategy (or that fail both in creating longer imitation lags, and in fostering knowledge sharing). After all, both knowledge protection and sharing hold the potential to provide competitive advantage.

KNOWLEDGE PROTECTION FOR IMPROVING FIRM PERFORMANCE

While protecting knowledge may reveal information in patent publications, for example, or send signals to competitors indicating that the firm considers certain development areas important, one of the consequences of obtaining and using knowledge protection mechanisms is that the time during which the firm can utilize the knowledge and innovations in a monopoly position (typically) lengthens. Being able to prevent others from using certain knowledge assets forces them to find (alternative) solutions on their own. Thus, the time to market for competing products and services is likely to be longer. The first hypothesis is designed to confirm the idea that the stronger appropriability regime is related to longer imitation lags:

Hypothesis 1: The strength of the appropriability regime has a positive effect on the imitation lag.

Appropriability regime's potential to increase imitation lags is important since the company's successfulness in terms of increasing its turnover and improving profitability depends at least to an extent on the head-start that it gains: the longer the imitation lag is, the longer the company can efficiently retrieve the investments put in innovation and product or service development (i.e., competing offerings may be absent from the markets). Of course, the longer imitation lag alone does not guarantee any benefits, in particular if the firm is not able to utilize it through selling the products profitably or by locking the customers in, for example. Furthermore, besides company capabilities, market features (consider, e.g., product life cycles and rates of diffusion), and competitors' capabilities (such as their absorptive capacity; see, e.g., Heiman and Nickerson 2004)) play a role in firm success as well. Still, it can be expected that imitation lag is not without importance with regard the financial outcomes from innovation activities:

Hypothesis 2a: Imitation lag has a positive effect on a firm's financial successfulness.

Another way through which a firm can take advantage of the longer imitation lag is fostering its innovation performance. A company that can profit from innovation can afford to reinvest in commercialization and in further invention (Teece 2006). Besides, the company can learn from the customer feedback and direct its efforts into development activities that further increase the value to the customers. All in all, it could be assumed that the longer the imitation lag is, the higher the incentives to invest in innovation are (van Dijk 2000), and the higher the innovation performance is:

Hypothesis 2b: Imitation lag has a positive effect on innovation performance.

KNOWLEDGE SHARING FOR IMPROVING INNOVATION PERFORMANCE

As suggested above, the appropriability regime of a firm is not only relevant in terms of making copying more difficult for competitors. In fact, utilizing it to enable knowledge transfer may be even more relevant for a firm trying to generate profits. The firm can surely decide to loosen its technical protection or redirect its HRM practices so that knowledge can flow more freely. In this case manipulating the appropriability regime by giving up and/or loosening strength of certain mechanisms willingly provides the basis for knowledge transfer. However, for instance when collaboration is conducted with parties that may end up being competitors for the firm, such an approach needs to be taken with caution. In such situations it may be wiser to rely on mechanisms that make knowledge sharing easier (safer) while making sure that its ownerships is not lost. IPRs and contracts, for example, provide a more concrete form to knowledge assets, which enables moving them from one organization to another without excessive fear of losing the competitive edge. Pisano (2006, p. 1124) expresses the same idea as he states that "in order to specialize (safely), markets for know-how must work effectively. Networks of innovation thus depend partly on intellectual property regimes. Strong intellectual property regimes would support broader and more diffuse networks of innovation." (see also Gulati and Singh 1998 about hierarchical controls as the response to appropriation concerns). Therefore, it can be hypothesized that:

Hypothesis 3: The strength of the appropriability regime has a positive effect on volumes of knowledge sharing.

The reason why knowledge sharing should be of concern is that it has a great influence on the innovation performance of a firm. The competitive advantage and success of companies

strongly depend on the effectiveness with which the firm can gain, create, transfer and leverage diverse knowledge-based assets both within the firm and beyond its boundaries (Crossan and Inkpen 1995, Grant 1996, Spender 1996, Teece et al. 1997, Chesbrough 2003, Dhanaraj and Parkhe 2006, Harrison and Håkansson 2006). In these activities knowledge sharing plays an important role. By acquiring new knowledge ideas can be generated, and the innovativeness of the firm improved. As a result, the following hypothesis can be formulated:

Hypothesis 4: Volumes of knowledge sharing have a positive effect on innovation performance.

EMPIRICAL EVIDENCE

SAMPLE AND DATA COLLECTION

The hypotheses were tested using the data drawn from a survey conducted in Finland in 2004. The data were collected by means of a structured questionnaire, using the key-informant technique. The initial population comprised Finnish companies engaged in R&D. The sample consisted of firms operating in different industrial sectors, which provides a fair degree of generalizability. All firms with at least 50 employees from selected industry sectors were included. The Blue Book Database was used to identify the companies. A total of 1,140 firms were identified, and 881 of them were contacted by telephone and found to be eligible. Of the 881 firms reached, 200 refused to participate in the study. The pretested survey questionnaire with an introductory cover letter was mailed to the 681 remaining companies, followed by a reminder e-mail to those that had not responded within two weeks. We received responses from 299 companies, representing a satisfactory effective response rate of 33.9% (299/881). Non-response bias was checked on a number of variables by following the suggestions of Armstrong and Overton (1977), and did not appear to present a problem. In this study data from 291 firms was utilized, leaving out firms from one industry (furniture) that differs notably from the others.

MEASURES

Appropriability regime was measured with seven-item measure, capturing strength of IPR, labor legislation, contracts, technical means, HRM, tacitness, and lead-time. The scores for each item were obtained with averages of 5-point scales. (See Appendix A)

Imitation lag was measured by asking the number of months before competitors brought a similar product to the markets. A natural logarithm of the actual imitation lag was used in the model in order to correct the skewness of the variable.

Volume of knowledge sharing was measured with two-item measure. Knowledge sharing was evaluated by combining two items covering the average amount of knowledge received by the firm from varying external and internal parties (13 items) and the amount of outbound knowledge flows (13 items) respectively (see Appendix A). Combining the volumes of both acquired and given knowledge into the knowledge sharing measure was warranted since certain appropriability mechanisms – in addition to allowing a firm to safely give out knowledge – also produce a signalling effect (e.g., Pénin and Wack, 2008 and Pénin, 2005; on signaling effect produced by patents) meaning that they enable other firms to scan knowledge assets and see find the innovating firm as a potential knowledge exchange partner. This should promote acquiring knowledge. Further, in collaborative innovation two-

directional knowledge flows are needed to improve innovation performance of the participants. Thus, the overall level of knowledge sharing was considered in this study.

Financial successfulness was measured with two-item construct. The items covered the company's assessment of their profitability compared to their competitors, and of increase in turnover compared to rival firms respectively. Both were measured with 10-point scales.

Following the Oslo manual (OECD 1997), *innovation performance* was measured as the share of sales from new or substantially improved products that were launched during the past three years (percentage of total sales). Logarithmic transformation was used.

Since the differences in the performance of different firms can be caused by several company-specific and external factors, we also controlled the potential effects of *R&D intensity*³ computed by dividing annual R&D expenditure by turnover. Logarithmic transformation was used in the analysis. Also firm's age and size (turnover) were included as control variables.

ANALYSIS AND RESULTS

The measures and the structural parameters for both the links between individual measurement items and constructs (in other words, loadings of the items to their respective constructs and the links between different constructs, i.e. path coefficients) were estimated together using structural equation modelling (LISREL 8.80 software). All the measurement items used in the study proved to be significant ($p < 0.01$ or smaller) and the reliabilities for multi-item scales were good (see Table 1).

Table 1. Assessment of the measurement items.

Construct	Item (code)	Standardized loading*	Composite reliability
Appropriability	IPR component	,663	0,81
Regime	Labor legislation component	,659	
	Contracts component	,829	
	Technical means	,683	
	HRM component	,514	
	Tacitness component	,480	
	Lead-time component	,476	
Financial successfulness	Growth of profitability compared to competitors	,623	0,69
	Growth of turnover compared to competitors	,816	
Knowledge sharing	Obtain information	,876	0,90
	Give information	,942	

* All loadings were significant ($p < 0.01$ or smaller)

³ Also the effects of size and age were examined, but since their influence was only marginal, they were not included in the final model.

The second element in the evaluation of validity of our research is the fit of the model itself. The χ^2 – test shows that the model does not fit the data perfectly. However, based on the other goodness-of-fit measures, which assess the closeness of fit with the data (such as RMSEA, IFI, TLI, and CFI; see Table 2), the model showed good fit with the data. The third element in the evaluation of the model is the assessment of the significances of the different path coefficients. Standardized path estimates are presented in Figure 1. Based on their significance, the tested hypotheses 1, 2a, 3, and 4 are supported. Hypothesis 2b is not supported, however.

Table 2. The results of structural equation modeling.

Dependent variable: Financial successfulness			
<i>Independent</i>	<i>Standardized loading</i>	<i>t-value</i>	
Imitation lag (ln)	.226	2.831	*
Knowledge Sharing	.121	1.607	
Innovation performance (ln)	.114	1.518	
R&D intensity (ln)	-.250	-2.857	*
Age (ln)	.018	0.259	
Size (ln)	.022	0.288	
Dependent variable: Innovation performance (ln)			
<i>Independent</i>	<i>Standardized loading</i>	<i>t-value</i>	
Imitation lag (ln)	.077	1.279	
Knowledge Sharing	.208	3.322	*
R&D intensity (ln)	.283	4.913	*
Dependent variable: Imitation lag (ln)			
<i>Independent</i>	<i>Standardized loading</i>	<i>t-value</i>	
Appropriability regime	.312	4.719	*
Dependent variable: Knowledge sharing			
<i>Independent</i>	<i>Standardized loading</i>	<i>t-value</i>	
Imitation lag (ln)	.191	3.120	*
Appropriability regime	.319	4.680	*
Model fit			
Chi-square = 231.77; df=91; p=.000			
RMSEA = 0.073			
SRMR = 0.057			
NNFI = .902; CFI = .926; IFI = .927; GFI = .909			
* Path loadings significant at p=0.05 flagged			

The squared multiple correlations for the key variables are presented in Table 3 below.

Table 3. Squared multiple correlations

Variable	R²
Imitation lag (log)	0,098
Knowledge sharing	0,176
Innovation performance (log)	0,147
Successfulness	0,153

DISCUSSION AND CONCLUSIONS

It has been shown in prior research that the protective strength of the appropriability regime has an effect on performance of a firm (e.g., Teece 1986, Jantunen and Hurmelinna 2006, Hurmelinna-Laukkanen et al. 2006), but the mechanisms through which this happens have lacked closer examination. Especially the increasingly networked innovation and operations environment has brought with it a need to approach protective mechanisms from different points of view than before. Indeed, the presence of strong barriers to imitation provides leverage not only through making it possible to keep others from producing similar products and services, but also through providing greater variety of opportunities to utilize – even share – the knowledge assets. Already the monopoly position itself may provide various benefits that materialize in improved performance and success: First, it provides better chances to enjoy higher profit margins, which can then be used for further R&D and innovation activities. Those higher profits also make sure that the incentives for investing in innovation stay high enough. Moreover, the (temporary) monopoly position enables the company to get feedback from customers, which can then be used to creating more or less notable improvements or completely new innovations, for instance. On the other hand, innovation performance may be improved by using the appropriability mechanisms to control other's use of the knowledge assets: The extreme examples include firms that do not have any manufacturing of their own, but that concentrate only on R&D and then licence or sell the resulting intangibles to other firms.

The empirical analysis conducted in this study suggests that the strong appropriability regime contributes to both lengthening the imitation lag and fostering knowledge sharing (see Figure 1 below). The reason behind this may be that the stronger the regime is, the more there is freedom in drafting the appropriate strategy for the firm, and the more there is room for both knowledge protection and sharing. For example, it is much easier to start taking down the protective power if situations at hand require it, than try to put up protective fences when results from collaborative innovation start to show.

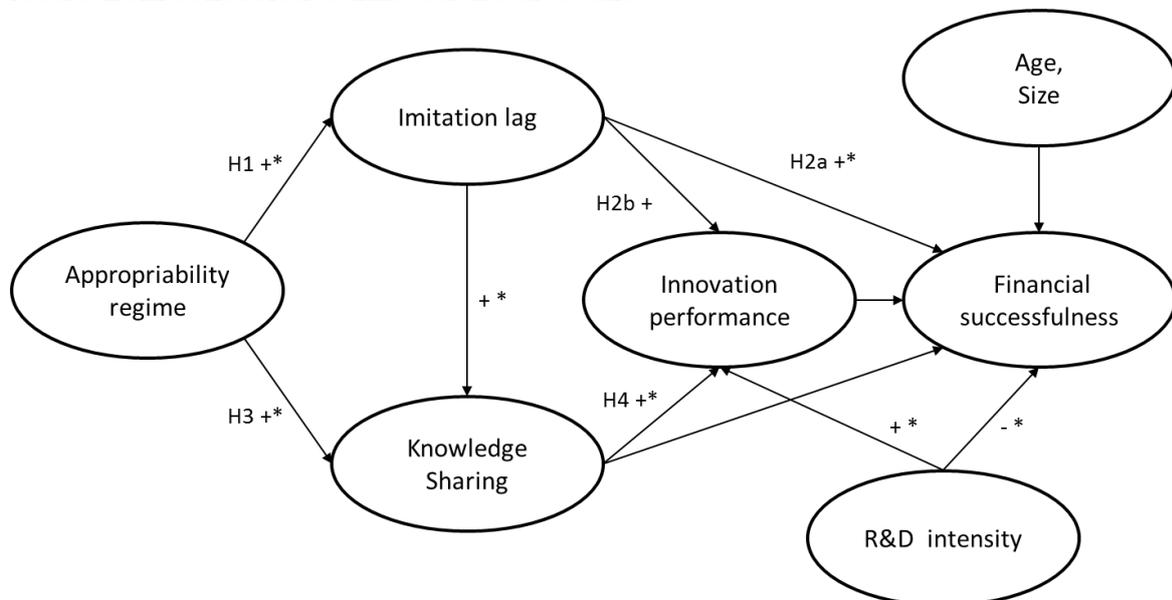


Figure 1: Hypotheses and results

The empirical evidence further shows, that knowledge sharing is the one improving innovation performance, whereas imitation lags are not without significance considering firm

success in terms of profitability and increased turnover. The first mentioned relationship is very much in line with prior research which describes the importance of knowledge transfer for innovation activities. For example, Cohen and Levinthal (1990, p. 128) note that “outside sources of knowledge are often critical to the innovation process,” and “most innovations result from borrowing rather than invention.” Considering the latter relationship between imitation lags and profitability, support can be found to, e.g., Teece’s (1998) idea that profiting from innovation requires having upper hand in terms of imitation prevention and keeping ahead of competitors.

Against our initial expectations, innovation performance did not seem to be affected by imitation lags. Then again, the empirical analysis reveals another connection: it seems that longer imitation lags increase knowledge sharing, which in turn has an effect on innovation performance. Surely this is partly natural: The longer the imitation lag is, the more knowledge will be flowing, more or less unintentionally. However, the imitation lag may also be part of relationships with mediating effects: The longer the firm can examine the possibilities to profit from innovation without fear of imitation, the more able it is to make an informed decision to exchange knowledge and start a new innovation cycle. This enforces the idea that the protective power of the appropriability regime is not without meaning considering innovativeness, and that it is not only the mechanisms that enable safe transfer of knowledge but also other mechanisms, that play a role.

Based on our findings, it can be noted that the combination of knowledge protection and sharing incorporated in the appropriability strategies indeed seems to be beneficial. Thus, the appropriability regime needs to be built in a manner that allows these both. While the means are different, the ends may be quite similar in terms of generating benefits – even if the outcomes take slightly different forms. A wide, integrative perspective enables a firm to perform better: the hybrid strategy where the appropriability regime’s both sides are utilized seems to enable more efficient innovation and profit generation, and especially those firms engaged in networked innovation need to consider adopting a wide range of appropriability mechanisms.

The conducted tests are only preliminary, however, and further research is needed in various areas. This is because the connections are not unambiguous and because the study at hand has some shortcomings. Part of this is related to the limitations of a cross-sectional nature of the survey method. Besides, there are quite a few factors that can contribute to knowledge sharing, imitation lags (consider, e.g., rival’s absorptive capacity and product life cycles) and a firm’s financial success (e.g., issues such as complementary assets or nature of the markets), and these factors should be examined together with the appropriability regime and its uses. Also, while our findings surely are relevant as the contexts within which companies operate are increasingly characterised by networking (requiring both knowledge sharing and protection), our data did not allow us to control for the extent to which the companies at hand engage in networked innovation. This would be an area for further empirical examination.

All in all, despite its limitations, this study provides a starting point for uncovering the chances of companies to create and capture profits efficiently in networked business environment. Later studies will show if and how integrating differing approaches can become the solution to the challenge of finding the balanced attitude towards appropriability.

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Appendix A.

Measures used.

Innovation performance:

How was Your company's turnover divided in year 2003 between new and old products?

The share of the new or substantially improved products launched in 2001 -2003 _____%

Successfulness:

How has Your company succeeded, on average, with regard to competitors during the last three (3) years considering the following indicators?

	1	2	3	4	5	6	7	8	9	10		
Profitability	Essentially worse	<input type="checkbox"/>	Essentially better									
Increase in turnover	Essentially worse	<input type="checkbox"/>	Essentially better									

R & D intensity:

	year 2001	year 2003	year 2005 (estimated)
R&D expences (thousand €)	_____ €	_____ €	_____ €
	year 2001	year 2003	year 2005 (estimated)
Turnover (M€)	_____ M€	_____ M€	_____ M€

Knowledge Sharing:

How much knowledge is transferred between the R&D unit/personnel and the following parties?

(the amount of aquired/shared knowledge: please, circle the appropriate number)

		The amount of shared/acquired knowledge				
		A little		A lot		
With subsidiary or parent company knowledge...	...is shared	1	2	3	4	5
From subsidiary or parent company	is acquired	1	2	3	4	5
With distribution chain	is shared	1	2	3	4	5
From distribution chain (e.g. independent suppliers, non-ownership based collaboration)	is acquired	1	2	3	4	5
With customers	is shared	1	2	3	4	5
From customers	is acquired	1	2	3	4	5
With universities and government research institutes and laboratories	is shared	1	2	3	4	5
From universities and government research institutes and laboratories	is acquired	1	2	3	4	5
With the company's own production operations	is shared	1	2	3	4	5
From the company's own production operations	is acquired	1	2	3	4	5
With the company's own marketing unit	is shared	1	2	3	4	5
From the company's own marketing unit	is acquired	1	2	3	4	5
With the company's general management	is shared	1	2	3	4	5
From the company's general management	is acquired	1	2	3	4	5
With own R&D unit's personnel	is shared	1	2	3	4	5
From own R&D unit's personnel	is acquired	1	2	3	4	5
With competitors	is shared	1	2	3	4	5
From competitors	is acquired	1	2	3	4	5
With consulting companies	is shared	1	2	3	4	5
From consulting companies	is acquired	1	2	3	4	5
With other R&D units of the company	is shared	1	2	3	4	5
From other R&D units of the company	is acquired	1	2	3	4	5
With new employees	is shared	1	2	3	4	5
From new employees	is acquired	1	2	3	4	5
With trade organizations	is shared	1	2	3	4	5
From trade organizations	is acquired	1	2	3	4	5

Appendix A.

Appropriability regime:

During the last three (3) years, how significant have the following mechanisms been in protecting the product and process innovations from competitors' (also potential competitors) imitation? (1=slightly significant, 5=very significant)

Product innovations	1	2	3	4	5
<i>IPR</i>					
Patents	<input type="checkbox"/>				
Copyright	<input type="checkbox"/>				
Trade secret protection (appealable right)	<input type="checkbox"/>				
Protection of utility models and designs	<input type="checkbox"/>				
Trademark protection	<input type="checkbox"/>				
<i>Contracts</i>					
Long-term collaboration agreements	<input type="checkbox"/>				
NDA: Confidentiality	<input type="checkbox"/>				
Other clauses in the contract (e.g. related to reporting and publishing)	<input type="checkbox"/>				
Various combinations of contracts and intellectual property rights	<input type="checkbox"/>				
<i>Labour legislation</i>					
Employee non-compete agreements	<input type="checkbox"/>				
Long-term employment contracts	<input type="checkbox"/>				
<i>Technical/practical concealment</i>					
Concealment/secrecy (knowledge is shared with just a few)	<input type="checkbox"/>				
Technical protective measures (passwords, other entry restriction)	<input type="checkbox"/>				
<i>HRM</i>					
Restricting personnel mobility in inter-firm collaboration	<input type="checkbox"/>				
Changing regularly the contact person in inter-firm collaboration	<input type="checkbox"/>				
<i>Lead-time</i>					
Pioneering with a product (rapid development)	<input type="checkbox"/>				
<i>Tacitness</i>					
Complexity of a product/process	<input type="checkbox"/>				

Imitation lag:

Please, consider the most significant product and process innovation (goods and services, business and manufacturing/production processes) during the last three (3) years.

How long did it take for competitors to launch a competitive alternative in the market?

Products: within _____ months

APPENDIX B. Covariance matrix for observed variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ipr component	,892													
2. labor legislation component	,404	,901												
3. hrm component	,174	,239	,365											
4. tacitness component	,383	,328	,179	1,770										
5. lead-time component	,480	,324	,153	,679	1,586									
6. contracts component	,483	,475	,259	,455	,367	,862								
7. technical means component	,378	,477	,185	,513	,512	,562	1,087							
8. Knowledge Sharing Giving information	,116	,056	,014	,118	,130	,137	,120	,231						
9. Knowledge Sharing Obtaining information	,092	,060	,037	,095	,093	,139	,131	,197	,248					
10. imitation lag ln (products)	,205	,100	,036	,266	,131	,164	,064	,100	,067	,976				
11. innovation performance	3,809	1,787	1,840	4,545	4,165	3,816	1,816	1,880	1,636	2,568	449,443			
12. profitability compared to competitors	-,027	,073	,068	,126	,088	,167	,177	,079	,076	,261	2,274	3,271		
13. turnover growth compared to competitors	,128	,152	,168	,222	,174	,252	,132	,137	,158	,289	4,492	1,619	3,142	
14. R&D intensity, logarithmic transformation	,201	,025	,169	,029	,006	,201	,132	,093	,051	-,026	9,262	-,546	-,557	3,816