

Appropriability profiles – different actors, different outcomes

Hurmelinna-Laukkanen Pia, Vanhala Mika, Olander Heidi

This is a Final draft version of a publication
published by World Scientific
in International Journal of Innovation Management

DOI: 10.1142/S1363919616400193

Copyright of the original publication: © 2016 World Scientific Publishing Co Pte Ltd

Please cite the publication as follows:

Hurmelinna-Laukkanen, P., Vanhala, M., Olander, H. (2016). Appropriability profiles – different actors, different outcomes. International Journal of Innovation Management, vol. 20, iss. 8. DOI: 10.1142/S1363919616400193

**This is a parallel published version of an original publication.
This version can differ from the original published article.**

Appropriability profiles – different actors, different outcomes

Pia Hurmelinna-Laukkanen*

University of Oulu, Oulu Business School
P.O. Box 4600, FIN-90014 Oulu, Finland
E-mail: pia.hurmelinna-laukkanen@oulu.fi

Mika Vanhala

Lappeenranta University of Technology, School of Business and
Management
P.O. Box 20, FIN-53851 Lappeenranta, Finland
E-mail: mika.vanhala@lut.fi

Heidi Olander

Lappeenranta University of Technology, School of Business and
Management
P.O. Box 20, FIN-53851 Lappeenranta, Finland
E-mail: heidi.olander@lut.fi

Abstract: Compared to existing knowledge of innovation appropriability in general, or individual mechanisms contributing to value appropriation, little is known about the configurations of isolating appropriability mechanisms. Such configurations – appropriability profiles – may look quite different for different actors, and may generate quite different performance outcomes. We examine survey data from 167 firms and identify specific profiles among different actors: subtle, attained, and controlled appropriability. We further show that industry, presence in international markets, and firm goals for protection, for example, are important attributes of these profiles. The results also suggest that different profiles relate to different performance outcomes in the market, innovation, and alliance dimensions. These findings can help managers build appropriability profiles that genuinely match their characteristics and needs, thereby escaping the problems with under- or over-protection that can easily take place if, for example, only appropriation strategies building on individual mechanisms, such as patents, are followed.

Keywords: Innovation appropriability; appropriability profiles; performance; firm characteristics.

* Corresponding author

Introduction

There are numerous examples of situations where firm performance and success depend on the ability to protect innovations and their prerequisites (e.g. Laursen and Salter, 2005; Ceccagnoli, 2009). However, there are also situations where a certain amount of vulnerability is (in)voluntarily accepted or where protection is not really the core of appropriating value from innovation (e.g. Bauer *et al.*, 2015). Collaborative activities, for example, may shift the focus, and appropriability (i.e. the ability of firms to benefit from their innovations based on having some control over them – the potential for realised appropriation) may reside well beyond establishing strict exclusivity (Ahuja *et al.*, 2013). Therefore, it is not always clear what kind of performance effects the use of isolating appropriability mechanisms, such as patents, tacitness, contracts, human resource (HR) practices, secrecy, or lead time (see Hurmelinna-Laukkanen and Puumalainen, 2007; Gallié and Legros, 2012), may produce, and what kind of factors cause companies to adopt specific approaches (protective, exploitative, or a mixture of the two) towards appropriability and appropriation. Yet over- and under-protection, which easily hurt innovative activities and other performance outcomes, can only be avoided if these issues are acknowledged and understood.

The issue of innovation appropriability has been addressed numerous times in the literature. For example, appropriability in general has been connected to innovative performance (e.g. Harabi, 1995), the effects of individual mechanisms (e.g. patents; see Park, 2008) have been considered separately, and the relevance of having variety in the adopted mechanisms has been examined (e.g. Hurmelinna-Laukkanen, 2014). However, relatively little has been confirmed about the configurations of isolating appropriability mechanisms (Hall *et al.*, 2012). Rather, it seems that aggregations of appropriability mechanisms have been approached by comparing categories of mechanisms. For example, patent-based strategies have been contrasted to those building on lead time (see James *et al.*, 2013), or formal and informal types of mechanisms have been aggregated (e.g. Gallié and Legros, 2012). Further, another gap in the research is apparent on a slightly different level: the strong connection between appropriability and innovative performance (e.g. Laursen and Salter, 2005) has overshadowed other performance effects that might be linked with different aggregations of isolating appropriability mechanisms.

Thus, our study was devoted to addressing these issues. We postulated that company features (e.g. resources and operations environment) and the expected outcomes from relying on specific appropriation strategies may (instead of solely giving way to selecting specific mechanisms, for example) contribute to the development of different *appropriability profiles* for different actors. We wished to acknowledge complementarities and connections between different mechanisms and suggested that firms' appropriability profiles could include any types of individual mechanisms in different proportions. We further posited that it could be more informative to consider the nature of the profiles than just the differences in the reliance on patents vs secrecy, or formal vs informal mechanisms, for example, by also considering the performance outcomes in relation to appropriability profiles. Besides innovation performance, different profiles may resonate with alliance or market performance to different extents.

To address the identified knowledge gaps, we took two explorative steps in our study. First, we examined what kinds of appropriability profiles could be identified in practice, and then what kinds of traits firms with different profiles exhibit. The latter question was aimed at determining, first, what kinds of factors drive the adoption of a certain type of

appropriability profile and, second, what kinds of performance outcomes would relate to each profile type. Our examination relied on survey data from 167 Finnish firms in 6 industries.

In the following section, we briefly discuss the theoretical background of innovation appropriability and appropriation. Then we turn to the empirical examination. The subsequent discussion reflects the findings in light of the previous literature and highlights the new insights that the findings provide. Finally, we conclude by specifying the managerial implications and providing suggestions for future research.

Developing a Profile Approach for Innovation Appropriability

Variation in the attributes of actors – starting point of different appropriability profiles

The appropriability of innovation is a multifaceted issue. It is not solely about protection, nor is it solely about generating profit or future innovation and the related financial gain by opening everything up (Hurmelinna-Laukkanen and Puumalainen, 2012; Ahuja *et al.*, 2013). Appropriability is not only about the comprehensive utilisation of the innovation as such either; it is also about utilising the means of controlling the innovation (consider, e.g., patents covering the innovation used as a bargaining chip) and complementary assets (Teece, 1986, 1998) in different ways. In essence, appropriation is benefiting from the innovation both directly and indirectly through various means that allow the innovating actor to decide what to do with its intellectual assets.

Numerous studies have introduced mechanisms used by companies to improve their chances of benefiting from innovation. These cover formal and informal mechanisms (Gallié and Legros, 2012) that can be, but not necessarily are, utilised for securing protection against imitation (see, e.g., Cohen *et al.*, 2000, for different appropriation purposes). Intellectual property rights (IPR), contracts, employment legislation addressing the innovation, innovation-specific lead time, and the tacit nature of innovation-related knowledge are brought up frequently. Included are also practical knowledge concealment of innovation features and HR practices that directly affect the inimitability of individual innovations (Teece, 1986, 1998; Liebeskind, 1996, 1997; Hurmelinna-Laukkanen and Puumalainen, 2007).

The ongoing discussion has shown that different firms are differently equipped to utilise these mechanisms (consider, e.g., Pavitt's taxonomy of innovating firms; see Pavitt, 1984; 2000; Archibugi, 2001). It is pointed out frequently that small firms struggling with limited resources have difficulty relying on complex and expensive patent protection, for example, and service-oriented firms, likewise, face difficulties in drafting their intellectual assets and offerings into a form that would match IPR with origins in the protection of more concrete and technical creations (Olander *et al.* 2009; Hurmelinna-Laukkanen and Ritala, 2010). Tacitness and secrecy are a poor fit for such industries, where disclosing the innovation is the way to engage customers (Pavitt, 1984; Blind *et al.*, 2003; Maskus, 2008). Another issue is that firms operating in international markets often need IPR and contracts, for example, to manage in those markets (de Faria and Sofka, 2010).

While the literature has provided valuable insights, the problem is that it remains unclear which combinations of appropriability mechanisms or which appropriability profiles are most typical of different actors. For example, are small firms heavy users of

less expensive forms of protection – that is, are they (forced to be) selective or are they challenged in all areas? Are older firms more experienced at using wider sets of mechanisms? Does a specific goal relating to protection mean that only those mechanisms fitting that goal are employed? All these aspects remain largely unknown. Yet detecting patterns in configurations of appropriability mechanisms might be important to acknowledge to understand, for example, the readiness of firms to change their strategies. In this study, we start examining this issue with *the expectation that there are differences in the appropriability profiles of different actors*, and let the empirical data tell us what these differences are.

Different performance outcomes attached to varying profiles

Leaving the attributes of the actors using different appropriability mechanisms and their combinations aside for a while, earlier research has suggested that appropriability mechanisms are used for different purposes (Cohen *et al.*, 2000). Hurmelinna-Laukkanen and Puumalainen (2007), for example, identify copy prevention and short- and long-term benefits as relevant dimensions in this regard. In fact, IPR and contracts, especially, are frequently used to share and transfer innovations and the related knowledge, even if they prevent others from utilising those innovations. However, the willingness or need to share knowledge, or protect it, may originate from differences in the activities in which a firm is engaged. The situation may be notably different for firms that aim to learn from others in alliances compared to companies that pursue efficient commercialisation and higher profit margins. Earlier studies, such as those by Teece (1986, 1998), suggested that asset structures, and therefore appropriability regimes and complementary assets, are of relevance in this respect.

Although the mere nature of an appropriability profile tells very little about the uses of appropriability mechanisms directly, some signs of the uses and strategies with regard to intended outcomes can be detected in the outcomes that the profiles produce. Hurmelinna-Laukkanen (2012), for example, suggests that a wide set of appropriability mechanisms is beneficial because it allows more variation in the uses of the innovation and the related appropriability mechanisms depending on the situation at hand. This readiness to change direction may be important, considering that performance outcomes depend to different extents on a firm's ability to protect or share its intellectual assets. It could be expected, for example, that tacitness and secrecy are sometimes problematic for the performance of an alliance that is dependent on mutual learning (Kale and Singh, 2007). Likewise, in international settings, and for future innovation, mixed influences might emerge, with protection ensuring incentives for these activities, but too much protection limiting the needed knowledge exchange (Martin and Salomon, 2003; Srivastava and Gnyawali, 2011). Then the composition of the set of appropriability mechanisms – where different outcomes can be secured with different means – might be more decisive than a strategy based on patent protection, for example (for different strategies, see James *et al.*, 2013). Given these considerations, *we expect that different appropriability profiles relate to various performance aspects to different extents*. Again, we let the empirical evidence reveal how different profiles and performance outcomes relate to each other.

Methods

There is little evidence of how appropriability mechanisms are connected to each other (Hall *et al.*, 2012) and the kinds of determinants and outcomes relate to firms' appropriability profiles. Therefore, we take an exploratory approach to study these issues empirically.

Sample and data collection

We employ a key-informant technique to examine survey data collected from 167 Finnish firms in 6 industries in Finland in 2008–2009. The target population comprised Finnish companies engaged in R&D and with at least 100 employees. Responses were received from 209 companies, representing a response rate of 36.7 per cent (209/570). Among the responses, 167 were usable for this study. Most of the respondents held positions such as chief executive officer, managing director, R&D manager, or development officer, suggesting that the respondents were knowledgeable about R&D and innovation issues in their organisations.

Measures

Main variable

We started with the premise that appropriability involves some initial control, and therefore, this construct was evaluated by asking the respondents to assess the strength of the mechanisms they used to protect the firm's own innovations: "During the last three years, how well have the following mechanisms protected your innovations (products, services, processes) from imitation by competitors?" A list of 18 mechanisms followed and the respondents rated these on a seven-point Likert scale (1 = not applicable to our innovations, 2 = poorly, 7 = very well). The items covered IPR (3 items), contracts (2 items), labour legislation (3 items), HRM (2 items), secrecy (2 items), lead time (3 items), and tacitness (3 items). See Appendix 1 for the wording of the items.

Outcome variables

We used three different types of performance as outcome variables: *Innovation performance* (5 items), adapted from Alegre and Chiva (2008), *market performance* (5 items), based on Delaney and Huselid (1996), and *alliance performance*, adapted from Kale and Singh (2007). The first two variables were measured according to the responses to the question, "How would you compare your organisation's performance over the last three years to that of other organisations operating in the same sector?" The respondents rated items on a seven-point Likert scale anchored with "performed very poorly" and "performed very well". The third variable was measured with four items under the question, "How well do the following statements describe your alliances?" The respondents rated items on a seven-point Likert scale anchored with "totally disagree" and "totally agree". Appendix 2 provides the wording of the items.

Antecedent variables

We examined a set of variables representing the antecedents of appropriability profiles. First, *presence in international markets* was covered by asking the respondents to evaluate

the share of turnover from foreign markets as well as the share of employees working abroad – that is, both were covered with one item. In addition, we used *firm goals for protection*, adopted from Hurmelinna-Laukkanen and Puumalainen (2007) and modified. The measure was constructed from the question, “To what extent do the following statements characterise the protection of innovations in your company?” The respondents rated 15 items on a 7-point Likert-scale (1 = totally disagree, 7 = totally agree). The items covered the safety/manageability of protection (7 items), defensive publishing of background knowledge (2 items), preservation of the prerequisites for innovation (2 items), availability of protection (2 items), and the inconvenience of protection (2 items). The wording of the items is provided in Appendix 3. We also evaluated the role of firm *size* (number of employees), firm *age*, and *industry*.

Assessment of bias

The data relied to large extent on self-reported measures; therefore, common method variance might have biased the findings. In order to mitigate potential problems, we used a questionnaire that was designed to address these issues *ex ante*, and we utilised Harman’s one-factor test (Podsakoff *et al.*, 2003) to assess the risk of such bias, with a principal component analysis that incorporated all items from all constructs. We investigated the solution in order to determine the number of factors required to account for the variance in all the items used in this study. We got a 14 factor solution and the largest factor accounted for 20 per cent, suggesting that common method bias was not a major concern.

Results

The first step in the analysis was to assess the reliability and validity of the measurement models. We then used cluster analysis in order to profile the firms by their appropriability dimensions. Finally, using a one-way analysis of variance (ANOVA) comparison of means, we tested the differences across the profiles in terms of presence in international markets and firm goals for protection. Furthermore, industry, size, and age related aspects were scrutinised, together with different types of performance.

Correlation analysis

Table 1 presents the correlation matrix, mean scores, and standard deviations for all the main variables. As the matrix shows, there are significant correlations between several variables, indicating that there are interconnections between them. For example, the correlations between the different protection mechanisms are rather strong with a 0.01 significance level, which is natural, as they are intended for the same overall purpose – namely, to protect knowledge and innovations.

Table 1 Correlation matrix

	<i>Mean</i>	<i>SD</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>15</i>	<i>16</i>
1. IPR	3.03	1.62																
2. Contracts	4.70	1.51	.357**															
3. Labour legislation	3.39	1.46	.243**	.444**														
4. HRM	4.57	1.47	.09	.267**	.381**													
5. Secrecy	4.11	1.66	.239**	.354**	.361**	.264**												
6. Lead time	4.87	1.28	.298**	.330**	.278**	.395**	.252**											
7. Tacitness	3.61	1.65	.177*	.305**	.236**	.354**	.300**	.271**										
8. Share of turnover from foreign markets	7.58	7.79	.341**	-.021	-.053	.019	.047	.002	.136									
9. Share of employees working abroad	3.46	5.09	.270**	.058	-.030	-.028	.153*	.037	-.007	.573**								
10. Safety/manageability of collaboration	4.20	1.36	.484**	.363**	.211**	.149*	.356**	.346**	.208**	.171*	.179*							
11. Defensive publishing of background knowledge	3.14	1.39	.144	-.010	.195**	.181*	.073	.202**	.016	-.069	-.117	.159*						
12. Preservation of prerequisites of innovation	4.70	1.40	.084	.133	.131	.180*	.302**	.419**	.216**	.047	.030	.158*	.195**					
13. Availability of protection	3.45	1.49	.453**	.234**	.269**	.113	.352**	.250**	.219**	.238**	.121	.521**	.276**	.219**				
14. Inconvenience of protection	5.08	1.71	.244**	.015	-.047	.043	.086	.160*	.181*	.328**	.183*	.301**	-.037	.136	.124			
15. Market performance	5.07	.93	.136	.110	.180*	.307**	.211**	.305**	.087	.005	.040	.150*	.120	.208**	.151*	-.017		
16. Innovation performance	4.80	.98	.227**	.249**	.236**	.309**	.182*	.454**	.114	-.118	-.008	.265**	.246**	.227**	.256**	.010	.537**	
17. Alliance performance	4.82	1.11	-.043	.064	-.014	.199**	-.021	.285**	.142	-.059	-.027	.036	.103	.178*	.030	.024	.288**	.259**

Notes: ** Correlation is significant at the 0.01 level; * Correlation is significant at the 0.05 level

Measurement models

We tested the measurement models for appropriability and for the performance measures by means of confirmatory factor analysis (CFA) with LISREL 8.50, and we used PRELIS 2.50 to compute the covariance matrix. We used the maximum likelihood estimation method.

The proposed factor solutions were supported. First, the measurement models for both appropriability and performance produced a good fit. According to Hair *et al.* (2006), for example, the root mean square error of approximation (RMSEA) should be around 0.06 and the goodness-of-fit index (GFI), the comparative fit index (CFI), the non-normed fit index (NNFI), and the incremental fit index (IFI) should reach 0.90. As can be seen in Appendix 1 (for appropriability) and Appendix 2 (for performance), our models meet these limits.

Second, according to the CFA findings, the loadings of all the items were high and statistically significant. In other words, the items were all related to their specified constructs, verifying the posited relationships between the indicators and constructs. Furthermore, all constructs exceeded the threshold levels for construct reliability (> 0.60) and Cronbach's alpha (> 0.70). Thus, the models provide reliable measurement of appropriability and performance (see Appendices 1 and 2 for the loadings and reliability measures).

Finally, we evaluated the discriminant validity of our main variable (i.e. appropriability) by assessing whether the average variance extracted (AVE) was greater than the variance shared between a given construct and the other constructs in the model (i.e. the squared correlation between two constructs; Fornell and Larcker, 1981). The constructs of our study fulfilled this condition: in our model (see Table 2), the diagonal elements (AVEs) were greater than the off-diagonal elements in the corresponding rows and columns. In sum, this test provided evidence of a sufficient level of discriminant validity.

Table 2 Discriminant validity statistics for appropriability

<i>Variable</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
1. IPR	.51						
2. Contracts	.13	.62					
3. Labour legislation	.06	.20	.50				
4. HRM	.01	.07	.15	.64			
5. Secrecy	.06	.13	.13	.07	.57		
6. Lead time	.09	.11	.08	.16	.06	.62	
7. Tacitness	.03	.09	.06	.13	.09	.07	.73

Notes: AVE associated with the construct is presented diagonally.

The squared correlations between the constructs are presented in the lower left triangle.

Because our measure for the firms' goals for protection was more explorative than established in the earlier literature, we utilised exploratory, principal-component factor analysis (PCA). The five-factor solution was supported. It explained 73.8 per cent of the total variance, and the loadings were high (varying from .693 to .947), with the sample size of this study being statistically significant (cf. Hair *et al.*, 2006). In addition, the Cronbach's alpha reliability coefficients for most of the scales exceeded the recommended level of .70. However, for *Defensive publishing of background knowledge* (alpha .48) and for

Preservation of prerequisites of innovation (.59) it fell somewhat short of the recommended level. Appendix 3 provides the factor loadings as well as reliability coefficients.

Cluster analysis

In order to establish the appropriability profiles, cluster analysis was performed. The cluster analysis involved profiling the companies by means of their appropriability dimensions. The objective was to identify many different kinds of combinations of the above-mentioned seven appropriability dimensions within the group of companies. We conducted a hierarchical cluster analysis using Ward's method (Hair *et al.*, 2006). We tested the possible cluster structure of three to five clusters. Following the commonly applied procedures used in the organisational research (see, e.g., Youndt *et al.*, 2004), we performed a visual inspection of dendograms and inspected the levels of appropriability dimensions in different clusters. The solution of three clusters was selected, as the respective composition of appropriability dimensions was the most distinctive.

Table 3 presents three distinctive combinations of appropriability dimensions (i.e. appropriability profiles) identified in the companies. Figure 1 provides a graphical illustration of this.

Table 3 Results of the cluster analysis – distinguishing the distinct appropriability profiles

Appropriability dimension	Subtle appropriability (N = 68)	Attained appropriability (N = 44)	Controlled appropriability (N = 55)
1. IPR	1.88	3.91	3.44
2. Contracts	3.52	5.39	5.39
3. Labour legislation	2.58	3.34	4.05
4. HRM	3.81	4.69	5.44
5. Secrecy	3.35	3.31	5.46
6. Lead time	4.05	5.61	5.11
7. Tacitness	2.86	3.38	4.84

Cluster 1, labelled as *subtle appropriability*, represents the companies exhibiting relatively low overall appropriability with regard protective strength and the related controllability. Cluster 2, *attained appropriability*, includes companies that rely on a mix of formal and informal mechanisms that are suitable especially for covering innovations with codified or explicit knowledge components; within this framework (due to various reasons, e.g. type of innovations, industry requirements, environmental dynamism, etc.) some effort needs to be put into reaching higher levels of appropriability (rather than it being readily available in the form of tacit knowledge, for example). Finally, cluster 3 includes companies that utilise multiple mechanisms widely. We labelled this cluster *controlled appropriability*, indicating that this profile provides notable levels of exclusivity and subsequent controllability of innovations.

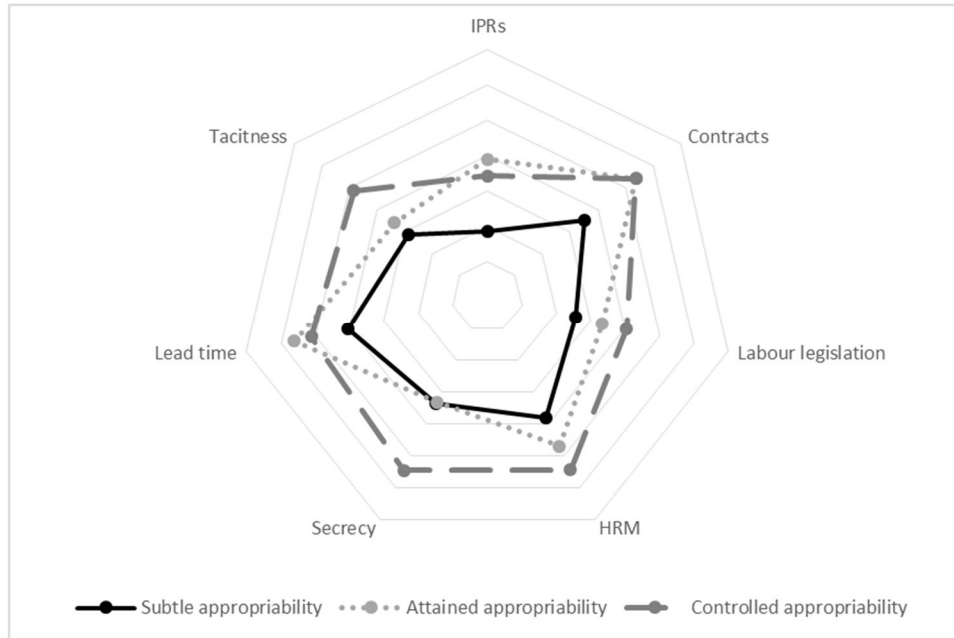


Figure 1 Graphical illustration of the clusters

Tables 4–6 demonstrate the distribution of *industry*, *age* of the firm, and number of *personnel* in the whole sample as well as in the three profiles identified. Next, we discuss each of the descriptive variables and examine their distributions in relation to the profiles identified.

First, we looked at the industry in order to determine if, and how, the three profiles reflect the underlying industry context (see Table 4). Beginning from the *subtle appropriability* profile, our results suggest that firms in this profile come especially from the manufacturing industry, and only a few actors are from the construction and infrastructure fields. In the *attained appropriability* cluster, most of the firms come from manufacturing and machinery, whereas there are no companies from construction and infrastructure; furthermore, services are underrepresented compared to the whole sample. The industry composition in the *controlled appropriability* cluster is quite similar to the *attained appropriability* profile. For both of these profiles, the shares of companies from manufacturing, machinery, and information and communications technology (ICT) are at the same level. However, services have a much greater representation, in the *controlled* profile than in the *attained* profile, while trade and transportation are underrepresented in the *controlled* profile.

Table 4 Industry distribution in different appropriability profiles

Industry (%)	Whole sample (N = 167)	Subtle appropriability (N = 68)	Attained appropriability (N = 44)	Controlled appropriability (N = 55)
Manufacturing	33.5	27.9	38.6	36.4
Machinery	19.8	14.7	22.7	23.6
ICT	15.0	17.6	13.6	12.7
Trade and transportation	11.4	16.2	15.9	1.8

Construction and infrastructure	6.6	8.8	0	9.1
Services	13.8	14.7	9.1	16.4

In terms of age (see Table 5), it seems that in the *attained appropriability* profile, there are, on one hand, substantially fewer young (age of 0–5 years) and, on the other hand, old (over 51 years) companies compared to the other profiles. On the other hand, the share of firms aged between 11 and 50 years is notably higher compared to the other profiles. In the *controlled appropriability* profile, companies aged from 11 to 50 years are underrepresented compared to the whole sample and especially in comparison to the *attained appropriability* profile.

Table 5 Age distribution in different appropriability profiles

Age (%)	Whole sample (N = 167)	Subtle appropriability (N = 68)	Attained appropriability (N = 44)	Controlled appropriability (N = 55)
0–5 years	11.38	13.24	6.82	12.73
6–10 years	21.56	16.18	25.00	25.45
11–50 years	55.09	55.88	63.64	47.27
51+ years	11.98	14.71	4.55	14.55

Further, based on the personnel distribution (Table 6), it can be said that in the *subtle appropriability* profile there are fewer large companies (over 1,000 employees) than in the other profiles. For example, the share of companies employing between 1,001 and 5,000 people is about half of the share of the respective group in the whole sample. However, the same group of 1,001–5,000 employees is overrepresented in the *attained appropriability* profile. Finally, it seems that firms employing more than 10,000 people are only found within the *controlled appropriability* profile.

Table 6 Personnel distribution in different appropriability profiles

Personnel (%)	Whole sample (N = 167)	Subtle appropriability (N = 68)	Attained appropriability (N = 44)	Controlled appropriability (N = 55)
100–150	24.54	27.27	27.27	18.87
151–200	10.43	13.64	0	15.09
201–250	9.20	13.64	4.55	7.55
251–300	12.88	10.61	6.82	20.75
301–500	15.34	15.15	22.73	9.43
501–1,000	12.27	12.12	13.64	11.32
1,001–5,000	14.11	7.58	25.00	13.21
5,001–10,000	0.00	0.00	0.00	0.00
10,001+	1.23	0.00	0.00	3.77

Analysis of variance

As the following step, we tested the differences of levels in both remaining potential antecedents and the outcomes of the appropriability profiles using a one-way ANOVA comparison of means, including the Bonferroni and Tamhane post-hoc test for comparison.

Table 7 shows the level of antecedent variables: presence in international markets and firm goals for protection, for different appropriability profiles, as well as the results of the

ANOVA tests. We found statistically significant differences between the three profiles in several outcome variables.

Table 7 Antecedents in the three appropriability profiles and the results of the ANOVA

Antecedent		Appropriability profile	Mean
Share of turnover from foreign markets	F = 3.087, sig. .046	Subtle appropriability	6.50
		Attained appropriability	9.20
		Controlled appropriability	9.78
Share of employees working abroad	F = 3.002, sig. .052	Subtle appropriability	2.44
		Attained appropriability	4.40
		Controlled appropriability	4.42
Safety/manageability of collaboration	F = 17.242, sig. .000	Subtle appropriability	3.46
		Attained appropriability	4.62
		Controlled appropriability	4.64
Defensive publishing of background knowledge	F = .412, sig. .663	Subtle appropriability	2.93
		Attained appropriability	3.12
		Controlled appropriability	3.14
Preservation of prerequisites of innovation	F = 9.765, sig. .000	Subtle appropriability	4.19
		Attained appropriability	4.51
		Controlled appropriability	5.26
Availability of protection	F = 7.070, sig. .001	Subtle appropriability	2.91
		Attained appropriability	3.65
		Controlled appropriability	3.82
Inconvenience of protection	F = 2.247, sig. .109	Subtle appropriability	4.67
		Attained appropriability	5.32
		Controlled appropriability	5.21

A post-hoc test (see Table 8) shows in more detail from where the statistically significant differences between appropriability profiles and their antecedents originate. First, in terms of presence in international markets, firms within the *controlled appropriability* profile have higher values than companies within the *subtle appropriability* profile in terms of both share of turnover from foreign markets (significance level of 0.065) and share of employees working abroad (0.103). Second, when examining the firm goals of protection, there were differences for firms under both the *attained appropriability* and *controlled appropriability* profiles compared to firms under the *subtle appropriability* profile. Safety/manageability of collaboration as a goal of protection (significance level of 0.000 for both comparisons) and availability of protection (0.024 and 0.002) are assessed higher in those two profiles compared to the *subtle appropriability* profile. In addition, preservation of prerequisites of innovation is more important a goal for firms in the *controlled appropriability* profile than for firms in the *subtle appropriability* (0.000) or *attained appropriability* profiles (0.021).

Table 8 Post-hoc test of the ANOVA (antecedents)

Antecedent	Appropriability profiles		Sig.
Share of turnover from foreign markets	Subtle appropriability	Attained appropriability	.227
		Controlled appropriability	.065
		Subtle appropriability	.227
	Attained appropriability	Controlled appropriability	1.000
		Subtle appropriability	.065
		Attained appropriability	1.000
Share of employees working abroad	Subtle appropriability	Attained appropriability	.145
		Controlled appropriability	.103
		Subtle appropriability	.145
	Attained appropriability	Controlled appropriability	1.000
		Subtle appropriability	.103
		Attained appropriability	1.000
Safety/manageability of collaboration	Subtle appropriability	Attained appropriability	.000
		Controlled appropriability	.000
		Subtle appropriability	.000
	Attained appropriability	Controlled appropriability	1.000
		Subtle appropriability	.000
		Attained appropriability	1.000
Preservation of prerequisites of innovation	Subtle appropriability	Attained appropriability	.677
		Controlled appropriability	.000
		Subtle appropriability	.677
	Attained appropriability	Controlled appropriability	.021
		Subtle appropriability	.000
		Attained appropriability	.021
Availability of protection	Subtle appropriability	Attained appropriability	.024
		Controlled appropriability	.002
		Subtle appropriability	.024
	Attained appropriability	Controlled appropriability	1.000
		Subtle appropriability	.002
		Attained appropriability	1.000

Finally, Table 9 shows the level of outcome variables (i.e. three performance measures) for the different appropriability profiles and the results of the ANOVA tests. The ANOVA test results indicated statistically significant differences between market, innovation, and alliance performance among the three profiles.

Table 9 Performance in the three appropriability profiles and the results of the ANOVA

Performance		Appropriability profile	Mean
Market	F = 4.221, sig. .016	Subtle appropriability	4.78
		Attained appropriability	5.16
		Controlled appropriability	5.25
Innovation	F = 9.887, sig. .000	Subtle appropriability	4.37
		Attained appropriability	5.10
		Controlled appropriability	4.94
Alliance	F = 3.503, sig. .061	Subtle appropriability	4.56
		Attained appropriability	5.08
		Controlled appropriability	4.88

Again, a post-hoc test of the ANOVA (see Table 10) shows in more detail where the statistically significant differences between appropriability profiles and their performance stem from. First, in terms of market performance, firms within the *controlled*

appropriability profile performed better than companies under the *subtle appropriability* profile (significance level of 0.020). Second, in the case of innovation performance, firms under the *attained appropriability* (0.000) and *controlled appropriability* profiles (0.003) performed better than firms with *subtle appropriability* profile. Finally, alliance performance was better in the *attained appropriability* profile than in the *subtle appropriability* profile. However, in this case, a more liberal interpretation of significance level (0.066) is needed.

Table 10 Post-hoc test of the ANOVA (performance)

Performance	Appropriability profiles		Sig.
Market	Subtle appropriability	Attained appropriability	.138
		Controlled appropriability	.020
	Attained appropriability	Subtle appropriability	.138
		Controlled appropriability	1.000
	Controlled appropriability	Subtle appropriability	.020
		Attained appropriability	1.000
Innovation	Subtle appropriability	Attained appropriability	.000
		Controlled appropriability	.003
	Attained appropriability	Subtle appropriability	.000
		Controlled appropriability	1.000
	Controlled appropriability	Subtle appropriability	.003
		Attained appropriability	1.000
Alliance	Subtle appropriability	Attained appropriability	.066
		Controlled appropriability	.396
	Attained appropriability	Subtle appropriability	.066
		Controlled appropriability	1.000
	Controlled appropriability	Subtle appropriability	.396
		Attained appropriability	1.000

Discussion

Our aim was to examine what kinds of appropriability profiles can be identified and what kinds of traits (attributes/antecedents and performance outcomes) firms with different profiles exhibit. In relation to the first research goal, we found that firms in fact have identifiable appropriability profiles, as the cluster analysis led to the following three appropriability profiles:

1. Subtle appropriability (N = 68)
2. Attained appropriability (N = 44)
3. Controlled appropriability (N = 55)

The composition of these profiles suggests that companies build these profiles not on the basis of the characteristics of the isolating appropriability mechanisms (i.e. there are no clear-cut differences suggesting that firms would be inclined towards relying on formal vs informal mechanisms, for example) but on firm-specific factors. Some firms utilise multiple mechanisms widely (i.e. have controlled appropriability) or exhibit subtle appropriability, characterised by low overall protective power of isolating appropriability mechanisms. Finally, the firms with the attained appropriability profile rely on a mix of formal and informal mechanisms that, in general, would be suitable for covering innovations with codified or explicit knowledge components, suggesting that they

inherently need to put effort into securing appropriability (i.e. without consciously formulating an appropriation strategy, their competitive advantage might be relatively easily eroded due to imitability). While no exact match exists here with Pavitt's (1984) taxonomy or versions of it, the findings resonate with the idea that structural aspects (see Teece, 1998), the behaviour of innovating firms, and the sources of innovation are linked to the ways in which appropriability is approached.

Industry factors and resources behind the profiles

In fact, regarding the question of what kinds of traits firms with different profiles exhibit, we found that there are different factors related to the emergence of the profiles. First, industry and offerings seem to be important factors determining the profile construction. Firms in the ICT (with short product lifecycles and a networked environment) and trade/transportation (with relatively hard-to appropriate intellectual assets) sectors are overrepresented under *subtle appropriability*, and construction and infrastructure sector and service firms are, quite understandably, underrepresented under *attained appropriability*, where the mechanisms are well-aligned with the explicit knowledge components largely missing in these sectors (see Hurmelinna-Laukkanen and Ritala, 2010). Moreover, not surprisingly, there are differences with regard to firm resources, with smaller firms typically having a *subtle appropriability* profile: with limited resources, it is difficult to establish strong protection (Kitching and Blackburn, 1999; Leiponen and Byma, 2009). However, also with small firms, it is worth noting that no trade-offs seem to emerge with regard mechanisms; rather, all mechanisms are still included in the profile.

Experience and international efforts determining the need for profile configuration

Presence in international markets also seems to play a role, as companies with more employees abroad and with turnover coming from foreign markets have a *controlled*, rather than *subtle, appropriability* profile (see Faria and Sofka, 2010). While this could be a question of experience or resources, the inherent need to follow the lead of other firms in international markets and to secure the firm's competitive advantage is relevant (Martin and Salomon, 2003). Then again, experience does not seem to be a decisive factor for the firm appropriability profile configuration, as the mean age seems to be roughly similar across the three groups, apart from the detail that firms with the *attained appropriability* profile are hardly ever very young or very old. It might be, for example, that very young firms are not yet capable of being selective, and that in more mature firms, tacit knowledge starts to accumulate naturally, thereby extending the profile beyond the *attained* profile. These issues would call for closer examination, however.

Firm goals affecting profile configuration

Finally, firm goals are significant. Firms concerned about the safety and manageability of collaboration fall under either to the *controlled appropriability* or *attained appropriability* profile, rather than the *subtle appropriability* profile, as codifiable knowledge needs to be covered to secure inherently easy-to-imitate knowledge in collaborative endeavours. Having a *controlled appropriability* profile also seems to relate to a higher motivation to secure future innovation by protecting the prerequisites of innovation. Earlier innovation often has both tacit and explicit components, and a preclusive component in generative appropriability targeting future benefits is stronger with a wider set of isolating

appropriability mechanisms (see Ahuja *et al.*, 2013). Finally, the difficulty of establishing protection is associated with *subtle appropriability*, which is in line with Hurmelinna-Laukkanen and Puumalainen (2007), who showed that if protection is (relatively easily) available, it will be acquired – that is, if isolating appropriability mechanisms are not readily at the firm's disposal, their strength is also easily reduced.

Performance outcomes of different profile configurations

Considering the performance outcomes as traits associated with different profiles, market performance is higher for those firms with a *controlled*, rather than a *subtle, appropriability* profile. In order to gain higher profitability and other such outcomes, increasing inimitability and exclusivity can be of relevance (Teece, 1986). Innovation performance is higher among those firms with *attained* and *controlled appropriability* compared to *subtle appropriability*. Safe knowledge transfer and securing incentives for investing in innovation may not be reached adequately with a weak assortment of isolating appropriability mechanisms (Hurmelinna-Laukkanen and Ritala, 2010). Finally, alliance performance is higher among the firms with an *attained appropriability* profile than among those with a *subtle appropriability* profile. Controlled appropriability does not seem to bring benefits here. It seems that in collaborations and alliances, it is appropriate to cover such knowledge that would otherwise be easy to copy (Klein Woolthuis *et al.*, 2005; Pisano and Teece, 2007; Olander *et al.*, 2013) so as to maintain the motivation to collaborate (Heiman and Nickerson, 2004), but building unnecessary fences or using mechanisms that make knowledge sticky by default is less viable (Szulanski, 2003).

Conclusion

Our study contributes to the existing knowledge, first, by showing that appropriability and the appropriation strategies of innovative firms can become visible in their appropriability profiles. Second, we provide information on the aspects that may explain the adoption of specific profiles. Some of these have already been touched upon in earlier studies, like the limited resources of firms (Olander *et al.*, 2009), but the profile approach provides additional information. For example, it may not be just IPR, such as patents, that smaller firms struggle with but appropriability, more widely. Third, our findings suggest that firms with different profiles illustrate different performance outcomes on the market, innovation, and alliance dimensions – while wide-ranging appropriability is useful, in general (as shown in earlier studies), more is not always better; yet there is a place for a more selective approach as well (see Srivastava and Gnyawali, 2011; Hurmelinna-Laukkanen *et al.*, 2012). Finally, considering all these aspects, our study suggests that perhaps appropriability should not be approached only from the point of view of isolating appropriability mechanisms (i.e. by concentrating on what explains the selection of patents over secrecy, for example) but perhaps from a more holistic view.

For managers, our study suggests that companies benefit, in general, from having a wide assortment of isolating appropriability mechanisms at their disposal, and that securing explicit innovation components is typically useful. That is, there are some important exceptions to the rule that point towards the benefits of strong appropriability. Learning from alliances requires that knowledge be transferred safely, which is shown in the strongest alliance performance being found in those firms with a profile allowing the management of explicit knowledge (attained appropriability). Even if firms that are

worried about securing existing knowledge assets and managing those in collaborations perceive it as inevitable that they will need to rely on multiple mechanisms, not all mechanisms are always absolutely necessary – or even useful. Tacitness and secrecy may have to be tuned down (if such a practice is possible; see Szulanski, 2003). Managers operating with limited resources, in particular, benefit from learning that the selective use of isolating appropriability mechanisms to cover the most easily copied and vulnerable assets may well suffice. More important than having the resources to acquire (formal) protection is to use fitting and suitable isolating appropriability mechanisms.

The findings need to be interpreted with a certain amount of caution, as limitations emerged in this study. A cross-sectional study in a single, developed country cannot reveal all nuances. Furthermore, some of the measures could be refined further. Despite these and other possible limitations, the findings so far suggest that the profile approach may make numerous factors observable that can explain appropriability and firm performance in a new way. Industry comparisons might also be perceived in a new light. We hope that this study can serve as a starting point for such future research.

References

- Ahuja, G, CM Lampert and E Novelli (2013). The second face of appropriability: Generative appropriability and its determinants. *Academy of Management Review*, 38(2), 248–269.
- Alegre, J and R Chiva (2008). Assessing the impact of organizational learning capability on product innovation performance: An empirical test. *Technovation*, 28, 315–326.
- Archibugi, D (2001). Pavitt's taxonomy sixteen years on: A review article. *Economics of Innovation and New Technology*, 10(5), 415–425.
- Bauer, J, N Franke and P Tuertscher (2015). The seven IP commandments of a crowdsourcing community. *Academy of Management Proceedings*, 13229.
- Blind, K, J Edler, U Schmoch, B Anderson, J Howells, I Miles and C Herstatt (2003). *Patents in the Service Industries. Final Report*. Fraunhofer: Institute System and Innovation Research.
- Ceccagnoli, M (2009). Appropriability, preemption, and firm performance. *Strategic Management Journal*, 30, 81–98.
- de Faria, P and W Sofka (2010). Knowledge protection strategies of multinational firms— A cross-country comparison. *Research Policy*, 39, 956–968.
- Delaney, JT and MA Huselid (1996). The impact of human resource practices on perceptions of organizational performance. *Academy of Management Journal*, 39, 949–969.
- Gallié, E-P and D Legros (2012). French firms' strategies for protecting their intellectual property. *Research Policy*, 41, 780–794.
- Fornell, C and DF Larcker (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.
- Hair, JF, WC Black, BJ Babin, RE Anderson and RL Tatham (2006). *Multivariate Data Analysis* (6th ed.). Hoboken, New Jersey: Pearson Education.
- Hall, BH, C Helmers, M Rogers and V Sena (2012). *The Choice between Formal and Informal Intellectual Property: A Literature Review*. NBER Working Paper Series, WP 17983.

- Harabi, N (1995). Appropriability of technical innovations. An empirical analysis. *Research Policy*, 24, 981–992.
- Heiman BA and JA Nickerson (2004). Empirical evidence regarding the tension between knowledge sharing and knowledge expropriation in collaborations. *Managerial and Decision Economics*, 25, 401–420.
- Hurmelinna-Laukkanen, P (2014). Appropriability regimes in the international playground for innovation. *European Journal of International Management*, 8(6), 621–643.
- Hurmelinna-Laukkanen, P, H Olander, K Blomqvist and V Panfilii (2012). Orchestrating R&D networks: Absorptive capacity, network stability, and innovation appropriability. *European Management Journal*, 30(6), 552–563.
- Hurmelinna-Laukkanen P and K Puumalainen (2007). The nature and dynamics of appropriability: Strategies for appropriating returns on innovation. *R&D Management*, 37, 95–112.
- Hurmelinna-Laukkanen, P and P Ritala (2010). Protection for profiting from collaborative service innovation, *Journal of Service Management*, 21(1), 6–24.
- James, SD, MJ Leiblein and S Lu (2013). How firms capture value from their innovations. *Journal of Management*, 39(5), 1123–1155.
- Kale, P and H Singh (2007). Building firm capabilities through learning: The role of the alliance learning process in alliance capability and firm-level alliance success. *Strategic Management Journal*, 28(10), 981–1000.
- Kitching, J and R Blackburn (1999). Intellectual property management in the small and medium enterprise (SME). *Journal of Small Business and Enterprise Development*, 5(4), 327–335.
- Klein Woolthuis, R, B Hillebrand and B Nooteboom (2005). Trust, contract and relationship development. *Organization Studies*, 26(6), 813–840.
- Laursen, K and A Salter (2005). *My precious. The role of appropriability strategies in shaping innovative performance*. Danish Research Unit for Industrial Dynamics, Working Paper (05-02).
- Leiponen, A and J Byma (2009). If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies. *Research Policy*, 38(9), 1478–1488.
- Liebeskind, JP (1996). Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, 17, 93–107.
- Liebeskind, JP (1997). Keeping organizational secrets: Protective institutional mechanisms and their costs. *Industrial and Corporate Change*, 6(3), 623–663.
- Martin X and R Salomon (2003). Knowledge transfer capacity and its implications for the theory of the multinational corporation. *Journal of International Business Studies*, 34(4), 356–373.
- Maskus, KE (2008). The globalization of intellectual property rights and innovation in services. *Journal of Industry, Competition and Trade*, 8(3–4), 247–267.
- Olander, H, P Hurmelinna-Laukkanen and J Mähönen (2009). What's small size got to do with it – Protection of intellectual assets in SMEs. *International Journal of Innovation Management*, 13(3), 349–370.
- Olander, H, M Vanhala and P Hurmelinna-Laukkanen (2013). Reasons for choosing mechanisms to protect knowledge and innovations. *Management Decision*, 52(2), 207–229.
- Park, WG (2008). International patent protection: 1960–2005. *Research Policy*, 37(4), 761–766.

- Pavitt, K (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, 13(6), 343–373.
- Pavitt, K (2000). *Technology, Management and Systems of Innovation*. Cheltenham: Edward Elgar.
- Pisano, GP and DJ Teece (2007). How to capture value from innovation: Shaping intellectual property and industry architecture. *California Management Review*, 50(1), 278–296.
- Podsakoff, PM, SB MacKenzie, J-Y Lee and NP Podsakoff (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879–903.
- Srivastava, MK and DR Gnyawali (2011). When do relational resources matter? Leveraging portfolio technological resources for breakthrough innovation. *Academy of Management Journal*, 54(4), 797–810.
- Szulanski, G (2003). *Sticky Knowledge: Barriers to Knowing in the Firm*. London: Sage Publications Ltd.
- Teece DJ (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, 15, 285–305.
- Teece, DJ (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, 40, 55–79.
- Youndt, MA, M Subramaniam and SA Snell (2004). Intellectual capital profiles: An examination of investments and returns. *Journal of Management Studies*, 41(2), 335–361.

Appendix 1. Measurement items for appropriability

<i>Concept</i>	<i>Item</i>	<i>Factor loading</i>	<i>AVE</i>	<i>CR</i>	<i>Alpha</i>
IPR	Patents	.636 ^a	.51	.76	.71
	Copyright	.723***			
	Trademark	.775***			
Contracts	Long-term collaboration contracts	.775 ^a	.62	.76	.75
	Non-disclosure/confidentiality agreements	.797***			
Labour legislation	Employees' non-competition agreements	.668 ^a	.50	.74	.74
	The legal loyalty obligation of employees	.832***			
	The legal right of the employer to assign tasks	.594***			
HRM	Making personnel committed to the firm (e.g. by offering perks)	.843 ^a	.64	.78	.76
	Small personnel turnover/minimizing it	.749***			
Secrecy	Using passwords	.776 ^a	.57	.73	.72
	Restricting access to meetings and the firm's premises	.740***			
Lead time	Getting to the markets first with a new product or service	.759 ^a	.62	.83	.80
	Continuous improvements in products/services/processes	.686***			
	Keeping ahead of competitors	.901***			
Tacitness	The fact that it is very hard to teach knowledge related to the product/service/process	.854 ^a	.73	.89	.89
	The fact that it is very hard to understand the features of the product/service/process by observing/examining it	.902***			
	The fact that knowledge related to the product/service/process may not be usable in other environments	.812***			

*** Statistically significant at a 0.005 significance level; ^a significance level is not available, because the coefficient is fixed at 1

Measurement model: chi-square (df)=201.45 (114), p=0.00, RMSEA=0.061, GFI=0.903, CFI=0.962, NNFI=0.949, IFI=0.962.

Appendix 2. Measurement items for outcome variables

<i>Concept</i>	<i>Item</i>	<i>Factor loading</i>	<i>AVE</i>	<i>CR</i>	<i>Alpha</i>
Market performance	Growth in sales	.802 ^a	.50	.83	.82
	Profitability	.641***			
	Market share	.819***			
	Market growth	.743***			
	Marketing	.478***			
Innovation performance	Replacement of products being phased out	.609 ^a	.34	.76	.74
	Replacement of services being phased out	.693***			
	Extension of product/service range within main market	.735***			
	Development of environment-friendly products/services	.413***			
	Opening of new domestic target groups	.619***			
Alliance performance	Our alliances are characterized by strong and harmonious relationships between partners	.732 ^a	.59	.85	.85
	Our company has achieved its primary objectives in forming alliances	.809***			
	The company's competitive position has been greatly enhanced due to alliances	.837***			
	The company has been successful in learning some critical skills and capabilities from its alliance partners	.697***			

***Statistically significant at a 0.005 significance level; ^a significance level is not available, because the coefficient is fixed at 1

Measurement model: chi-square (df)=140.77 (74), p=0.00, RMSEA=0.066, GFI=0.912, CFI=0.961, NNFI=0.952, IFI=0.962.

Appendix 2. Measurement items for firm goals for protection

<i>Concept</i>	<i>Item</i>	<i>Factor loading</i>	<i>Alpha</i>
Safety/ manageability of protection	Protecting innovative products/services/processes helps improve the company's reputation with stakeholder groups	.705	.91
	Protecting innovative products/services/processes maintains our freedom	.736	
	Protecting innovative products/services/processes helps prevent their copying and imitation	.780	
	Protecting knowledge and innovations makes collaboration with different organizations more manageable	.818	
	Protecting knowledge and innovations makes collaboration safer	.823	
	Protecting knowledge and innovations facilitates international activities	.747	
	With protection we get better results, when competitors do not introduce comparable products/services	.789	
	Defensive publishing of background knowledge	We share information related to our innovations rather than protect it	
We publish information related to our innovations so that competitors cannot seek patents or protection		.693	
Preservation of the prerequisites for innovation	It is more important for our company to protect the prerequisites of innovativeness than innovations	.754	.59
	Our aim is always to retain innovation enabling knowledge within the company	.862	
Availability of protection	It is easy for our company to employ various protection mechanisms	.834	.77
	Our innovations frequently meet the criteria for seeking legal protection	.799	
Inconvenience of protection	It is costly to acquire, maintain and defend intellectual property rights	.916	.91
	It is laborious and costly to defend intellectual property rights	.947	