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INNOVATION DOES NOT EQUAL R&D: STRATEGIC INNOVATION PROFILES AND FIRM GROWTH

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ABSTRACT: In this paper, we examine firm innovation and its link to firm growth. Instead of using the conventional conceptualization and operationalization of innovation in terms of the R&D budget, we use a more elaborate 12-dimensional conceptualization, which takes into account also the non-technological aspects of innovation. The 12-dimensional operationalization further enables the examination of strategic innovation profiles of individual firms. We find that different kinds of innovation activity all have effects on firm growth, but in different ways. R&D activity is important in that it leads to introduction of new products, but innovation in other dimensions – value chain strategy, brand, and distribution channels – is also linked to new product introduction. Value chain innovation is also related to the development and introduction of new services: innovation aimed at development and improvement of the customer experience in particular has a significant role in the development and introduction of new services.

KEY WORDS: Innovation, firm, growth, non-technical, technological, technical

JEL: L86, L8, L25

KETOKIVI, Mikko and **ALI-YRKKÖ**, Jyrki, **INNOVAATIO EI OLE SAMA KUIN T&K-TOIMINTA: STRATEGISET INNOVAATIOPROFIILIT JA YRITYSTEN KASVU.** Helsinki, ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2010, 22 s. (Keskusteluaiheita, Discussion Papers; ISSN 0781-6847; no. 1220).

TIIVISTELMÄ: Tässä tutkimuksessa tarkastellaan empiirisesti yritysten innovaatiotoimintaa ja sen vaikutuksia yritysten kasvuun. Sen sijaan, että yritysten innovaatiotoimintaa mitattaisiin vain t&k-toiminnalla, tässä tutkimuksessa innovaatiotoiminta jaetaan 12 eri ulottuvuuteen. Tämä mittaristo ottaa huomioon myös sellaisen innovaatiotoiminnan, joka ei liity teknologian kehitykseen. Lisäksi mittaristo mahdollistaa yritysten strategisen innovaatioprofiilin tarkastelemisen. Tulosten mukaan erityyppinen innovaatiotoiminta vaikuttaa yritysten kasvuun, mutta vaikutus tulee markkinoille tuotujen uusien tuotteiden ja palvelujen kautta. T&k-toiminnan lisäksi uusien tuotteiden onnistuneeseen kehitykseen vaikuttavat myönteisesti myös yritysten tarjoamaan, brändiin ja jakelukanaviin sekä arvoketjustrategiaan liittyvä innovaatiotoiminta. Arvoketjustrategiaan liittyvä innovaatiotoiminta vaikuttaa myönteisesti myös uusien palvelujen onnistuneeseen kehitykseen. Arvoketjustrategian sisällä erityisesti käyttäjäkokemukseen kohdistuva innovaatiotoiminta on merkittävässä roolissa uusien palvelujen kehityksessä.

AVAINSANAT: Innovaatio, tekninen, teknologinen, ei-tekninen, liiketoiminta, kasvu, yritys

JEL: L86, L8, L25

"What exactly is innovation? Although the subject has risen to the top of the CEO agenda, many companies have a mistakenly narrow view of it. They might see innovation only as synonymous with new product development or traditional research and development… In actuality, business innovation is far broader in scope than product or technological innovation."

Sawhney, Wolcott & Arroniz (2006: 75)

1. INTRODUCTION

1.1. Background

The role of innovation in economic growth is a well-researched topic, and the role of innovative activity in economic growth unquestionable (e.g., Stokey, 1995). Despite volumes of research, however, the specific mechanisms through which innovation contributes to firm growth are still poorly understood. There are two fundamental and related questions in particular where our understanding must be expanded:

1. How does innovation lead to growth and renewal in individual firms (e.g., in terms of sales)?
2. How is firm-level innovation and growth related to economic growth at the level of an entire economy?

The primary focus in this paper is to address the first question, both theoretically and empirically. The second question is addressed conceptually, but it is discussed, because the second question in particular has strong implications to economic policy. Also, both questions have at their foundation the same fundamental question: How does one measure innovation (Smith, 2005)?

One of the enduring challenges in innovation research is complexity of measurement. It is a well-established empirical fact that firms seek growth through innovation in drastically different ways: "innovation involves multidimensional novelty in aspects of learning or knowledge organization that are difficult to measure or intrinsically non-measurable" (Smith, 2005: 149). Yet, we often speak of innovation in terms of R&D budgets, technology, and new product development. Extant empirical research has tended to focus on R&D intensity (R&D-to-sales ratio) and technology patents as the primary proxy for innovativeness, and many economic

policy initiatives, such as *EU's Lisbon Strategy*[1], also rely on the R&D intensity proxy, which is typically calculated at the national level as *gross expenditure on R&D* (GERD) or *business expenditure on R&D* (BERD) as a percentage of *gross domestic product* (GDP).

Simplistic operationalizations do not do justice to the concept of innovation, and in a peculiar way rob it of the richness of its meaning. Indeed, R&D intensity is a measure of intensity, not skill or success: engaging in R&D does not automatically lead to economic growth, neither within the firm nor the economy as a whole. Further, the outcomes of R&D are not limited to new products and services: Cohen & Levinthal (1989) in particular have emphasized that R&D should be viewed also more broadly as a learning mechanism by which firms not only generate new knowledge (manifested in new products and services) but also enhance their ability to assimilate and exploit existing information. Sawhney et al.'s (2006) idea of considering the broader concept of *business innovation* (as opposed to *product* or *technological* innovation) echoes the same sentiment, a view that is further supported also in the more recent edition's of OECD standards (OECD, 2005: 46).

1.2. Toward direct measures of firm-level innovation: The *Strategic Innovation Profile (SIP)*

Sawhney et al. (2006) have provided one of the most comprehensive contemporary summaries of the multidimensional nature of innovation at the firm level, as well as a measurement tool for its assessment. They distinguish 12 different ways in which firms may seek innovation: offerings, platforms, solutions, customers, customer experience, value capture, processes, organization, supply chain, presence, networking, and brand.[2] The 12 ways are neither mutually exclusive nor wholly independent of one another, but they are each clearly distinct and unique in their emphasis.

In order to describe and measure the innovativeness of a firm, Sawhney et al. developed a tool entitled *the innovation radar*, which maps the 12 different dimensions of innovation and their respective emphases within the firm. Each firm has its unique "footprint" on the innovation radar screen. We label this footprint *the strategic innovation profile (SIP in short)*. The pro-

[1] See for example `http://ec.europa.eu/archives/growthandjobs_2009/pdf/complet_en.pdf`

[2] The definitions and scopes of each dimension are given in Appendix 1.

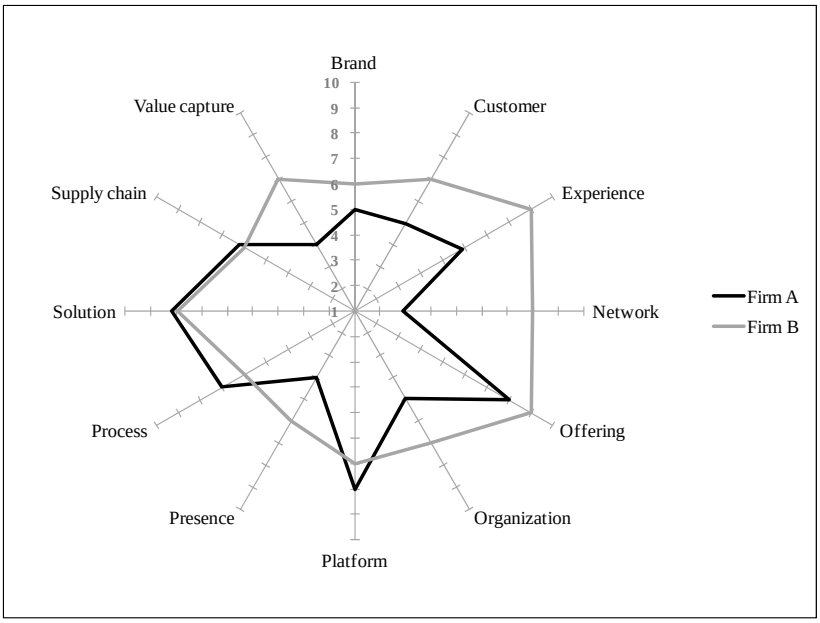
files are labeled *strategic*, because they reflect the strategic choices that firms have made with regard to innovation. Conventional measures such as the size of the firm's R&D budget give us very little information on the scale and the scope of innovation within the firm. Understanding firm-specific SIPs is the key to understanding innovation as it occurs within individual firms.

Figures 1 and 2 illustrate the limitations of the most commonly used measure, R&D intensity (R&D-to-sales ratio), as a measure of innovation. The firms in figures 1 and 2 are real firms from the firm database used in the empirical part of this paper (described in section 2), but their real names are omitted for confidentiality reasons.

In Figure 1, two firms with identical R&D intensities (11%) are depicted. Both firms emphasize product- and technology-oriented aspects of innovation (i.e., solutions, offerings, platforms) in a similar way, which could explain the similar observed R&D intensities. The overall scale and scope of innovation are, however, clearly broader in Firm B, which focuses in addition heavily on the non-technical aspects of innovation: value capture, network, and experience. Innovative activity in these dimensions is not necessarily captured by the firm's R&D budget. Indeed, the size of B's "innovation footprint" is 40% larger than A's. Identical R&D intensities can thus reflect very different innovation scales and scopes of innovative activity.

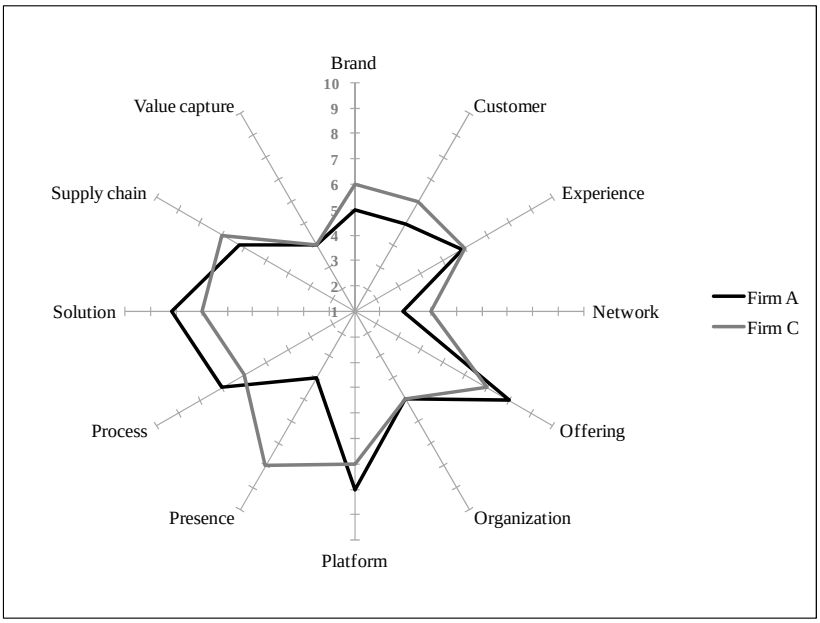
In Figure 2, Firm A is compared to another firm, Firm C. Firm C's innovation footprint is almost identical to Firm A's, yet, Firm A's R&D intensity (11%) is twice as high compared to Firm C's (6%). Therefore, firms with very different R&D intensities can actually have similar scales and scopes of innovative activity. In our entire sample of 83 firms (see section 2) for which both R&D intensity and the SIP were measured, the correlation between the firm's R&D intensity and the size of the innovation footprint was, for all practical purposes, zero (r=0.141, not statistically significant). This leads us to an important conclusion: *the size of a firm's R&D budget tells us very little about the scale and scope of innovative activity within the firm*. Interestingly, among the 83 firms there were about a dozen firms whose R&D budget was non-existent (= R&D intensity is zero) but whose scale of innovative activity based on the innovation radar was considerable, indeed higher than in many sample companies whose R&D intensities exceed 10% and would thus be considered *high-tech* firms in light of even the most conservative definitions. This is clear systematic evidence that innovative activity in firms does not necessarily manifest itself in R&D budgets.

Figure 1: The scale and scope of innovation in two firms, depicted using *the innovation radar*. Firms A and B have identical R&D intensities, but conspicuously different SIPs.



Note: We used two Likert-type questions to measure each of the 12 dimensions (see Appendix 2). The values presented in Figure have been calculated by summing the values of these two answers for each dimension.

Figure 2: The scale and scope of innovation in two firms, depicted using *the innovation radar*. Firms A and C have almost identical SIPs, yet, Firm A's R&D intensity is twice that of Firm C's.



Note: We used two Likert-type questions to measure each of the 12 dimensions (see Appendix 2). The values presented in Figure have been calculated by summing the values of these two answers for each dimension.

In conclusion, while the use of R&D intensity as a measure can be understood because it is easy to retrieve from financial reports, it is difficult to justify its use as a valid proxy of innovation at the firm level (see Hughes, 1988). As a telling example, Dell CEO Michael Dell questioned (Berger, 2005: 152-153)

> *"whether there's anything great about spending a lot on R&D. In fact, Dell spends less than 1 percent of sales on R&D. [A] lot of companies say they're better than us because they spend more on R&D. What are they better at? A lot of the R&D spending is actually spent to protect things that are proprietary, of no benefit to the customer. We only do the kind of R&D that benefits the customer… Innovation can occur in supply chain and logistics, manufacturing and distribution, and sales and service."*

In addition to anecdotal evidence such as Dell, researchers have demonstrated that R&D intensity as a proxy of innovation is suspect (e.g., Hughes, 1988; Smith, 2005) and that economic growth policies that are based on the metric are equally questionable. For example, "among 12 countries that experienced R&D intensity above the OECD average [in 1995-2005], only 3 show a GDP growth rate higher than the OECD average" (Pessoa, 2010: 153). A further example of this is what has become to be known as *the Swedish Paradox*: Sweden's GERD/GDP ratio has been among the highest in the OECD, yet, its economic growth has been below OECD average (Pessoa, 2010: 153).

The use of R&D expenditure as a proxy for innovation is widely adopted and is still embraced—recent advances and more broad definitions notwithstanding—in various normative international statistical guidelines as well, such as OECD's *Frascati Manual* (OECD, 2002) and *Oslo Manual* (OECD, 2005), although more recent editions have highlighted the importance of developing more proximate and sophisticated measures of the concept. R&D expenditure as a proxy for innovation is equally institutionalized in various economic policy initiatives. But the fact that it is widely used as a policy tool does not eliminate the fact that it is a poor measure of multidimensional and complex processes of innovation that occur in firms.

Equating innovation with R&D and R&D further with new product and technology development can indeed be described as a narrow-minded and political *de facto* definition of innovation. For example, the Frascati Manual (OECD, 2002: 42) states that: "If the primary objective is to make further technical improvements on the product or process, then the work

comes within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, the work is no longer R&D." Excluding market development and process development from R&D is clearly an arbitrary choice, and does not do justice to the multidimensional nature of innovative activity.

The advantage of conceptualizing innovation in terms of the SIP is that it incorporates both the overall importance or scale (the size of the footprint) as well as the scope (the shape of the footprint) of innovative activity; considering both scale and scope are essential in trying to understand how a firm is using its *innovation strategy* to seek growth and renewal. As Figures 1 and 2 clearly demonstrate, it is wholly inappropriate to conclude that two firms with the same R&D intensity are equally innovative, or that a firm with an R&D intensity twice that of another firm would be twice as innovative. In contrast, the conclusion that two firms with identical innovation footprints (identical scale and scope of innovation) are, perhaps not identical but at least similar in their innovative posture, is more justifiable. This commensurability makes the econometric analysis of statistical samples also more appropriate.

The innovation radar and the SIP further highlight that innovation and R&D are not just about new products and new services, they may also be aimed at the development of the firm's processes, organizational structures, supply chains, and market presence. This is in line with the received definitions of innovation: innovation should not be defined in terms of products and services (outcomes), it is best defined as "the ability to challenge existing ways of thinking and to replace them with new ones" (Van de Ven, 1986). Even contemporary definitions and conceptualizations of innovation tend to be technology and product centered. The ultimate objective in innovation may be growth and competitiveness, but these are not definitions for innovation as much as they are consequences of successful innovative activity. It is further important not to equate innovation with "progress" or "success" (e.g., Kimberly, 1981; Strang & Macy, 2001). Limiting the scope of inquiry to successful innovative activities does not do justice to the well-known fact that most innovative activities result in failure, or at least, do not lead to the desired consequences (Klein & Sorra, 1996); innovation is always process of trial and error, where tolerance for failure and ability to redirect and to adapt is crucial (e.g., Holmström, Ketokivi, & Hameri, 2009), or as Kline and Rosenberg (1986: 294) put it, "the central dimension that organizes innovation, if there is one, is uncertainty."

In a similar vein, the operationalization of innovativeness in terms of *inputs* (e.g., R&D intensity) is problematic (Kleinknecht, Van Montfort, & Brouwer, 2002). This leads us to an important conceptual and theoretical premise in this paper: we separate innovation and innovativeness from both its antecedents and its consequences. This is also an important distinction from the point of view of economic policy, which has tended to focus either on inputs or output, but not innovation itself. We discuss the relationship between innovation and its inputs and outputs in the following, in conjunction with our empirical analysis of the software development.

2. DATA AND EMPIRICAL ANALYSIS

2.1. Data

In the empirical portion of this study, we used survey data on software development activities in Finnish industrial firms operating in the metalworking, engineering, and electronics industries. The data were collected using a web-based survey in November 2008 – March 2009 by a research group at Helsinki University of Technology[3]. The informants providing the data in the surveys were either the chief executive officer or the chief technology officer.

The final sample of 83 firms was obtained through the following sampling procedure:

1) A mailing list was created by combining a list of large industrial firms with a list of smaller firms. The list of large companies was created using the member list of the Federation of Technology Industries, Talouselämä's list of 500 largest companies in Finland and Asiakastieto's list of large manufacturing companies. The list of smaller companies was obtained from the industrial partners participating in the study.
2) The questionnaire was mailed to 1,753 firms, of which 236 participated.
3) Out of the 236 firms, 83 firms provided all necessary data required in this study.

[3] The main purpose of the questionnaire was to examine the volume and significance of software development activities in industries outside the pure software industry.

2.2. Variables

In order to examine the innovation profiles of the firms, we used an abridged version of Sawhney et al.'s (2006) measurement instrument.[4] Specifically, we used two Likert-type questions to measure each of the 12 dimensions, resulting in a total of 24 questions (see Appendix 2).

The dimensionality of innovation was examined by conducting a factor analysis on the 24 innovation questions. A Varimax-rotated factor solution suggests that there are three distinct dimensions underlying the 24 innovation items (see Appendix 3 for statistical details):

1) Value chain strategy
2) Brand and distribution channels
3) Offerings and solutions

Based on the factor-analytic results, we created factor scores for these three factors using the *regression method* (e.g., Johnson & Wichern, 1998).

In addition to the innovation variables, we used the following variables in the analysis, either as control variables or other theoretically relevant variables:

1) *Company size*: The number of employees. We used the logarithmic transformation in the analyses.

2) *Company age*: Because the questionnaire does not include the establishing year of firms, we merged the questionnaire data with the company register of Statistics Finland. The company register included the year that firms were established and we used that information to calculate the firm age and the logarithm of the age of company that we use in our analyses.

3) *R&D intensity*: R&D expenditure divided by net sales.

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[4] We thank Professor Mohanbir Sawhney and Dr. Jiyao Chen for sharing the original measurement instrument with us.

4) *New products and services*: The proportion of sales from products and services introduced in the last three years.

5) *High tech* -dummy variable: The variable obtains value 1 if the firm is high-tech firm and 0 otherwise. The variable is based on survey question: *Is the primary industry in which your firms operates considered, generally speaking, high-tech? (Yes=1, No=0)?*

Summary statistics for the variables appear in Tables 2 and 3.

Table 2: Descriptive statistics

	N	Mean	Median	SD	Min	Max
Net Sales, Meur	83	68.7	5.3	273	0.25	2200
Revenue growth, %	83	12.2	5.9	33.7	-48.1	164.3
Number of employees	83	217	37	637	2	4514
Age	83	17.4	15.0	12.1	1.0	62.0
R&D intensity, %	83	1.9	0.5	4.7	0.0	31.8
Share of new products of net sales, %	83	20.8	10.0	24.8	0.0	100.0
Share of new services of net sales, %	83	6.4	0.0	14.5	0.0	100.0
Share of old products of net sales, %	83	52.3	60.0	34.9	0.0	100.0
Share of old services of net sales, %	83	20.5	5.0	32.0	0.0	100.0
Value chain strategy*	83	0.1	0.0	0.9	-2.0	2.3
Brand and distribution channels*	83	0.0	-0.1	1.0	-1.9	2.6
Offerings and solutions*	83	0.0	0.0	0.9	-2.3	2.1

* The factor analysis method produces factor scores with a mean of zero and standard deviation one.

As Table 2 demonstrates, the sample consists mainly of small and medium-sized companies: the median of net sales is 5.3 MEUR. The average number of employees is 217 (mean) and 37 (median). R&D intensities in the sample firms are highly variable: the average R&D intensity is 1.9%, but it ranges from 0% to 31.8%.

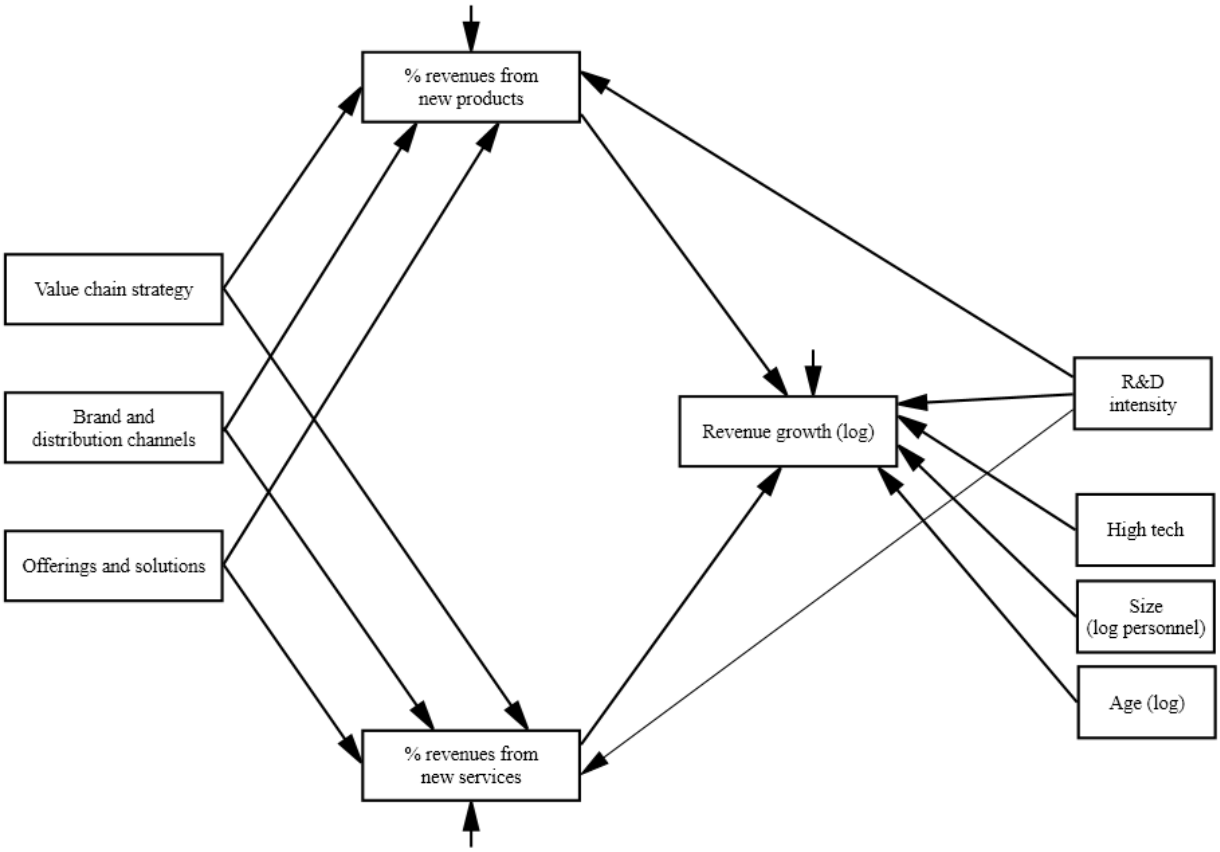
Table 3: Correlation matrix

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
[1] Net Sales	1.00									
[2] Growth, %	0.02	1.00								
[3] Number of employees	0.77	-0.01	1.00							
[4] Age	0.03	-0.29	0.09	1.00						
[5] R&D intensity	-0.08	0.21	-0.08	-0.06	1.00					
[6] New products	-0.06	0.42	-0.02	-0.26	0.32	1.00				
[7] New services	0.00	0.08	-0.03	0.01	-0.10	-0.10	1.00			
[8] Value chain strategy	0.10	0.11	0.13	-0.14	-0.02	0.00	0.29	1.00		
[9] Brand and distribution channels	0.07	-0.07	0.25	-0.06	0.13	0.23	-0.11	-0.01	1.00	
[10] Offerings and solutions	0.18	0.09	0.08	-0.14	-0.06	0.24	-0.02	0.09	0.06	1.00

2.3. Model and Statistical Analysis

We formulated the empirical hypotheses as a *structural equation model* (Bollen, 1989). The model is a system of simultaneous equations and can be used to incorporate both direct and indirect links from various aspects of innovation to new products and services and ultimately, sales growth. The model is depicted in Figure 3.

Figure 3: The structural equation model of innovation and sales growth.

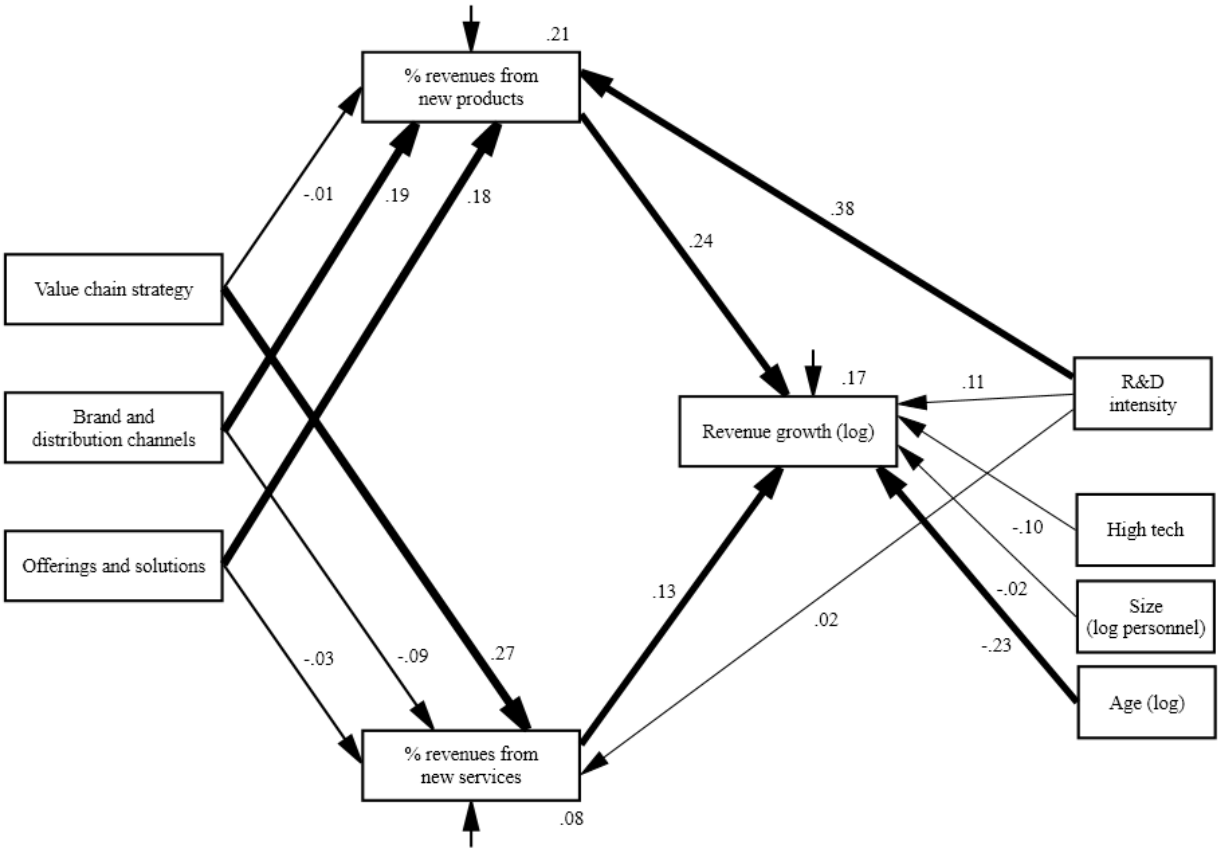


In the model, we posit the three innovation factors to contribute to firm growth through introduction of new products and services. According to Evans (1987), firm size and age potentially affect firm growth; therefore, we added these variables to the model as controls. As an additional control variable, we control for potential differences in the growth rates of high- and low-technology firms using the high-tech dummy variable.

The model was estimated using *full-information maximum likelihood* (FIML) estimation (Johnston, 1984). We used a variant of the FIML estimator that can be used when missing data is present (Arbuckle, 1996).

The results are summarized in Figure 4 (see Appendix 4 for details). The parameter estimates are the standardized coefficients, and statistically significant paths appear boldface. The squared multiple correlations are also reported for each endogenous variable: the variance explained in the *% revenues from new products*, *% revenues from new services*, and *Revenue growth (log)* are 21%, 8%, and 17%, respectively.

Figure 4: The structural equation model of innovation and sales growth: statistical results.



The results support our premise that R&D activity should indeed be considered an input variable. In the model, R&D intensity is positively related firm-growth, but only indirectly through new products (standardized coefficient 0.38 with p-value <0.001); there is no effect from R&D to growth through new service, as the path from R&D intensity to new services was found non-significant.

The three dimensions of innovation are clearly complementary to R&D intensity. *The Value Chain Strategy* dimension is positively (coefficient 0.27 with p-value 0.004) linked to the share of new services. This result supports the idea that successful development of new ser-

vices differs from traditional R&D activity. Instead of technology development, new services are clearly associated more with non-technology innovation activities such as customer experience, value capture and new customer segments (these activities are incorporated into the value chain strategy factor).

The two other innovation dimensions, *Brand and Distribution Channels* and *Offerings and Solutions* are positively linked to new products, but not to new services; the coefficients are 0.19 (p-value 0.020) and 0.18 (p-value 0.026), respectively.

Of all the control variables, only the effect of firm age is significant, and in the expected direction: older firms tend to have less growth than younger firms.

We also estimated a model where the three dimensions of innovation were directly linked to revenue growth: one could argue that innovation can lead to firm growth also in ways other than through new products and services. The direct paths did not, however, appear significant, therefore, we conclude that at least in this dataset, development of new products and/or services is a necessary condition for revenue growth.

3. CONCLUSIONS AND DISCUSSION

3.1. Main results

The results of this study highlight the importance of considering the multidimensional nature of innovation. The conventionally used measure, R&D intensity, is linked to firm growth, but this link is mediated by new products and services: investing in R&D leads to firm growth only insofar as it leads to introduction of new products.

The descriptive analysis of our sample provided an interesting result related to the distribution of sample firms' net sales. Sales from products developed in the past three years constituted, on average, 21% of total net sales. The corresponding figure for new services was only 6.5%. At least in this context, therefore, new products seem to have been a more important source of new business as well as growth. This is further supported by the finding that the link from new products to revenue growth is stronger than from new services to growth (Figure 4).

The three dimensions of innovation clearly complement the role of traditional R&D, and each of the three dimensions has a distinct role. As we would have expected, the *Offerings and*

Solutions and *Brand and Distribution Channels* factors are associated with the introduction of new products and indirectly firm growth. The *Value Chain Strategy* dimension is, in turn, associated with the introduction of new services, and it is an interesting and important association, because in this model the *Value Chain Strategy* factor is the only antecedent to new services that appears significant. But the link from this factor to new *services* in particular is not surprising when we look at the individual items and sub-dimensions of the *Value Chain Strategy* factor: firms with a high value on this factor understand where and how value is created and what their own role in the chain is. In particular, these firms understand the customer experience, which is key to development and introduction of new services.

R&D intensity likely captures the technological skill and investment associated with innovative activity, and remains an important measure of innovation. But the concept of *strategic innovation profile (SIP)* complements the R&D measure and helps us understand the non-technical aspects of innovation that are clearly less technology driven. The SIP and the associated innovation radar add important dimensions to empirical analysis that are still scarcely applied in innovation research. Specifically, these additional dimensions are closer to the strategic and marketing aspects of the firm than its technological prowess.

In summary, the empirical results of our analyses unequivocally support the notion that the SIP and the associated measurement instrument offer not an *alternative* but a *complementary* measure to the conventional measures: R&D intensity is not only merely weakly correlated with the complementary measures proposed in this paper, but the empirical results also demonstrate that the complementary measures—the *Value Chain Strategy* dimension in particular—have different statistical associations with new products, new services and firm growth than the conventional measures. This evidence provides strong support to the idea that measures of innovation are in need of further elaboration.

3.2. Policy implications

One of the characteristics that policy discussions in Finland share with discussions in other countries is that the focus has mainly been on technology and product innovation. This emphasis has also been manifested in numerous policy initiatives, where governments have granted private R&D subsidies and R&D tax credits. This further implies that the R&D function and the R&D expenditure in firms has been viewed as the primary—even exclusive—means of fostering innovation.

Both our conceptual analysis and empirical data add an important perspective to policy discussions. Specifically, using the innovation radar we have shown that innovative activity within firms encompasses a scope broader than merely product or technology development. Indeed, the size of a firm's R&D budget tells us very little about the scale and scope of the firm's innovative activity. This observation implies that also innovation policy should be broader. In this sense, the idea of a *broad-based innovation policy* emphasized in the proposal for Finland's innovation policy (Aho et al., 2008) seems appropriate.

3.3. Conclusion

Complex concepts cannot be turned into simple measures, and simple measures tend to bias our thinking of the nature of these concepts. R&D intensity as a measure of innovation suffers from both these problems. Our aim in this paper has been not to dismiss but to augment existing measures of firm-level innovation by applying the *innovation radar* (Sawhney et al., 2006) and *strategic innovation profiles*. Applying these two empirically to a preliminary examination of innovation in software development suggests that these new measures may have merit in helping us understand both innovation as an activity as well as the link from innovation to firm growth. Further research is needed both in further refinement of the instrument as well as examination of its links to economically relevant variables.

In closing, we wish to point out the potential drawback of both more complex multidimensional measures as well as the general idea of a *broad-based* innovation policy. While innovation should be viewed from a broad and multidimensional perspective, we must maintain a clear definition of what innovation is and what it is not, so as to avoid a situation where just about every activity can be argued to be innovation. Our aim is certainly not to propose an all-encompassing definition that can be used to justify just about any activity as innovation. But the issue is not black and white: innovation can be construed as multidimensional and broad based, while still maintaining the strict definition that innovation must demonstrate "*the ability to challenge existing ways of thinking and to replace them with new ones*", as Van de Ven's (1986) definition suggests. Comparing firm activities with this definition as the benchmark, an honest observer should come to the conclusion that most activities within the firm are not innovation.

4. REFERENCES

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5. APPENDIX

5.1. Appendix 1: The 12 dimensions of innovation

This appendix defines and describes the scope of the 12 dimensions of innovation developed by Sawhney et al. (2006); the page numbers below are in reference to this article. It should be noted that each dimension addresses *innovation* in the specific dimension. For instance, brand in and of itself is not relevant, what is relevant is whether or not brand is "[leveraged] or [extended]… in creative ways" (p. 80).

1. **Offerings** = "A firm's products and services. Innovation along this dimension requires the creation of new products and services that are valued by customers." (p. 77).

2. **Platform** = "A set of common components, assembly methods or technologies that serve as building blocks for a portfolio of products or services. Platform innovation involves exploiting the 'power of commonality'." (p.77).

3. **Solutions** = "A customized, integrated combination of products, services and information that solves a customer problem. Solution innovation creates value for customers through the breadth of assortment and the depth of integration of the different elements." (p. 78).

4. **Customers** = "The individuals or organizations that use or consume a company's offerings to satisfy certain needs. To innovate along this dimension, the company can discover new customer segments or uncover unmet (and sometimes unarticulated) needs." (p. 78).

5. **Customer experience** = "Everything a customer sees, hears, feels and otherwise experiences while interacting with a company at all moments. To innovate here, the company needs to rethink the interface between the organization and its customers." (p. 79).

6. **Value capture** = "The mechanism that a company uses to recapture the value it creates. To innovate along this dimension, the company can discover untapped revenue streams, develop novel pricing systems and otherwise expand its ability to capture value from interactions with customers and partners." (p. 79).

7. **Processes** = “The configurations of business activities used to conduct internal operations. To innovate along this dimension, a company can redesign its processes for greater efficiency, higher quality or faster cycle time.” (p. 79).

8. **Organization** = “The way in which a company structures itself, its partnerships and its employee roles and responsibilities. Organizational innovation often involves rethinking the scope of the firm’s activities as well as redefining the roles, responsibilities and incentives of different business units and individuals.” (p. 79).

9. **Supply chain** = “The sequence of activities and agents that moves goods, services and information from source to delivery of products and services. To innovate in this dimension, a company can streamline the flow of information through the supply chain, change its structure or enhance the collaboration of its participants.” (p. 79).

10. **Presence** = “The channels of distribution that a company employs to take offerings to market and the places where its offerings can be bought or used by customers. Innovation in this dimension involves creating new points of presence or using existing ones in creative ways.” (p. 79).

11. **Network** = “A company and its products and services are connected to customers through a network that can sometimes become part of the firm’s competitive advantage. Innovations in this dimension consist of enhancements to the network that increase the value of the company’s offerings.” (p. 80).

12. **Brand** = “The symbols, words or marks through which a company communicates a promise to customers. To innovate in this dimension, the company leverages or extends its brand in creative ways.” (p. 80).

5.2. Appendix 2. The measurement instrument

The respondents were asked to assess the extent to which their firm engaged in the following activities (1=not at all, 2=a little, 3=somewhat, 4=a lot, 5=very much):

1. Offerings:

1.1. We upgrade and improve our existing products and services faster than any other firm in our industry.

1.2 Our customers consider our new products and services innovative.

2. Platform

2.1. We have developed new ways of integrating external technologies or resources into our products.

2.2. We use modularity or product platforms more than our competitors.

3. Solutions

3.1. We combine products and services in new ways to create integrated solutions.

3.2. We have a well-defined process for creating solutions for customers.

4. Customers

4.1. We serve customer segments that others do not recognize as opportunities.

4.2. We are able to identify underserved customer needs better than our competitors.

5. Customer experience

5.1. We provide a better customer experience than our competitors.

5.2. We have developed new ways of differentiating ourselves from our competitors at different stages of the customer's buying process.

6. Value capture

6.1. We have created innovative pricing schemes for our products and service (e.g., subscription pricing) more than our competitors.

6.2. We innovate ways to monetize intellectual property assets in business.

7. Processes

7.1. Our operating processes are very creative compared to industry standards.

7.2. We look for higher levels of operational effectiveness by innovatively managing our business processes.

8. Organization

8.1. We consider our organization design to be a source of competitive advantage.

8.2. Our company culture is regarded as creative and innovative.

9. Supply chain

9.1. We have created more new ways than our competitors for sourcing our inputs and delivering our products and services to our markets.

9.2. We have made innovations to interact with our supply chain partners.

10. Presence

10.1.We have created new channels or methods to tap into new markets compared to industry standards.

10.2. We lead the industry in terms of applying new channels of distribution.

11. Networking

11.1. We use network technologies to deliver our product or services more than our competitors.

11.2. We have been pioneers in creating Internet versions of traditional products and services.

12. Brand

12.1. We are considered to be innovators in terms of how we have managed and built our brands.

12.2. Our brand innovations have allowed us to enter new markets and customer segments more than our competitors.

5.3. Appendix 3. The factor-analytic results

The three-factor structure uncovered by factor analysis is as follows (the largest factor loading for each item appears in boldface):

Item (see Appendix 2 for detailed content)	Factor		
	Value chain strategy	Brand and distribution channels	Offerings and solutions
Brand1	.255	**.854**	.261
Brand2	.310	**.764**	.247
Customer1	**.484**	.268	.352
Customer2	**.633**	.218	.316
Experience1	**.630**	.091	.307
Experience2	**.713**	.231	.229
Networking1	.226	**.701**	.223
Networking2	.207	**.738**	.250
Offerings1	.334	.355	**.571**
Offerings2	.239	.245	**.675**
Organization1	**.369**	.148	.233
Organization2	**.445**	.367	.352
Platform1	.278	.218	**.637**
Platform2	.225	.267	**.682**
Presence1	.509	**.547**	.216
Presence2	.452	**.608**	.227
Process1	**.596**	.445	.107
Process2	**.511**	.467	.296
Solutions1	.297	.124	**.785**
Solutions2	**.481**	.224	.321
Supply1	**.636**	.342	.234
Supply2	**.499**	.384	.305
Value1	**.591**	.317	.233
Value2	**.558**	.490	.180

5.4. Appendix 4. Parameter estimates for the structural equation model

			Unstandard-ized estimate	Standard-ized estimate	P
New Products	<---	Value chain strategy	-0.287	-0.011	0.452
New Products	<---	Brand and distribution channels	4.634	0.190	0.020
New Products	<---	Offerings and solutions	4.558	0.181	0.026
New Services	<---	Value chain strategy	3.987	0.269	0.004
New Services	<---	Brand and distribution channels	-1.327	-0.093	0.175
New Services	<---	Offerings and solutions	-0.483	-0.033	0.371
New Products	<---	R&D intensity	1.648	0.379	<0.001
New Services	<---	R&D intensity	0.057	0.022	0.416
Log of revenue growth	<---	High tech industry	-0.048	-0.099	0.148
Log of revenue growth	<---	Lof of age	-0.066	-0.228	0.016
Log of revenue growth	<---	Log of personnel	-0.003	-0.021	0.822
Log of revenue growth	<---	R&D intensity	0.005	0.113	0.149
Log of revenue growth	<---	New Services	0.002	0.132	0.083
Log of revenue growth	<---	New Products	0.002	0.243	0.010