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Information and knowledge base of innovation policy-making:

An analysis of documents on innovation information and knowledge

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Abstract

This study focuses on information and knowledge in innovation activities and policies. It is crucial to develop a good understanding of the information and knowledge base of innovation for successful innovation policy-making. This paper carves out the characteristics of 'innovation information' and 'innovation knowledge' that are prevalent in the conceptualization of innovation strategies and policies. Measurement problems, innovation modes and hierarchy of data, information and knowledge are discussed first. The empirical part focuses on how innovation information and knowledge are defined and understood in strategy, policy and other documents. The study focuses on Finland. It confirms that, despite some positive changes, data collection and documents still reflect a narrow, conventional, science- and technology-oriented view of innovation mainly concerning the private sector. This dominating, simplified view of innovation driven by science and technology does not capture and reflect qualitative processes of creativity or learning, nor does it embed and discuss the effects of wider societal changes on processes of innovation. The study contributes to improving the information base for decision-making concerning innovation policy and activities. Suggestions for moving forward and improving innovation information and knowledge are presented.

1 Introduction

"Given the importance of innovation to individuals and societies everywhere, the global inadequacy of tools—even a rigorous vocabulary—to measure innovation and trace its effects is striking." Carl Schramm, 2008

Innovation is a 'hot' topic nowadays. Purely science and technology-oriented thinking has made way for more holistic viewpoints. Today innovation is understood as covering many different types – from product innovation to process, organizational, service, social, and so forth; open innovation is sought for and advocated and practice-based innovation is increasingly gaining interest (Harmaakorpi/Melkas 2012). Is this wider view reflected in statistics and data collection, strategy documents, conventions, and alike at international, national, regional and organizational levels? How do the different sectors perform in this regard?

Widely available indicators such as R&D inputs, patent counts, patent citations, counts of new product announcements and more specific survey-based measurements have been used in trying to capture companies' innovative performance (Hagedoorn/Cloodt 2003). Indeed, statistics on R&D and patents have become easily accessible, while it is much more difficult to develop variables capturing creativity and the characteristics of learning organizations and to link those to innovative performance (Lorenz/Lundvall 2006). Today's measurements and criteria of innovation do not capture societal changes; there is a clear need for new ways to measure results and identify them and new ways to conceive innovation information and knowledge (cf. Lundvall 2007).

Information and knowledge are concepts that are widely referred to in discussions and research of innovation. Yet, their characteristics as well as their interaction and relationship as well as implications of that interaction are hardly focused on. This study analyses present views of innovation information and innovation knowledge. On the basis of the results, it proposes ways in which to look into them in the future in order to narrow the gap (cf. Melkas/Harmaakorpi 2012) between high-level innovation strategies and policies on the one hand and grassroots innovation activities on the other hand. Narrowing such a gap might increase effectiveness and long-term sustainability of innovation strategies and policies (cf. OECD 2008).

This study focuses on how innovation information and knowledge were defined and understood in different years in strategy, policy and other documents. The research materials consist of national, regional and international documents retrieved from the Internet and containing these concepts either in the English or Finnish languages. The purpose is to 'test' the following proposition: *Data collection, strategy and policy documents and alike still reflect a narrow, overly science- and technology-oriented view of innovation taking place mainly in the private sector.* The study contributes to the improvement of the information base for decision-making concerning innovation policy and activities. The study also clarifies the problematic situation by "disaggregating" it: where is the problem in the information base and how does it manifest itself? The results may also help in improving interactions between decision-makers, practitioners and researchers.

The theoretical background contains themes to be taken into account when considering innovation information and knowledge. The theoretical discussion lays the foundation for understanding how wide a topic innovation information and knowledge should be in the future.

2 Theoretical background

2.1 STI and DUI modes of innovation

Today, innovations are often created in practical contexts where many different sources of information are exploited in solution-centred processes (Melkas/Harmaakorpi 2012). Practice-based innovation processes for example, have been defined as being *triggered by problem-setting in a practical context and conducted in non-linear processes utilising synthetic knowledge production and creation in multi-actor, cross-disciplinary innovation networks* (Harmaakorpi/Melkas 2012; Harmaakorpi et al. 2011).

Many innovation systems are about to change from a Science, Technology and Innovation (STI) mode towards a Doing, Using and Interacting (DUI) mode. STI is a mode of innovation that focuses on codified knowledge and science-based learning. DUI is a mode of innovation where the focus is on tacit knowledge, organizational learning and user needs (Jensen et al. 2007). The DUI mode requires a new kind of innovation culture in an organization, implying the ability to produce innovations in everyday work. The DUI mode of learning most obviously refers to know-how and 'know who', which is tacit and often highly localised. While such learning may occur as an unintended by-product of the firm's design, production and marketing activities, Jensen and his colleagues emphasized that the DUI mode can be intentionally fostered by building structures and relationships that enhance and utilise learning by doing, using and interacting (Jensen et al. 2007).

STI and DUI are also related to different modes of knowledge production. ibbons and his colleagues (1994) defined two modes of knowledge production: Mode 1 is usually a hierarchical process, during which knowledge tends to preserve its form. Mode 2 is a more heterarchical process which is transient by nature. In Mode 1, problem-solving is usually carried out following codes of practice relevant to a particular discipline and problem-solving and it relies on a homogeneous theoretical basis, while in Mode 2 knowledge activity is more diffuse by nature; it combines heterogeneous knowledge interests in a multidisciplinary manner – often in very practical environments. These modes have been widely discussed in research. Harmaakorpi and Melkas (2012) recently proposed dividing Mode 2 knowledge production into two sub-categories to understand the prerequisites of practice-based and also broad-based innovation activities (cf. Edquist et al. 2009), and to support them in practice (see also Figure 1):

Sub-category 2a contains intellectual cross-fertilisation, for instance in innovation sessions, in which scientific and prac-

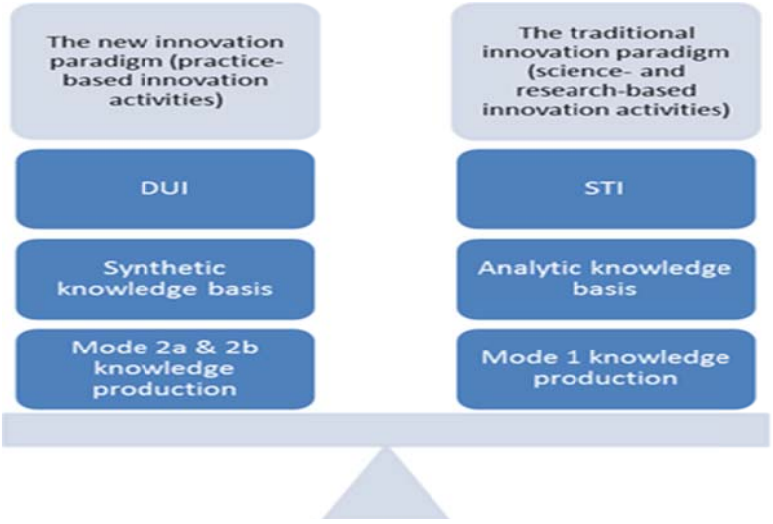


Figure 1: The need for balance between certain conceptual pairs related to innovation (Harmaakorpi/Melkas 2012).

tical expertise are combined with the help of various ideation and creative methods; such sessions may aim at, for instance, a concrete product or process innovation.

Sub-category 2b contains more heterogeneous, longer-term development of organizations, the effectiveness of which becomes visible more slowly. This may be conducted with the help of, for instance, applied community-based theatre methods and learning by doing. In this kind of development that aims at, for example, organizational and social innovations, every employee – and customer – is an expert.

2.2 Innovation measurement

Innovation is viewed as an evolutionary process within an organization to adopt any change pertaining to a device, system, process, policy, or service that is new to the organization (Calantone et al. 2002). Measuring innovation can be challenging, especially when there is a need to bring clarity to a fundamentally creative process (Skarzynski/Gibson 2008). Traditional corporate measurements focus on aspects such as innovation process efficiency, employees' contribution and motivation as well as benefits for customers. Measured values vary widely between businesses, covering such indicators as new product revenue, investment in R&D, time to market, customer and employee satisfaction, number of patents and additional sales resulting from past innovations.

For the political level, measurements of innovation usually focus on a country or region. The types of innovation measured have increased, but traditional methods of measuring still inform many policy decisions. The accuracy of innovation measurements is widely discussed, but changes are slow due to various practical challenges in data collection. This study concerns both organizational and political levels, but indirectly. That is, the data concern both levels, but the levels are not the focus of our attention in the results. This is because we believe that many of the problems should be dealt with at both levels at the same time. Skarzynski and Gibson (2008) noted, concerning innovation measures at the organizational level, that they can help managers in two ways: (i) to make informed decisions based on objective data; and (ii) to help align goals and daily endeavors with the near- and long-term innovation agenda. Both ways are also relevant for the political level. If the two levels do not speak "the same language", problems in measurement likely persist.

In general, intangibles are hard to concretize, and that is why they are also hard to measure and manage (Bontis 2001; Marr 2007). When measuring intangible things, indirect indicators are usually used to capture things that cannot be measured directly. If the phenomenon itself cannot be measured, then something closely linked to the phenomenon has to be measured. Indirect measures can be divided into objective and subjective measures. According to Saunila et al. (2012), all in all, the current types of measurement are especially difficult to apply to practice-based innovation because it often is more intangible by nature than traditional science- and research-based innovation. Current objective innovation measurements are focused on industrial and technological innovations, while service innovations have no proper way of being measured. Subjective measurement has traditionally been conducted via questionnaires or other subjective assessment models (for further information, see Saunila et al. 2012).

Lundvall (2007) noted that traditional innovation indicators reflect outputs such as number of patents or inputs that are easy to measure such as R&D expenditure. When it comes to indicators of knowledge, there is a strong bias in favour of explicit knowledge. Investment in scientific knowledge is measured by surveys on R&D and innovation. The know-how built up through learning by doing, using and interacting – while, for instance, co-creating service or social innovations – is much more difficult to measure.

Human capital measurements may register formal investment in education but what people learn at the workplace or as customers is not easy to capture through standard measurements. The absence of indicators makes the area less visible for policy makers, which contributes to a bias in innovation policy toward promoting STI (Science – Technology – Innovation) rather than DUI (Doing – Using – Interacting) activities. For example, you can have better technology, but there are also crucial learning tasks involved that are important for innovation. Such measurements and research are still missing, to a great extent.

2.3 From data to knowledge and further

We now move on to the remaining fundamental concepts that lay the foundation for this study. It is important to understand the relationship between the three concepts of data, information and knowledge and how the quality of one affects the others. There are significant differences in how people describe and understand data, information and knowledge. (Pierce et al. 2006.) The role and quality of information, knowledge and data in enhancing functions of innovation management and therefore in innovation policies are crucial. Knowledge controls and guides decision-making and other processes through assessment of information. Quality of information, again, cannot be improved independently of processes that produced this information and of contexts in which information consumers utilize it (Strong et al. 1994; Lee/Strong, 2003). The same applies vice versa; contexts and processes cannot be improved independently of quality of information. The relationship between information management and knowledge creation is close. Good information quality helps greatly in knowledge creation (Huang et al. 1999).

Unfortunately, a line is typically drawn between data- and information-related research and research on knowledge management, leading to a situation where the important interrelationship between these is often overlooked (Melkas 2004). In innumerable research studies, the terms data, information and knowledge are used interchangeably. Between information and knowledge, there is also considerable conceptual obscurity. Some researchers emphasize that despite their difference, the relationship between information and knowledge is interactive (English 1999; Huang et al. 1999). The situation is further complicated by different types of knowledge – explicit, tacit and self-transcending (see, e.g., Nonaka/Takeuchi 1995; Pierce et al. 2006). Scharmer's (2001) concept of self-transcending knowledge means tacit knowledge prior to its embodiment; the ability to sense the presence of potential, to see what does not yet exist. Drawing the lines between the various concepts is quite problematic. Explicit and tacit knowledge, for instance, are not independent of each other but mutually complementary (Melkas 2004; Pässilä et al. 2013).

One reason for the general confusion occurring in conceptual discussions may be caused by a "chaining process" that takes place in organizations (Miller et al. 2001). Some explicit knowledge may be treated as data by higher level processes. Explicit knowledge also may be sent to decision-makers who view it as information. Certain information may likewise be treated as data by higher level processes. Miller et al. (2001) emphasized that recognizing and understanding this chaining process may contribute to perceiving the complexity of the field. About ten years later it is still rarely discussed, although a similar chaining process appears to take place – not only internally but also between organizations and the political level. The concepts in question have been

summarized as follows by Miller et al. (2001: 365):

"Data: A representation of an object.

Information: The aggregation of data into something that has meaning (semantics) through interpretation by human or automated processes.

Knowledge: That which is derived and inferred from assimilating information against perceived context, experience or business rules.

Decision: A process for arriving at a solution to a problem, using knowledge to assess and judge information.

(Situational) awareness: The assessment of information into decisions and actions, guided by knowledge of the contextual domain."

Awareness foregoes, in our view, understanding. That concept will be discussed in the concluding section of this study.

2.4 Quality issues for data, information and knowledge

Information quality has traditionally been studied by researchers interested in information systems, databases and their management and data security, to mention a few. Researchers have concentrated on company environments and business information. Studies of information quality in the context of innovation are still few. Knowledge quality is a newer concept than data and information quality. Conventionally, information quality has been described as how accurate information is. Huang et al. (1999) claimed in their comprehensive "guidebook" that no standard definition for the concept exists. English (1999) listed two general definitions:

"information quality is consistently meeting knowledge worker and end-customer expectations through information and information services, enabling them to perform their jobs efficiently and effectively; and information quality describes the attributes of the information that result in customer satisfaction."

Wang and Strong (1996: 6) defined "data quality" briefly as "data that are fit for use by data consumers". On the basis of these definitions and the theoretical discussion on, for instance, measurement problems, it can be argued that the quality of innovation-related information is generally far from high quality. We are dealing with an issue – innovation – that is characterized by highly fragmented information and knowledge as well as needs. Moreover, the Web has become a large repository of information with varying qualities, and many users consume that information without knowing its quality (Zhu et al. 2011). The following empirical part sheds some light on the complicated reality.

3 Material and methods

There is a body of research literature on information and knowledge for innovation, for instance, information and knowledge sourcing practices of companies. Veshosky's (1998) study concerned innovation information – the ways in which project managers in the U.S. engineering and construction industry attempted to obtain information about relevant innovations and the ways in which industry firms attempted to facilitate their project managers' abilities to obtain such information. He found that project managers rely heavily on trade magazines and conversations with coworkers for information about innovations and that firms' efforts to facilitate information seeking by their project managers focus primarily on information from internal sources; reports of "lessons learned" and other means. Project managers are often unaware of their firms' policies or programs intended to assist them in obtaining innovation information, or do not use available assistance (Veshosky 1998). While this is not a new study, its conclusions are still valid.

The following is a case study in which strategy and policy documents and statistics are investigated qualitatively to find out about definitions and descriptions concerning innovation in-

formation and innovation knowledge. This is not a literature review, as we claim that strategy and policy documents and statistics reflect current understanding at the national and regional levels in Finland better than research studies. Moreover, in today's changing communication environment, it was seen as apposite to investigate publicly available documents.

of sufficient quality and depth for a detailed investigation. The initial aim was to investigate an equal number of documents from various hierarchical levels – the national, regional and local levels, for instance – but the quality of the data was such that the criteria had to be changed. The 48 documents were finally selected – not because of their origins but – as they contained either

2008	2010
48 documents, of which	44 documents, of which
- 22 concerned innovation information - 26 concerned innovation knowledge	- 39 concerned innovation information - 5 concerned innovation knowledge
- 5 were national, regional or international policy documents (produced by ministries or other public bodies) - 10 were industry-related documents - 13 were science-related documents (not research papers but produced by research institutes or alike)	- 23 were national, regional or international policy documents - 11 were industry-related documents - 10 were science-related documents

Table 1: The research data

Finland was chosen as the country focused on due to, for instance, relatively advanced innovation strategies and policies. The situation in Finland may well be indicative for other countries, too. The study does not focus directly on different types of innovation or on the concept of innovation itself.

The documents to be studied were chosen after a review of 250 strategy, policy or statistical documents on the Internet that included the concepts of innovation information, innovation knowledge or the corresponding concepts in the Finnish language (*innovaatiotieto, innovaatiotietämys)*. The documents, most of which concerned Finland or were strategy documents of international organizations were originally retrieved in the autumn of 2008. They were produced in 2002–2008. Out of the 250 original documents 48 were

some kind of a definition of one of the concepts or a practical content related to it (or both), as understood by the authors of the documents or organizations that had published them. The documents are characterized in Table 1.

The difficulty of finding and selecting relevant documents is a result in itself; despite the importance of the concepts they are focused on surprisingly rarely. To improve the quality of the study, 20 other national and regional innovation policy related documents (that did not come up in the original search) were retrieved and read with – interestingly – no traces of the concepts sought for.

Another search with the same concepts was conducted in 2010. At that time, 44 documents were found and studied. Updates were sought for in 2012, but the actual study was conducted on the basis of the earlier materials. There

was very little change from 2010 to 2012, but updates were checked to improve quality.

As the study concerns many agencies and their work in a light that is not necessarily beneficial for them, the results are partly anonymized, that is, the names of the agencies or website links are in some cases not given. The study sheds light on practical definitions and limitations of the concepts of innovation information and innovation knowledge. The study provides support to the theoretical discussion concerning the widening innovation discourse and recommendations for policy-makers. The interest is not in the change itself, although the samples were obtained in 2008 and 2010 partly also in 2012. Many of the earlier documents were still available in 2010 and 2012. Only the new documents or updates were retrieved, resulting in smaller numbers of documents for the later year. In this type of study, the data are not comparable as such across years. In this reporting of the results, the most comprehensive 2008 search is primarily focused on, but this does not imply discounting the later data or overlooking the change altogether.

The key questions in analysing the documents included:

How is innovation information or innovation knowledge defined?

How is it discussed in practice; what does it include? What does it not include?

What needs are there concerning innovation information or innovation knowledge in the context discussed?

4 Results

4.1 Views of innovation *information*

'Innovation information' was focused on by studying the contents of 22 strategy, policy or other public documents from Finland (produced by national agencies, regional agencies, universities and research agencies or companies) and abroad (OECD, European Parliament, European Commission) for 2008, and 39 for 2010. The concept was not defined properly in any of the documents that referred to 'innovation information'. 'Information' referred in these documents first and foremost to scientific information and utilisation of research results, although the concept was not precisely defined. This is typical when discussing information – it is not broken down in detail and thus the core of challenges and cause-effect relationships typically remains hidden or overlooked (cf. Melkas 2004). It was indeed striking that even the concept 'innovation' was not defined in the documents concerning that phenomenon. That would be the starting point with regard to innovation information, too, as the view of innovation has a significant impact on how innovation information (and knowledge) is understood.

A document by the Finnish Funding Agency for Technology and Innovation (Tekes 2008) for instance, presented results of an innovation index developed by the World Economic Forum. Finland was placed at the top when looking at the results of an international comparison. The index reflects (i) quality of research of research organisations, (ii) R&D costs of companies, (iii) collaboration between universities and companies, (iv) availability of researchers and engineers, (v) use of patents and (vi) protection of immaterial rights. With regard to projects funded by Tekes, the following outputs were measured: (i) academic theses, (ii) publications, (iii) patent applications of research units, (iv) patent applications of companies, (v) new or substituting products, (vi) new or substituting services and (vii) production processes.

A generally held view of innovation information is that it is business information and thus confidential and protected, for instance patented. Scientific information, by definition, should not be any of those. Scientific information is needed by many others

than companies: ordinary citizens, non-governmental organisations, political decision-makers, judicial bodies, and companies other than those particularly concerned (discussion in a scientific web blog, October 2008.) Despite this important point, the understanding concerning innovation information in the documents analysed concerned 'technical' issues such as number of patents and volume of R&D activities in terms of their costs.

For instance, in a research presentation on utilisation and protection of innovations in the building industry and use of innovation information in that industry (written at a Finnish university), it was noted that 80-90 per cent of all technology information is published in patent applications. By using patent information, developing already existing technical solutions again may be avoided. Other types of innovation information listed in the document included usability models, model rights and other immaterial rights. An innovation chain was understood as starting from acquisition of innovation information, registration of possible patent or other rights and licence agreements and continuing to information management related to copying and distribution of advanced planning and building solutions. (A research presentation by Finnish researchers, October 2008.)

Business intelligence (BI) and competitive intelligence (CI) are also concepts that one comes across in this type of study with the search term 'innovation information'. They are fields that focus on ways in which companies can efficiently acquire strategic information needed for management and decision-making. This kind of strategic information is related to, for instance, market acquisitions, information on competitors' activities, even industrial espionage, threats to one's technology advantage, ways to attract new customers, retaining the customer base, knowing customers and their needs (both visible and hidden) and buying behaviour. A business intelligence system is used to analyse and interpret the information collected, such as information on the population and address information, marketing data, innovation information (not defined), information on Internet use and information on on-line events. It was mentioned in the document in question that

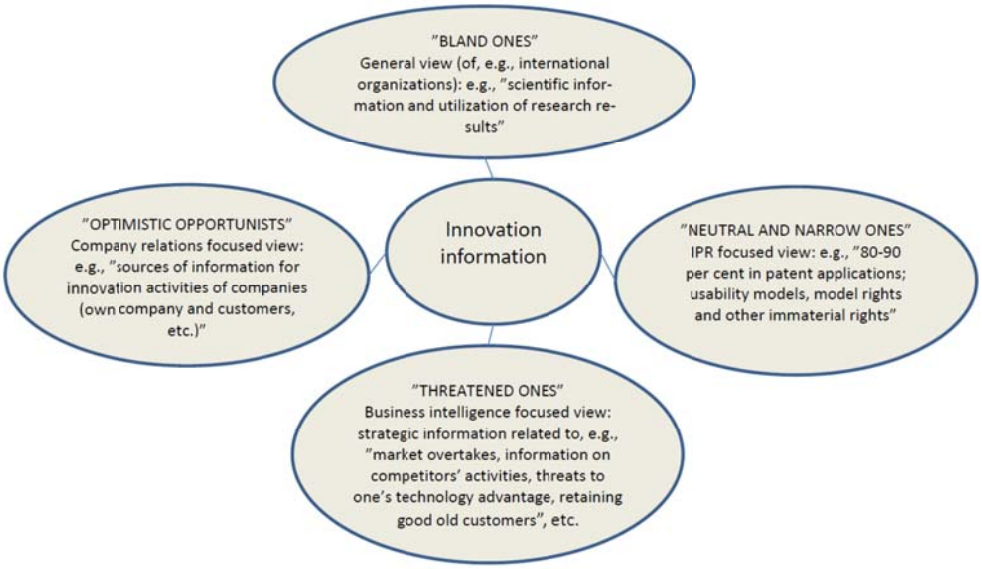
> "the information that has been collected with much effort needs to be refined to become part of a company's knowledge and developed into clear operational strategies that are based on real information on customers, competitors and markets, so that the company gains a significant competitive advantage." (A development centre related to the information society, October 2008)

In a Finnish regional action plan for internationalization (Keski-Suomen… 2009), innovation information was also brought up as needing to be better exploited in development work of different actors. There were suggestions for measures and targets of assessment, but they were quite conventional ones and not even very much related to innovation information. The concept of innovation information was not defined. Koski (2007), again, wrote about innovation information as sources of information for innovation activities of companies (own company and customers being the most important ones).

In Figure 2, typical directions of understanding innovation information are given on the basis of the findings. There are other directions as well, but these were identified as typical ones (through a quantitative and qualitative assessment). The general view (usually without any definitions) was most common among international organizations and their strategy documents. The intellectual property rights (IPR) focused view was found both in international documents and national, company-oriented documents. The other two, the company relations focused view and the business intelligence focused view were both found

mainly in national strategy and policy documents, but their nuances were different – the company relations focused view appeared to follow the open innovation thinking in that the main concern was to find a suitable, clever and novel combination of information from different sources. Networking was a positive thing and the view reflected a positive and outward looking attitude. In the business intelligence focused view, again, innovation information appeared to be perceived from a somewhat more 'selfish', inward looking and perhaps even negatively oriented perspective. Each view has been given a descriptive title in Figure 2.

Figure 2: Different types of views concerning innovation information



Innovation information in databases

Databases are here discussed separately because of their very different characteristics as well as traditional importance for innovation policy makers. VTT Technical Research Centre of Finland has an innovation database covering the majority of Finnish product innovations from 1945. SFINNO is a longitudinal database of some 4500 individual product innovations of Finnish businesses from across the Finnish economy. The SFINNO database contains data on the following issues: data on commercializing firms, characteristics of the innovations, origins of the innovations, R&D organization, innovation management, sources of information, collaboration during the innovation process, role of public funding & services, intellectual property rights, the 'life after' commercialization, internationalization, impacts & benefits and problems & challenges.

Innovation is defined in SFINNO as "… invention which has been commercialized by a firm or equivalent. … technologically new or significantly enhanced product from the firm perspective" (≈ OECD Oslo Manual). Innovations are identified from professional journals of industrial fields. Annual reports of large Finnish firms are also included as well as expert opinions. Most of the innovations are commercialized product innovations. Nowadays, the database contains also some process innovations. There have only been very few service innovations; they were not included in the definition when the database was launched and have thus not been systematically identified. This situation is, however, changing. (See

Valovirta et al. 2009, on the use of SFINNO in innovation research.)

In addition to VTT, Statistics Finland compiles a wide variety of statistics on innovation: new products, services and processes of industries and certain service sectors, production methods, costs of innovation activities, their structure and impacts as well as factors related to innovation processes (sources, collaboration, obstacles). The data are collected from companies only. Statistics Finland has lately included novel types of data in its data collection. The definitions of Statistics Finland concerning innovation and innovation activities are relatively broad. An innovation is "a new or significantly improved product (goods or services) brought to market by an enterprise or a new or significantly improved process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations implemented by an enterprise". Innovation is seen from the point of view of products, processes, marketing methods or organizational methods. Innovation activity has two definitions, of which the broad definition is indeed quite broad: "Innovation activities mean all operations and steps which lead, or are intended to lead, to the implementation of innovations."

In a reform of definitions, the concept of innovation was widened to cover marketing and organizational innovations in addition to product and process innovations. These types of innovations were focused on for the first time in the results for 2004–2006 (published in 2008). Bigger companies are covered to a higher degree, which is likely to reflect a more traditional view of innovation in the results. In the context of the 2008 results, Statistics Finland noted on its website: "Innovation and innovation activities are only possible to define at a general level. As innovation research is based on the enterprise's own interpretation of the given definitions, in addition to a sampling error, also a measurement error is possible."

Table 2: The topics of the reviews of statistics in 2008 and 2010 (main results).

2008	2010
1. Introduction	1. Introduction
2. Innovation activity connected to product and process innovations in 2006 - 2008	2. Innovation activity related to product and process innovations 2008-2010
3. Marketing and organisational innovations 2006 - 2008	3. Marketing and organisational innovations 2008-2010
4. Introduction of innovations producing environmental benefits in 2006-2008	4. Creativity
	5. User orientation in corporate innovation activity and the production of innovative products 2008 - 2010
	6. Innovation activity in human health and social work activities 2008 - 2010

For the Innovation Survey 2010 (covering 2008–2010), in addition to harmonized EU data, the Finnish survey collected other types of data that were considered important for the descrip-

tion of innovation activity. The questions asked at the national level related to topics such as procedures used by enterprises to integrate user orientation in their innovation activity and in the manufacturing of innovative products. National results on human health and social work activities were also reported on. These novelties are quite interesting; it could be assessed that steps are indeed taken in a more multi-faceted direction. Table 2 shows that several new topics were included in 2010.

With regard to creativity for instance, methods to stimulate new ideas or creativity were investigated. User orientation in the innovation activity was also assessed (incorporation of user information and users into innovation activity and the production of innovative products in 2008-2010 in enterprises with product innovations new to their markets). Obstacles of innovation activity were surveyed and the results indicated that lack of technological and market information was among recognized obstacles for some enterprises All in all there is a wealth of new data, also on effects, objectives and reasons of innovation activity. For instance, information sources for innovation activity in human health and social work activities were investigated in 2008–2010, according to importance of sources, in enterprises with innovation activity (www.tilastokeskus.fi/til/inn/kas_en.html).

4.2 Views of innovation *knowledge*

'Innovation knowledge' was focused on by investigating 26 strategy, policy or other public documents from Finland and other countries for 2008, and 5 for 2010. This was a less used and more obscure concept. There was a large amount of documents emphasizing the link between innovation, knowledge creation and knowledge transfer – and on the other hand, innovation information from a very technical point of view, as discussed in the previous section. Syntheses or common understanding or wider views hardly existed (apart from OECD 2008). This result reflects two polarized approaches – knowledge management in innovation on the one hand and patent information on technical appliances or other quite narrow types of information on the other. However, innovation information and knowledge is or should be a strategic issue at different levels. There was very little change – if any – in the situation in this study from 2008 to 2010. The results also showed that while there were some interesting documents with well-developed ideas, these ideas had apparently not reached, for instance, national strategy makers yet.

A unique document identifying innovation knowledge was a Finnish workbook related to IPR issues. In it, innovation knowledge (*innovaatiotietämys* in Finnish) was seen as a sub-category of business knowledge (see Table 3). This is an example of a narrow view, but at least there was a definition. Defining the concept in this way for this particular type of workbook is, as such, understandable.

4.3 Future needs and directions

Despite the shortcomings, it could be seen in some of the documents – and especially the databases – that understanding is gradually changing and increasing with regard to innovation. In an OECD document (2008) – that could be called very advanced in this study – it was noted that a key policy challenge for OECD countries is to develop and implement policies that support innovation in a broader sense (e.g., including organizational and non-technological innovation) and to include sectors that do not undertake much R&D (e.g., resource-based and traditional sectors) as well as services. OECD's view was confirmed in this study's documents; many government initiatives targeting innovation remain focused on technological or science-based innovation. Interestingly, impact assessment was brought up as a cor-

nerstone of innovation policy by the OECD. Policies to foster innovation are increasingly emphasized in many countries and governments need to justify how much they invest in innovation, where they invest and how much the public gets in return. It was noted that assessing the socioeconomic impacts of public R&D is crucial in order to evaluate the efficiency of public spending, assess its contribution to achieving social and economic objectives and enhance public accountability.

Determining and measuring the various benefits of investment in R&D for a society is difficult. R&D spillovers and unintended effects are likely, since many key scientific discoveries are made unintentionally and applications of scientific research may be far from the original goal of the R&D. The time required to reap the full benefits from R&D may be quite long. According to OECD (2008), indicators based on innovation surveys are an important source of information for measuring innovation activities in firms and innovation performance across countries, but their usefulness for guiding policy is limited by their extensive use as average pointers for benchmarking purposes. They hide the great heterogeneity of innovation patterns across firms, sectors and locations.

Indeed, the OECD report suggested using more sophisticated indicators based on innovation microdata (i.e. at firm level) to assess the individual characteristics of firms according to firm size, industry sector and "mode" of innovation. Understanding and measuring different forms of innovation can help to improve policy design and implementation. The OECD Innovation Microdata project is the first large-scale multinational attempt to exploit firm-level data from innovation surveys for economic analysis and the development of new indicators. Even if common innovation patterns have been identified, there is no "single" mode of innovation, and there appear to be major national differences in patterns of competitive and comparative advantage. Innovation in firms goes considerably beyond technological innovation and own generation of technology; policies to foster innovation will need to account for this diversity. Innovation surveys can be exploited further, for example by matching innovation survey data with other firm-level data and administrative rec-

Table 3: Business knowledge (source: http://palveluverkko.prh.fi/immateriaalityokirja/immateriaalityokirja.pdf, accessed 24 July 2012).

Customer knowledge	Competitor and partner knowledge	Innovation knowledge
• Account of customer needs • Research on consumer behavior • Market analysis • Analysis of potential licensees	• Analysis of competitors • Monitoring of competitors • Competitors' patent applications (analyses of patent statuses, claims and cancellations) • Research on production and marketing obstacles • Mapping of potential collaboration partners, subcontractors or license sellers	• Account and analysis of the technical level • Monitoring and analysis of the technical field • Search for the technical solution • A technology map

ords, such as balance sheets, R&D surveys, etc. This would allow for a better understanding of innovation performance and the policies that affect innovation. (OECD 2008.) Despite these advanced ideas the document still reflects a very company-oriented view. What we need is a view that also covers the public and third, non-governmental sectors as well as hybrid constellations. These were missing from the documents investigated in this study. A clear emphasis on long-term effectiveness – as already called for by the OECD, implicitly – would also be needed and innovation information and knowledge likely play a major role in it. This is an important issue for future research.

In a regional document from Finland (Osaava Pohjois-Suomi 2009), future directions related to innovation information were assessed in a rare way. They were listed as improvement of regional research management, juridical services for companies and other services to support establishment of new companies. It was noted that research in the region was *"stuck in optimizing what is existent"*. Researchers are employed in various regional development assessments and investigations, and the danger is that new openings are not made – openings that would enhance regional innovativeness, competence and learning. A significant challenge for researchers is to bring traditional industrial companies to sources of innovation information. The role of innovation networks and their support was highlighted. Rather than supporting individual innovative companies, innovation networks should be supported. (Osaava Pohjois-Suomi 2009.) This brings up a new problem: how can networks and their innovativeness and innovation be discussed and made visible? Are there suitable concepts for monitoring, for instance, networks of knowledge-intensive service companies focusing on, for example, various consulting tasks? Foresight activities as well as a better combination of research and practice were also brought up in the document.

5 Discussion and conclusions: Towards clarity and innovation understanding

This study has its limitations; Internet searches may have many shortcomings. However, the research data that were obtained with the help of the Internet searches would not have been possible to collect otherwise. The aim was to gain an overview of the views and contents of innovation information and knowledge at various 'fronts' at two points in time. This was deliberately not a literature review of academic publications. The results showed that while there was some variety in views concerning innovation information and knowledge, the concepts were usually not defined and were understood in a narrow, let's even say, old-fashioned way. Their use typically reflected traditional "faith" in science and technology policy. According to the results, both concepts need clarification and widening in future documents. The present views also focus mainly on companies, failing to acknowledge that there are many other types of actors in innovation activities nowadays, also networks. Even the wider views did not cover the various types of innovations in a clear way. Nor did they cover the STI – DUI distinction and interaction, or innovation modes 2a and 2b (cf. section 2.1).

Against this background, follow-up questions arise. Why is this so? Why is there a gap between ambitious new concepts of innovation – such as practice-based innovation or social innovation – and rather old-fashioned views on innovation in the selected documents? Is this mainly a problem of measurement? Or are there other factors at work? What are the starting

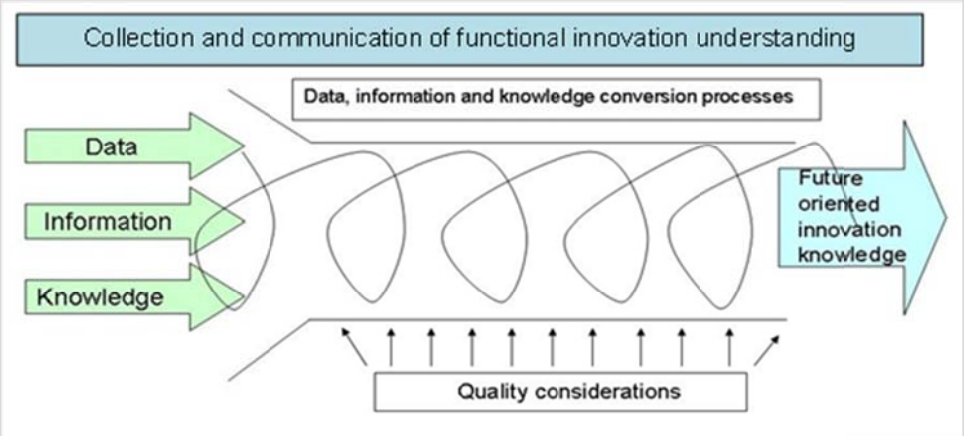
points to narrow this gap? Changes in attitudes are slow; awareness-raising by the national innovation policy authorities and funders would be needed. New concepts are being used even though their contents are still quite obscure. Other views are pondered upon in the subsequent final paragraphs.

Given the hierarchy of data, information and knowledge, most of what is collected nowadays and referred to as innovation information (or more rarely, innovation knowledge) is actually innovation data (statistics, etc.). They are important as such, but attention should also be paid to their conversion into innovation information and innovation knowledge (see Figure 3). In addition, comprehensive combinations and recombinations of the different types within this hierarchy should be focused on. Otherwise we are still very far from the aspirations expressed by the OECD and a few others.

In fact innovation data, information and knowledge could be seen – rather than from the present "mechanistic" viewpoint – from an increasingly "functional" viewpoint that is, how they can truly help societies, organizations and people in their activities. This perspective was missing from the documents this study analyzed. The mechanistic view is "technical" and often based on higher-level rhetorical arguments concerning inputs and outputs. This view does help in establishing a common understanding between those who are already acquainted with the topic. It reminds us of the way in which innovations used to be linked to top-level science and technology policy only (or mainly). In the same way, the concept of innovation information has been set on a "pedestal" by some, even though it could increasingly be treated as a tool for thinking and collaboration between different levels and sectors.

The functional view would then emphasize links between data, information and knowledge, on the one hand, and effectiveness, quality, and benefits to the society from the point of view of people and organizations, on the other. Such a view was hardly visible in this study, but making such a distinction might advance increasingly holistic discussions of *innovation understanding* in the future (Figure 3). The focus would then be especially on how innovation data, information and knowledge *interact and serve* society, organizations and people in a novel way. Language reflects thought, but it is also the other way around – thought is affected by language and use of concepts, so which concepts we use

Figure 3: Towards innovation understanding (adapted for this study from Melkas/Uotila 2007, Figure 4).



when talking about innovation is not irrelevant. From fragmented and unde-undefined initiatives we thus need to move towards *collection and communication of understanding concerning innovation*.

This study resulted in a few other considerations as well. Firstly, new emphases such as user-driven innovation and broad-based innovation (e.g., Finnish Government 2009) highlight the need for a more holistic view. Should we reach communication of functional innovation understanding, we could reflect the wide variety of innovation and make things that are not visible in current statistics and measurements visible and more valued. Secondly, in future research, the relevant embodiments of innovation information and knowledge for different types of innovations could be specified, through case studies for instance. What sort of innovation information and knowledge would be needed for social innovation; what about organizational innovation? Obviously, this is complicated by the different levels – the organizational and the political. In this study the levels were deliberately "politically" blended, but in future research, they could be separated, yet included in the same study. For instance, what sort of information or knowledge would reflect creativity and what kind of information and knowledge does creativity need? Combining individual-level views concerning innovation information and knowledge and national-level views is increasingly important; a national funding authority considering how to help innovativeness in Finland catch up to the international level and a local public sector employee who considers how to support innovation in her/his sector should not be as far from each other as at present.

The initial proposition of this study – that data collection, strategy and policy documents and alike still reflect a narrow, overly science and technology-oriented view of innovation taking place mainly in the private sector – was clearly confirmed. The innovation discourse is still dominated by the natural science tradition; evidence for instance, is typically understood as quantitative data, while qualitative studies on the co-creation of information and knowledge should be (at least) equally as important (e.g., Pässilä et al. 2013). Such studies, if conducted in a careful and ethical way, disclose factors that increase innovativeness and creativity at the individual and organizational level. In general, what is also missing is innovation information and knowledge that measures and reflects well-being – the numbers of school drop-outs, statistics on youth education, information on 'illfare' in work life, just to mention a few. Such information is collected, but for different purposes only and the various sources and types of information relevant for innovation do not meet, unfortunately. Are we then actually talking about innovation information and knowledge, or information and knowledge innovations? It seems that both are needed in the present innovation context that would require increased openness, effectiveness and a multi-disciplinary, or rather – a "post-disciplinary" approach. Public awareness of innovation is an important part of innovation activities and it is not just a question for innovation journalism, communication studies, or any other discipline alone.

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