Coordinated Action WORK-IN-NET

ANALYSIS OF R&D INFRASTRUCTURES OF WORK-ORIENTED INNOVATION IN SELECTED EUROPEAN COUNTRIES

Elise Ramstad and Tuomo Alasoini

WORK-IN-NET

Labour and innovation: Work-oriented innovations – a key to better employment, cohesion and competitiveness in a knowledge-intensive society

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Preface

This report contains the main findings of the third benchmarking exercise that was carried out in 2007-2008 as part of the WORK-IN-NET project.

WORK-IN-NET stands for '*Labour and Innovation: Work-Oriented Innovations – a Key to Better Employment, Cohesion and Competitiveness in a Knowledge-Intensive Society*' and is a five-year project (2004-2009) supported within the Sixth Research Framework Programme of the European Commission. WORK-IN-NET brings stakeholders and experts on work-oriented research in Europe together. The overall aim of the WORK-IN-NET is to set up sustainable communication and cooperation channels in Europe between the still fragmented national and regional research activities in the area of work-related innovation issues. To cope with the lasting innovation, productivity and employment challenges in European countries, the focus of WORK-IN-NET lies on three key themes:

- qualitative human resource development,
- corporate social responsibilities and cultures, and
- regional development alliances.

Promoting work-oriented innovations as a part of the broader innovation system is vital for achieving the goal set by the Lisbon European Council – to become the most competitive and dynamic knowledge-based economy in the world by 2010, capable of sustainable economic growth with more and better jobs and with greater social cohesion.

The present study was carried out under the coordination of the Finnish partners of WORK-IN-NET and investigates national innovation systems with special focus on work-oriented innovations in four countries: Germany, Norway, Sweden and Finland. Particularly the R&D units working in the field of work-oriented innovations were in the centre of interest of this study. The report was written by Elise Ramstad in cooperation with Tuomo Alasoini from the Finnish Workplace Development Programme (TYKES) at the Finnish Funding Agency for Technology and Innovation – Tekes. Special contributions and comments to the report were made by the experts in connection with country wise case studies.

Claudio Zettel
Coordinator WORK-IN-NET

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1 Introduction

Owing to rapid technological developments, increased global competition, and shorter product life cycles, workplace are confronted with strong pressures to develop their organization and to innovate. At the moment, many workplaces rely on their own knowledge and struggle with the development activities by themselves internally. Rather seldom they use external expertise as a part of their innovation activities. Particularly the universities and government research institutes are the least widely used sources of innovation activities according to The European Community Innovation Survey (OECD, 2005). However, the earlier organizational and management literature (e.g. Schön, 1998; Schienstock, 1997), and also the innovation and knowledge management literature (Lundvall, 1992; 2005; Nelson, 1993; Etzkowitz & Leydesdorff, 1998) suggests that the use of external research and development units (R&D units) could help the workplaces in several ways such as in problem-solving, knowledge creation, organizational development and learning through interactive and reflexive learning processes.

Today, many researchers and governmental policy makers argue that the innovation infrastructure of a country is becoming increasingly important in the increased global competition (e.g. Kuhlman, 2006; Schienstock & Hämäläinen, 2003; Miettinen, 1999). The innovation infrastructure refers here to both public and private research and development units (R&D units), which have the potential to help workplaces innovate. The public sources may include e.g. universities, government research institutes, polytechnics, and other educational and training institutes, while the private sources refer to knowledge intensive consultancies, such as management consultancies and other types of research and development organizations. The roles, activities and methods used by the R&D units may vary in the different phases of the innovation process.

In order to ensure and reach the needs of workplaces there is a need for a well-functioning innovation infrastructure policy in European countries. The country-wise assessments have shown that the Far East countries are closing the R&D gap they have to Europe, regarding both volume and quality. The Green Paper of European Research Area (European Commission, 2007) started a broad institutional and public debate on what should be done to create a unified and attractive European research area, which would fulfil the needs and expectations of the scientific community, workplaces and citizens. According to the Green Paper, most European R&D institutions lack critical mass and have difficulties in meeting expectations and the quality with the resources available to them in the more demanding environment where e.g. competition for funding and talent

is intensifying both within Europe and with other countries outside Europe. In order to create a world-class innovation infrastructure, it was suggested that there is a need to develop and enhance the human resource potential of European research and development, increase professionalism, create rich networks across diverse R&D units, better link research activities to the needs of industry and society in the entire EU and overcome the fragmentation of research activities across Europe. Also sufficient public funding directed towards these challenges has pivotal significance to the creation of competitive innovation infrastructure in Europe.

This study is restricted to the R&D infrastructure of work-oriented innovations. It is suggested here that in order to gain better performance outcomes of innovation activities and policy in a country there is a need to develop, in addition to workplaces also the R&D infrastructure of work-oriented innovations and collaboration between R&D units and workplaces. The earlier innovation studies have shown that there are several reasons for the limited collaboration between R&D units and workplaces. The study by Nieminen & Kaukonen (2001) showed that about 45 per cent of enterprises in Finland were not aware of cooperation possibilities, 36 per cent did not have resources to use these services and 30 per cent had difficulties to get into contact with public R&D units. One of the main tasks of this report is therefore to increase awareness of diverse expert organizations, improve collaboration between workplaces and R&D units and to promote collaboration between R&D units across European countries.

2 Purpose, method and the background of the study

This report focuses on the innovation infrastructures and R&D performers in the field of work-oriented innovations in selected European countries, in this case Finland, Germany, Norway and Sweden. It is carried out as a part of the benchmarking exercise of the WORK-IN-NET project. The WORK-IN-NET project is supported within the ERA-NET programme of the European Commission's Sixth Framework Programme for Research and Technological Development. The project aims at promoting exchange of information, cooperation and mutual learning between programmes and organizations financing R&D on work-oriented innovation in various countries of Europe (for more details, see www.workinnet.org). In administrative terms, this paper constitutes the deliverable of work package 8, task 8.2 of the WORK-IN-NET project. This paper contains a description of the process and the framework used in the benchmarking exercise and summarizes its main findings.

In our earlier benchmarking tasks the focus was on a programme level, while only little attention was paid to the R&D infrastructure. However, as a part of task 3.2 "Benchmarking of R&D programmes" (Alasoini et al., 2005) based on Naschold's framework, we gathered some information about the national R&D infrastructures on programme level. We concentrated on two aspects, 1) the role of researcher education and training in the activities of the participating programmes and institutes as a means to strengthen the national (or regional) pool of experts in R&D on work-oriented innovations, and 2) the diversity of the pool of expertise that is used in project activities. In this new task, we will deepen our knowledge on workplace R&D units, with more precise questions addressed directly to the workplace R&D units in selected countries.

As described in the WORK-IN-NET project plan, the aim of this task is to make an analysis on the infrastructure of work-oriented innovations in different partner countries, with a special focus on research and development (R&D) units. Our benchmarking analysis in this study is on two levels:

1) infrastructure of the R&D units of work-oriented innovations and
2) performers of work-oriented innovations.

Firstly, a review and analysis on innovation infrastructure literature in partner countries is being made. The innovation infrastructure is analysed on four different levels: government, ministry, programme and performer levels. The analysis aims to describe and locate the R&D units of work-oriented innovation in the broader innovation system context for each country separately. The linkage of R&D units to general innovation system is important in understanding the environment

and the philosophy behind the directing and supporting mechanisms of work-oriented innovations in a country. For example the public funding system affects to the sectors and areas developed in a country. The analysis is presented in the Chapter 2.

The second research task is to benchmark the resources of R&D units with a help of a questionnaire directed to the main R&D units. For this purpose a framework for knowledge measurement of R&D units is being used (Ramstad, 2008). In Chapter 3 the knowledge measurement framework and the major outcomes of the inquiry will be presented. The data gathering process was the most challenging in this task, while there does not exist comprehensive registers on R&D units of work-oriented innovation in Europe. Finding the actors in the innovation system was the key objective for the research. We got registers of the main R&D units from four different countries – Finland, Germany, Norway and Sweden – which where chosen to the task. The R&D units represented most often public or semi-public R&D units. Their role is important, as more than 35 per cent of all research is undertaken by universities and public research organizations in Europe. They are the primary source of both basic research and research on issues of public interest, as well as an important provider of applied research that helps underpin business research and innovation.

In addition of the above mentioned two research methods (i.e. literature analyses of innovation systems and questionnaire to R&D units), we organized a one-day workshop in Berlin 30.03.2007, as a part of the German conference "Potential for Innovation in a Modern Working Environment" by the Federal Ministry of Education and Research (BMBF). In the morning the participants of WORK-IN-NET gathered to the "Forum 9: Learning from Europe – Innovation knows neither borders nor boundaries". The forum was open also to other participants in the conference. The aim of the forum was to approach work-oriented innovations on both innovation system level and R&D infrastructure level. The Forum included contributers from four European countries. Finnish researcher and consultant Mari Hjelt from Gaia Consulting had a presentation on "Benchmarking of innovation systems in Europe", researcher Thomas Tydén from Sweden (Dalarna Research Institutes) focused on "R&D units of working life in Sweden", project coordinator Elise Ramstad told about the "Finnish R&D units as a part of workplace innovation system" (Ramstad, 2007) and director Ewald Heinen from Germany (itb Karlsruhe) focused on "Internationalization of services" (Heinen et al., 2007). The day continued with a joint discussion and group-work on the following areas: 1) the R&D units in different participating countries and 2) the strengths and challenges (e.g. personnel resources, knowledge base) of the national R&D infrastructure of work-oriented

innovations. Representatives of all R&D programmes of the WORK-IN-NET took part in the discussion.

The last Chapter 5 contains conclusions and proposals for further action both nationally and on the EU level. As a part of this benchmarking task also a prototype of “database” of R&D units is created presented at the end of the study in order to validate the results and to increase awareness of R&D units in the different countries.

3. Innovation systems from the work-oriented R&D infrastructure point of view

At present there exist several interesting studies on innovation policy and the innovation infrastructure (e.g. Frinking et al., 2002; Kotilainen, 2005; Arnold & Kuhlman, 2001). However, what is characteristic of the earlier studies is that they rather often have a narrow view on innovation. The focus has been mainly on technological innovations and the structures of science and technology policy, such as technology-oriented programmes and innovation performers of technology. Instead the earlier studies have not been keen on the structures and actors related to work-oriented innovations. Though, an increasing amount of studies (e.g. Freeman & Louça, 2001 Sanidas, 2005; Ramstad, 2005) have shown that organizational or work-oriented innovations are important sources of productivity growth and well-being in a country. Reforms in the organizational processes, boundaries and practices, such as self-managing teams, flatter hierarchies, diversifying personnel skills and trust-based management systems can contribute to competitiveness and to the faster exploitation of new technology.

In order to fulfil the missing link, in our analyses we focus on innovation infrastructure particularly from the work-oriented innovation point of view. In this chapter, we will approach the R&D infrastructure from system perspective, while first studying the conditions and the bodies that direct and perform innovation policy in a country. The chapter presents shortly the R&D infrastructure of work-oriented innovations from the innovation policy point of view in selected countries. In general, work-oriented innovations cover typically only a small part of the broader innovation policy area in a country.

National R&D infrastructures are typically directed by science and innovation policy. Science policy, mostly regarding basic research, is the most beneficial, while it applies to education that benefits the whole society by providing a well-educated workforce and promoting knowledge creation. Innovation policy concentrates on application of science and supporting instruments for industry as well as the public sector. These policy sectors often works independently. However, today many researchers and policy makers argue that more collaboration is needed in order to enhance innovation in a country as a whole, e.g. education of individuals, and research and development of both technology and organization. There is a discussion of broader innovation policy including both horizontal and vertical collaboration. As a result, broader understanding of innovation is bringing about institutional changes in many countries at the moment. Organizations are being re-organized and merged. This is also the case in all the studied countries in this study.

In figures 1-4 the main actors in the national innovation systems of German, Norway, Sweden and Finland concerning work-oriented innovations are presented. Each country has differently functioning innovation systems, and this way they are specific and not directly comparable. In the following sub-chapters the innovation systems of each country will be discussed separately.

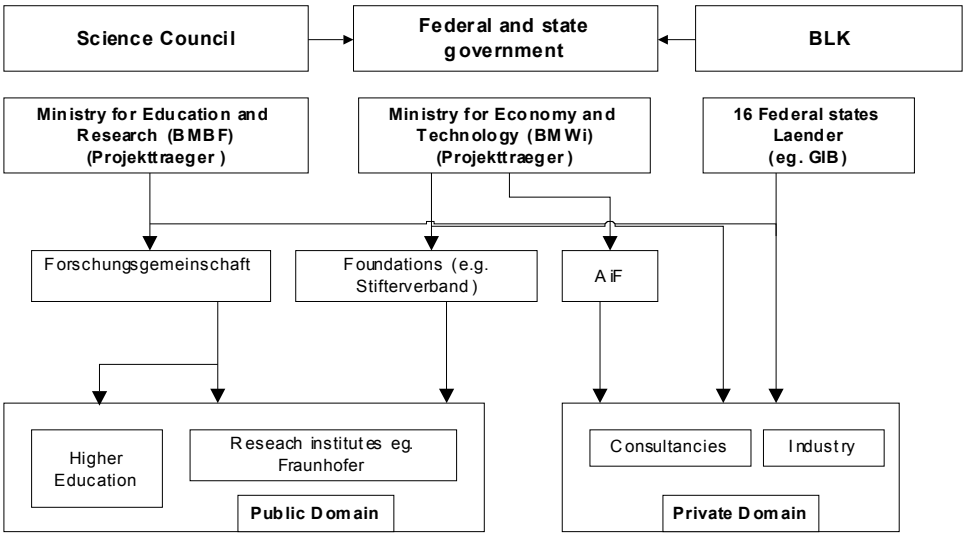


Figure 1. German innovation system.

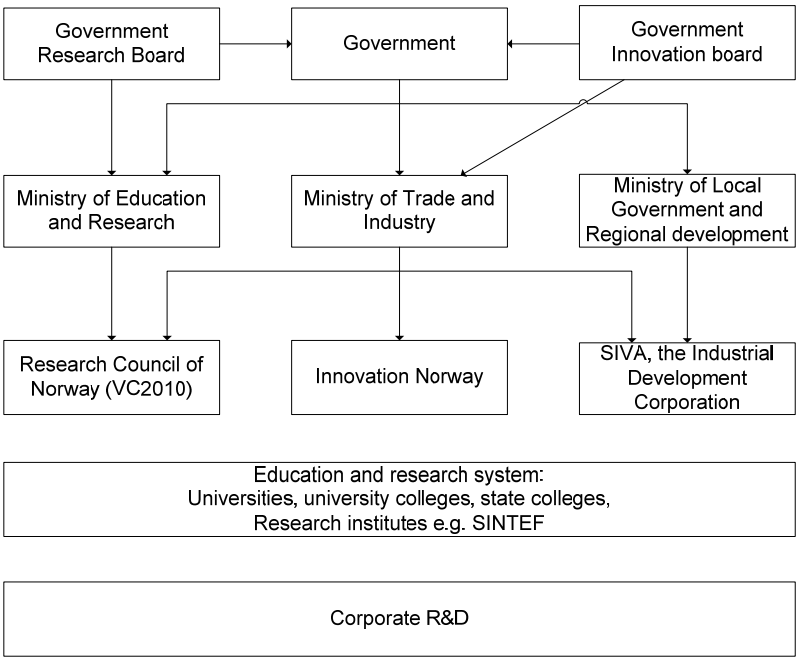


Figure 2. Norwegian innovation system.

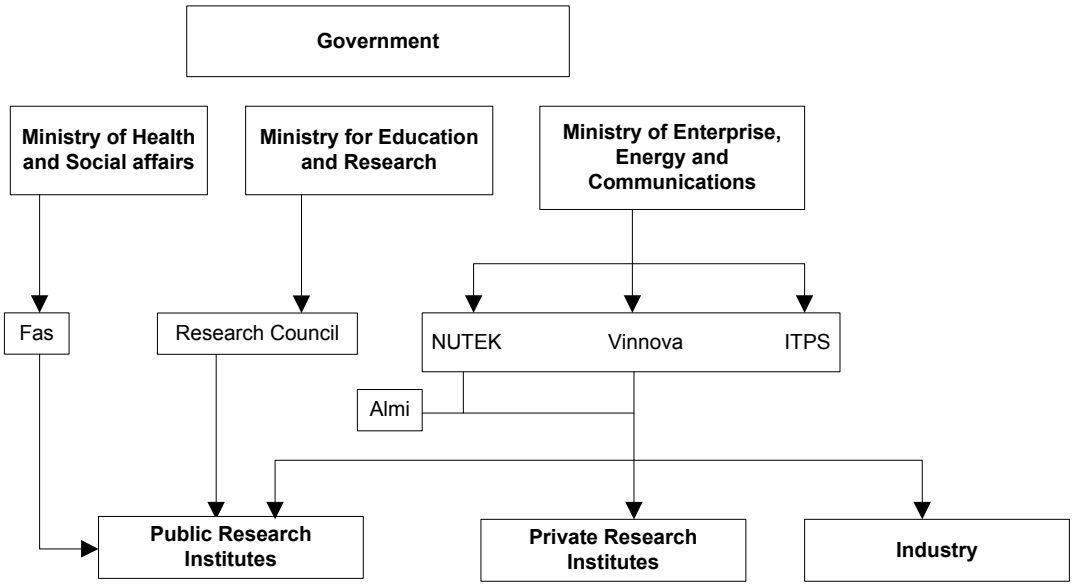


Figure 3. Swedish innovation system.

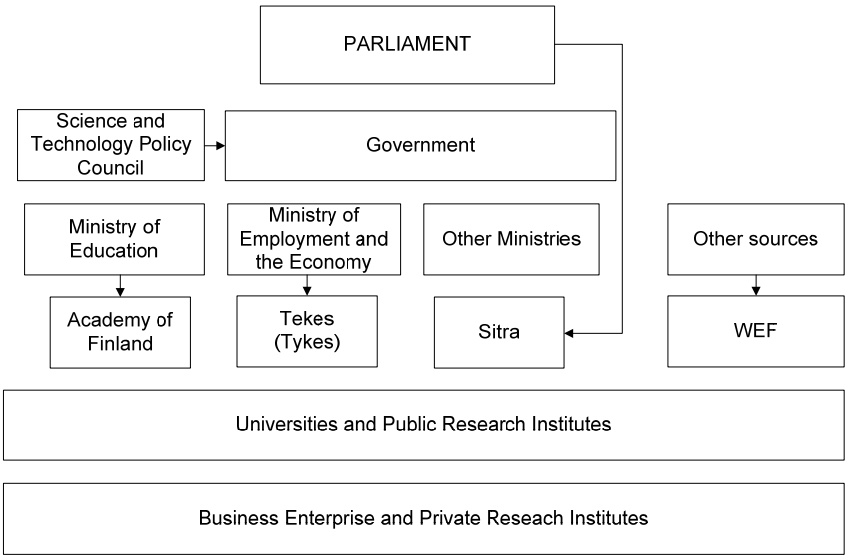


Figure 4. Finnish innovation system.

3.1 Germany

The German innovation system is complex, because of its size, its federal and state government structure and the history of its development. There is a clear division between the funding of government, intermediary institutions and the performance of research and development. Innovation is emphasized at a high political level (OECD, 2003; Kotilainen, 2005). It is typical that the government makes the decisions over the thematic areas for programmes and the allocation of the funding, while the agencies handle the operative part.

The German Science Council (Wissenschaftsrat) is the most important scientific advisory body in German. It is co-funded by the Federal Government and the governments of the 16 Länder. Its function is to draw up recommendations on the development of higher education institutions (universities, universities of applied sciences and non-university research institutions), their structure and performance, development and financing, and general questions relating to the system of higher education. In January 2008, a new forum Gemeinsame Wissenschaftskonferenz (GWK) (www.gwk-bonn.de) was established in order to emphasize joint science and research coordination between the federal and state government. The GWK aims to coordinate research policy and planning, and where responsibilities and arrangements are agreed.

Germany's total R&D investment of its GDP I 2005 was about 2.5 per cent, which is a somewhat higher figure than the OECD average (2.3 %). Compared to the other studied countries here, Sweden (3.9 %) and Finland (3.5 %) spent more money on R&D, while Norway ranked lower (1.8 %) (OECD, 2007). German invested on R&D much higher in the 1970s and 1980, but the level of funding shrank significantly in the beginning of the 1990s. However, today in Germany we see a rise in this investment.

At the Federal level funding of R&D is granted by two ministries: the Ministry for Education and Research (BMBF) and the Ministry for Economy and Technology (BMWI). The BMBF is responsible for almost two thirds of the federal R&D budget. Research projects of the both ministries are managed and coordinated by the Projektträger, a form of management organization (Project Management). The role of the intermediaries is to distribute funding, monitor the projects, disseminate information and foster connections between research and customers. The Projektträger of Deutsches Zentrum für Luft- und Raumfahrt DLR manages work-oriented R&D programme, called the Research and Development Programme "Working – Learning – Developing Skills:

Potential for innovation in a modern working environment" of the Federal Ministry of Education and Research. In 2006 the programme financed 304 work-oriented projects with altogether 25 million Euros. Most of the projects were run by research institutes and universities, while the combined projects included also consultancies and development agencies (Deutches Zentrum für Luft- und Raumfahrt und Raumfahrt e.V. Projektträger im DLR, 2007). In this sense the Projektträger resembles the status of Tekes/Tykes in Finland and Vinnova in Sweden.

The funding system at the provincial (Länder) level is similar to federal funding and thematic areas, however the administration is lighter and the support system can vary in different provinces. The Federal Republic of Germany is made up of 16 federal states, i.e. Länder. In different regions there may exists own activities for work-oriented innovations. In the case of North Rhein-Westphalia (NRW), the G.I.B. (Gesellschaft für innovative Beschäftigungsförderung mbH) has a programme called Work-Oriented Modernization Programme that finances the development of workplaces through collaboration between expert organizations and industries. In the Pre-operating studies the role of universities and research institutes is important, whereas in the joint projects and "Potenzialberatung" consulting companies, as transfers of new knowledge, are the main group of experts. The G.I.B. is governed by the Land NRW, which in turn is directed by the Federal Ministry of Labour, Health and Social Affairs (Ministerium für Arbeit, Gesundheit und Soziales).

The German R&D infrastructure is institutionally complex, being one of the largest in the OECD. In Germany R&D units have traditionally been divided into institutes of higher education, governmental institutes, research institutes, laboratories of the Confederation of Industrial Research Association and national research centres. Responsibilities of the R&D infrastructure are shared between federal and state governments.

There are approximately 350 institutes of higher education, of these 92 universities and almost 160 state-funded and state-recognized universities of applied science (Fachhochschulen) (www.bmbf.de). The number of universities and post-secondary institutions changed dramatically during the late 1990s as educational reforms in eastern Germany were implemented. The difference between universities and Fachhochschulen is that the Fachhochschulen cannot educate doctoral students and their R&D activities are limited and applied by nature.

The governmental public institutes include the so called Bundes- and Ländesforschungsanstalten which carry out research for the government and provinces. The four biggest research networks are

the Max Planck Society (basic and interdisciplinary research, 77 institutes), the Fraunhofer Society (long-term applied research and intermediary activities, 58 institutes), Helmholtz Association comprising 15 national research centres (long-term, large-scale and high cost research activities) and the Leibniz Association with 80 non-university institutes. Together with several other research institutes these employ altogether about 70,000 full-time researchers. In addition, the laboratories of the Confederation of Industrial Research Association (AiF) employ a research staff of 128,000 that carry out product-oriented industrial research particularly on behalf of the SMEs.

Concerning the performers of work-oriented innovation there does not exist nation-wide studies of the amount of R&D units that are active in the field. At the moment, some information exists on the websites of individual R&D units and also from the R&D programmes that finance work-oriented innovations.

3.2 Norway

R&D investments on innovation are relatively low in Norway compared to the other studied countries. It has been argued that the high incomes from the oil industry have overshadowed the importance of research and the creation of a knowledge-based society (Kotilainen, 2005; Thoresen & Paus, 2004). However, in recent years more attention has been paid to the development and coordination of innovation policy also in Norway. There is a goal that Norwegian R&D investments should exceed the level of the other Nordic countries by 2010.

There is no single forum with an innovation policy responsibility in Norway, but the responsibility for innovation as well as R&D matters is divided between several ministries. At the governmental level two boards focus on the coordination of innovation and R&D policy issues. These are the Government's Innovation Board and the Government's Research Board. The Ministry of Trade and Industry is responsible for comprehensive innovation policy, while the Ministry of Education and Research is responsible for coordinating sectoral R&D policies, e.g. organizational research and development. Research programmes are funded directly from the ministries or through governmental funding institutes like Research Council of Norway, Innovation Norway and the state owned enterprise SIVA, the Industrial Development Corporation of Norway.

Public funding of research and innovation efforts of work-oriented innovations in Norway has relied to a large extent on programmes set up by the Research Council of Norway

(www.forskningsradet.no). The Research Council of Norway is a national strategic research agency with a responsibility for promoting and funding basic and applied research in all fields, and advising the Norwegian government on questions of research policy. There are three main divisions in the Research Council. The Division of Science is responsible for basic research, Strategic Priorities assists ministries in policy issues and the Innovation Division promotes value creation. The Research Council is technology and science-oriented, but there exists also programmes for workplace development (Value Creation 2010). The duration of national programmes of the council are ten-year initiatives with a mid-term evaluation in between each five years (5+5). The programmes have also usually regional aspects. Value Creation 2010 is a research-supported development programme and at the same time an educational PhD programme of researchers in the field of workplace development. In the programme there are about 45 researchers from regional and national R&D units (universities, research institutes and university colleges), which support enterprise development in the 11 regional modules covering the whole country. The consultants do not have a direct role in the projects funded by the VC2010.

The Research Council works closely with the Innovation Norway. The main functions of Innovation Norge are regional development through funding of companies, running networks, encouraging investments and counselling inventors. Innovation Norge has 40 offices in 34 countries and 20 regional offices in Norway, employing altogether 700 people. The core group of clients consists mainly of Norwegian companies, particularly SMEs.

The main R&D performers in Norway are the universities, university colleges, state colleges, research institutes and corporate R&D units. Norway has only seven universities (Oslo, Stavanger, Bergen, Trondheim, Tromsø, Agder and the Norwegian University of Life Sciences in Ås), six specialized institutions at university level, 24 public university colleges (vitenskapelige høgskoler) and two private university colleges (Ministry of Education and Research, 2008). The higher education sector carries out approximately one fourth of Norway's total R&D activities. The R&D efforts are financed through basic funding from the state, grants from the Research Council and contracts with private and public workplaces.

The Norwegian science and educational system has recently undergone several changes. During the nineties, a "Network Norway", linking all universities, university colleges and state colleges was established. The aim was to improve the quality of education and research through better utilization of resources, and by establishing a network of national centres of competence. The changes in

university law (2004) created opportunities for universities to establish independent companies for performing commissioned research or for buying into existing companies. This possibility has been used only during the last few years. It has given a possibility to universities to expand their external research funding.

In addition, there are approximately 70 institutes devoted to research and development. The biggest research institutes in the field of innovation are the SINTEF Teknology and Society, NIFU STEP, FAFO, Agderforskning, Rogalandforskning and IRIS International Research Institute of Stavanger. Research institutes have traditionally played a strong role in the Norwegian research system concerning the performance of applied research for private and public purposes. Collaboration between institutes and universities is extensive, while the largest research institutes have a long history of close and formal collaboration with universities.

Norway is currently underway to improve the knowledge platform for innovation policy. There is a challenge to prioritize research fields and establish a better system for the dissemination and exchange of knowledge (Thoresen & Paus, 2004). A special priority has been given to research that offers a basis for growth and development in industrial and business sectors. Concerning work-oriented innovation, a special research priority has been given to research on management, organization, information technology, health, and environment.

3.3 Sweden

Since 2001 several changes in the innovation system in Sweden have occurred, while new organizations have been built with new tasks, and at the same time a large number of research councils and institutes have been dissolved and closed down. This can be seen both on the governmental, programme and performance level.

At the governmental level the National Research Committee consisting of researchers and industrial representatives gives advise to government concerning research policy. In 2000 the Ministry of Education and Research was chosen to chair the Research Committee which has the responsibility for the coordination of the research policy of the government including science and technology innovation policy. In addition, the Ministry of Education and Research is responsible for the school system, education and research.

The Ministry of Enterprise, Energy and Communications is responsible for R&D issues relating to technology, employment, workplace, labour market and regional policy. The Ministry coordinates three authorities for research and development: the Swedish Agency for Economic and Regional Growth NUTEK, the Swedish Agency for Innovation System Vinnova and the Swedish Institute for Growth Policy Studies ITPS. NUTEK is responsible for questions related to the creation of new enterprises, economic development of companies and regional development. NUTEK has around 260 employees in 11 offices around the country. NUTEK cooperates closely with the ALMI Group, whose objective is to create growth and renewal of the trade and business by financing in combination with business development. ALMI operating in 21 regional offices offers management programmes, business-development consultation and advice to the companies. Both Vinnova and ITPS were established in 2001. Vinnova funds needs-driven R&D to support innovation systems and sustainable development and growth. This is done in close partnership between three groups of players: industry, academia and political/public sector. Vinnova has around 190 employees. Concerning the R&D infrastructure, one of Vinnova's tasks is to develop the role of research institutes in the Swedish innovation system by inviting institutes to participate in the programmes and by funding R&D. Vinnova consists of six competence area divisions; one of them is the Working Life Department. All the programmes financed by the department are implemented by public R&D units, such as universities and research institutes in close cooperation with industry or public organizations. The objective of ITPS is to develop and disseminate knowledge concerned for future oriented economic growth.

In addition, since 2001 there are three new research councils in Sweden. The largest of them is the Swedish Research Council (Vetenskapsrådet) that supports basic research in general and provides analyses of research policy. The other two research councils have been set up for the purpose of creating new knowledge in specific areas. The Swedish Research Council for Working Life and Social Sciences (FAS) supports basic research and needs-driven research related to work organization, social care, health care, labour market and welfare. The FAS is a government agency under the Ministry of Health and Social Affairs. The FAS gives grants to research projects as well as scholarships for post-doc studies abroad. Almost all projects by FAS take place at university departments or university-connected institutes. The third council, the Swedish Research Council for Environment, Spatial Planning and Agricultural Sciences, is related to several ministries and has its focus on research for sustainable development within its area of responsibility.

The university sector is the main actor of research and development, as the sector of research institutes is small in Sweden in an international comparison. In Sweden, there are altogether 39 institutions of higher education, of which 14 are state universities and 25 university colleges (högskolor) (The Swedish National Agency for Higher Education, 2007). Only universities are allowed to offer postgraduate education. However, also some university colleges are entitled to conduct research in a particular discipline, and have the right to offer postgraduate programmes in these fields. Both universities and university colleges are publicly funded. At the moment discussion is going on whether the number of universities is too high in such a small country like Sweden. Most universities and university colleges are in financial difficulties due to reduced funding per student, reduced base funding for R&D and increased costs.

The Swedish National Agency for Higher Education is a central agency responsible for matters relating to institutions of higher education. The higher education institutions in Sweden have three main tasks: teaching, research and interaction with the society. The latter, the so-called "third mission" was added to their basic tasks as early as in 1997 including knowledge transfer. This means that workplaces cooperate with universities or university colleges based on industrial needs and also for the needs of the labour market.

Alongside the public universities and colleges, there are a small number of privately run higher educational institutions that receive government grant funds. These include the Stockholm School of Economics, Chalmers University of Technology and the University College of Jönköping. The clear majority of their funding comes directly from the government through the Ministry of Education and Research. Additional R&D funding is secured by project funding from research councils, public agencies and the EU as well as from the workplaces.

Of the governmental research institutes the National Institute for Working Life was for a long time the main actor in the field of workplace research and development. It was, however, closed down in the summer of 2007. The government saw that work life R&D should be implemented in universities. Many of the activities of the institute were split up and transferred to the universities and other institutes. Nevertheless, no extra money was directed to the work life research in universities.

Outside the upper secondary school system there are folk high schools (Folkhögskola) which provide state-supported adult education. Post-secondary studies include advanced vocational

training (Kvalifiserad yrkesutbilding) which is intended to meet the labour market's needs with the skills required for modern production of goods and services. About one third of the course periods takes place at the workplace.

3.4 Finland

Like in Sweden a special committee advises the government in science and innovation policy in Finland. The chairman of the committee is the Prime Minister himself, so the committee has a high political status. The Science and Technology Policy Council of Finland, also chaired by the Prime Minister, advises the Council of State and the ministries in strategic matters concerning research, technology and their use, dissemination and evaluation.

As in other countries, also in Finland there have been big reforms in the innovation system during the last years. In the beginning of 2008 the Ministry of Labour, the Ministry of Trade and Industry and the Regional Development Unit in the Ministry of the Interior were merged into a new Ministry of Employment and the Economy. The new ministry has a broad task, while it is responsible for Finland's entrepreneurial and innovative activities and environment, for the functioning of labour markets and employees' employability and for regional development.

As part of this reform the Finnish Workplace Development Programme (Tykes) was transferred from the Ministry of Labour to the Finnish Funding Agency for Technology and Innovation Tekes that is the main governmental financing and expert organisation for research and technological development in Finland. This way Tekes will broaden its scope from funding of pure technology development and innovation towards more broad-based innovation including also work-oriented innovations. The Tykes programme will continue as a one of the Tekes programmes until the end of year 2009. After that it is suggested that workplace development would continue as an integrated part of Tekes activities. The budget of Tekes comes from the Finnish state budget via the new Ministry of Employment and the Economy.

In the Finnish Workplace Development Programme strengthening the national infrastructure of R&D on work-oriented innovations has been one of the main objectives since 1996. Half of the development projects in the Tykes programme are implemented by private consultancies, in about one third by higher education institutes (universities, polytechnics) and about one fifth by other research and educational institutes. The role of consultants is particularly important in the

workplace development projects, while the more long-term and research-oriented learning networks and method development projects are generally coordinated by universities, state research institutes and polytechnics.

Performers of innovation activities in Finland represent diverse organizations. It has been counted that in 2002, the number of the R&D workforce of the national innovation system in Finland totals over 55,000 persons of which 70 per cent are researchers (Haukka, 2005). More that half of the researchers worked in business enterprises, one third in higher education institutes and ten percent in the government sector (e.g. governmental research institutes). In addition, there are about 22,000 students taking part in innovation activities through postgraduate courses.

The Finnish higher education system comprises two parallel sectors. The university sector contains 20 universities, ten of them multi-faculty universities. Universities are state-owned institutions, and free for students. Each university has also separate further education institutes, which often offer services for workplaces in the field of work-oriented innovations. The non-university sector consists of 29 regional polytechnics (universities of applied science) offering vocational education and Bachelor degrees studies with a professional emphasis. It is worth noticing that until the 1970s the universities in Finland were not even allowed to cooperate with companies. Cooperation was considered to be damaging to the general purpose of the universities, such as research and education. The situation has dramatically changed due to changes in public policy. In the mid 1980s the universities were allowed full autonomy in terms of teaching, research, tuition, student intake, number of staff and appropriations and other internal affairs. In the early 1990s Finland was the first country to adopt the national innovation system approach in its science and technology policy, and as a result the universities were encouraged to cooperate with the companies. Also the polytechnics have got a statutory task “third task” to support working life and regional development.

There is a link between research training in science and innovation policy in Finland. In addition to the Ministry of Education, research training in Finland is supported through research grants from Tekes, Tykes and the Finnish Work Environment Fund. For example in 2004 Tekes funded 603 public research projects which resulted in altogether 999 academic theses. The Tykes programme has a target of financing 70 postgraduate education degrees (doctor or licentiate thesis) in the field of workplace development between the years 2004-09.

There are also other R&D units, such as governmental research institutes, educational and training organizations and units by social partners and foundations working in the field of work-oriented innovations. The most important governmental research institutes are the Institute of Occupational Health, VTT Technical Research Centre of Finland and the National Research and Development Centre for Welfare and Health (Stakes).

Finland has been ranked high in its innovation performance by the European Innovation Scorecard (European Commission, 2004). The key strengths include high investments (both public and private) in R&D, innovation collaboration and high educational qualifications. At the same time, there are also several challenges facing science and innovation policy. Currently a new broad-based innovation strategy for Finland is under development. The strategy aims at enhancing the industrial competitiveness of Finland and speeding up the reform of the public sector. The understanding of the innovation concept is broader, and the concept includes also workplace development as one of the thematic areas. A broad-based steering group, chaired by the President of the Finnish Innovation Fund SITRA under the supervision of the Finnish Parliament, is responsible for the strategy. Departing from the traditional government strategy work, the project fosters interaction and public debate, and provides opportunities for citizens, associations, and organizations to influence the strategy. In addition, Finnish and foreign experts, companies, interest groups, actors in the innovation system and citizens have been consulted on a large scale during the preparation phase (Hjelt et al., 2008). The strategy will be published in the spring of 2008.

3.5 Summary

We have studied the innovation infrastructure of work-oriented innovations in four different countries: Germany, Norway, Sweden and Finland. There exists several contextual factors such as different economic developments, political traditions and cultural developments that affect the relationships between the different players in the innovation systems in a country. This way each innovation infrastructure for work-oriented innovations is unique.

Characteristic of each country is that the national innovation system consists of several structural levels. We can differentiate between the government, ministry, programme/council and performer levels. Characteristic of the government level is that the government is given advice by the councils of science, research or technology. In Germany the advisory boards are the Science Council and the GWK, in Norway the Government Research Board and the Government Innovation Board and in

Finland the Science Council. In Sweden, there are three research councils, which operate under different ministries.

Policies promoting work-oriented innovations seem rather dispersed, with several ministries involved. On the ministry level the responsibility of innovation policies is given at least to two ministries in each country; to the one that is responsible for education and science and the other responsible for issues related to industry, employment or economy. In addition, in Sweden and Germany also the ministry responsible for health and social affairs is responsible for the work-oriented innovations to some degree. In addition, in Germany also the local governments (Länder) play an important role as actors of the national innovation system.

The programmes and councils are usually intermediary organizations that are responsible for the implementation, coordination and funding of work-oriented innovations. Germany and Norway resemble each other, as R&D programmes of work-oriented innovations are financed through the Ministry of Education and Research, while in Finland and in Sweden this is done by the ministry responsible for employment, trade and industry. In Finland and Sweden the main role of the Ministry of Education and Research in the national innovation system is to support basic research of universities. In these countries there exist also specific institutes that finance basic research of work-oriented innovation, such as the Finnish Academy and Finnish Work Environment Fund in Finland and the FAS in Sweden. Individual R&D programmes usually have a lot of independence and flexibility in terms of the implementation of innovation activities. This is the case particularly in Finland (Tekes & Tykes) and in Sweden (Vinnova). Instead, in Germany the programmes are closely controlled by the ministries, while in Norway the programmes are governed by the research council.

At the performer level, there are several potential actors of work-oriented innovations. The basic research funding is mainly directed to public R&D units, while research-assisted development programmes finance both public R&D units and private consultancies. The above examination shows that in each studied country there is finance available for public R&D units. Instead, it seems that it is more difficult for consultancies to get public support for development activities, particularly in Norway, but also in Sweden. In Finland and Germany public money is available for both public and private R&D units. The tendency to support mainly public R&D units seems rather understandable from the public policy point of view. While supporting the activities of public R&D units, it is possible to increase the dissemination of knowledge to other organizations and improve

learning within the innovation system through other knowledge production activities such as research and education.

In addition, while studying the strategies for future orientation of innovation policies in different countries, it seems that the countries share many similarities. For each country typical characteristics for the future directions for innovation policy were the improvement of the overall structure of R&D infrastructure, increasing and ensuring investments in education and research, increasing joint activities between public R&D units and industry and promoting internationalization.

4 Framework and results of the inquiry

In this empirical part of the study, we will present the process and results of an inquiry focusing on national R&D units that carry out research and development on work-oriented innovations, and examine their resources. At first, we will describe the framework used for the benchmarking exercise.

4.1 Knowledge measurement model for R&D infrastructure

In an earlier study, Ramstad (2008) suggested a knowledge measurement model for R&D infrastructure, which will be used here. The knowledge measurement model aims to understand the strengths and dissimilarities of R&D performers as a potential for learning from differences and complementarity of resources. The model is based on the fact that organizational development is institutionally bound and R&D units of different kind may in different countries produce and disseminate different types of knowledge.

The framework differentiates between four types of knowledge sources. These are human resources, knowledge resources, relational resources (vertical and horizontal) and financial resources that are measured with different assets (table 1).

Table 1. Measurement model of knowledge systems (Ramstad, 2008).

1. Human resources: number of employees, gender and age of experts, employment relationships
2. Knowledge resources: 1) level of expertise: knowledge base, level of education, field of education, development of expertise, 2) type of development activities (e.g. development methods, motives and values, participation and goal-orientation of development activities) and 3) other activities in knowledge creation process
3. Relational resources: collaboration with clients and other expert organizations
4. Financial resources: finance of work-oriented innovations

With human resources we refer to the number of experts working in the field, gender and age of experts and employment relationship. The assets for knowledge resources are of three types: 1) level of expertise, 2) type of development activity and 3) activities in the broader knowledge creation process. The level of expertise refers to the fields of knowledge base, level of knowledge, competences and skills (level of education and educational backgrounds of experts) and also to the

development of expertise. The type of development activities illustrates the basic attitude of R&D units to the organizational change from goal-setting to implementation and evaluation of the outcomes. It uncovers what underlies and determines development activities of experts, such as development methods, patterns, reasons and principles of thinking. The development methods may be well grounded and formalized or based on experience and the tacit knowledge of experts. The third feature concerns the other activities in the broader knowledge creation process, such as production, use and dissemination.

The relational resources concern the external relationships with the clients and other expert organizations. Client relationships include the value embedded in a firm's relationship with customers with different sectors and sizes. Horizontal collaboration refers to joint activities between diverse expert organizations.

The last object of examination is the financial resources of organizational development that can have crucial effects on personnel and knowledge resources. Organizational development activities can be financed in different ways. Much of the external services are bought by the client organizations themselves. However, today there exists several national and international sources, e.g. development programmes and structural funds by the European Commission, which finance development work and enable the use of external experts.

In the following sections the process of data gathering will be presented and the R&D units for each country will be studied separately by using the knowledge measurement framework. Lastly, the main characteristics, similarities and dissimilarities, of the R&D units in different countries are presented in a joint matrix.

4.1 Data gathering and the questionnaire

Data was gathered from Finland, Germany, Norway and Sweden, which had registers on the main R&D units active in the work-oriented innovations. In the case of Sweden, we only had the names of the R&D units, while the addresses needed to be searched in the Internet. Based on our earlier experiences from Finland, we knew that it takes a lot of time to gather data on all R&D units, particularly when there does not exist any statistical data on units researching and developing workplaces. In addition of the inquiry, we gathered information based on document analyses and webpages of R&D units.

4.2 Target group

The inquiries were sent to over 1,300 R&D units in the four participating countries during the years 2006-07. Altogether 178 R&D units stated that they carry out research or development on workplaces (table 2). In Finland there is a long tradition of gathering information on workplace R&D units (e.g. Ramstad, 2007), which may partly explain why the number of responses was clearly higher in Finland. The number of responses is very low in the other countries, which makes the comparison and generalization of answers impossible. We can only generalize the results concerning the Finnish R&D units.

Table 2. Responses to the workplace R&D inquiry.

	Sent inquires	**Informed that they did not practice workplace R&D or did not have time to answer**	**Number of answers (response rate)**
Finland	420	18	138 (37 %)
Germany	834	12	23 (4 %)
Norway	13	-	5 (38 %)
Sweden	76	4	12 (21 %)
Total	1343	34	177 (13 %)

Most of the units represented non-profit public institutes such as universities, polytechnics or governmental research organizations. There were only few private R&D units in the data (Germany and Finland).

4.3 Human resources

The number of R&D personnel

In table 3 the number of R&D personnel of the units and their average size are presented for each country. The average number of R&D personnel per unit is rather small, while there are typically about ten employees, except in the case of Norway where the mean of R&D personnel in the units is 20 employees. It seems that the R&D personnel working for work-oriented innovations represent typically only a small part of the whole personnel working in the unit in Finland, Germany and Sweden. In the case of the Norway, the personnel of the units consists mainly of workplace R&D personnel.

Table 3. Number of personnel and working life R&D personnel in the units for each country.

	Number of personnel in the unit	**Number of workplace R&D personnel (% of total amount)**
Finland		
Median	40	10
Sum	12 294	3194 (26%)
Germany		
Median	17	9
Sum	1499	394 (26%)
Norway		
Median	25	20
Sum	155	121 (78%)
Sweden		
Median	43	10
Sum	1196	219 (18%)

Most of the personnel work as researcher-developers (Germany 74%; Sweden 72%; Norway 70%; Finland 61%), i.e. they carry out both research and development of work life. About one fourth (23-27%) of the personnel in Germany, Sweden and Norway carry out only research related to work-oriented innovation. In Finland the corresponding figure is somewhat lower (7%). This can be explained by the fact that among the Finnish R&D units there are vocational and adult education institutes that are not research-oriented as is the case of universities and research institutes.

There is a clear difference in the nature of work contracts across the countries. In Norway the personnel are better off, while almost all employees have permanent job contracts (96%). In the other countries the share is lower (Finland 70%; Germany 62%) – particularly in Sweden (50%).

The rate of women working in the field is somewhat higher in Finland (57%) and in Sweden (51%) than in Germany (45%) and Norway (45%).

4.4 Knowledge resources

Level of education

The findings show that the workplace R&D personnel are highly educated. In Sweden (94%) and Norway (98%) and also in Germany (94%) almost all the personnel working in the field had a higher degree education, including doctoral, licentiate or master degree education. In Finland the level of education was somewhat lower; only 85 per cent had a higher degree education. This can be

explained by the fact that the data of Finnish R&D units is more versatile, including also some vocational and adult education institutes where the personnel has often lower level education. In Finland also students at the universities and polytechnics participate in the development activities at workplaces as a part of their course studies or post-degree studies.

Background of the education

In general the findings concerning the educational background show that the R&D personnel represent several sciences, which unveils the multidisciplinary nature of work-oriented innovations. Workplace R&D personnel come from a variety of disciplinary fields. What is interesting is that the most typical education is social sciences among R&D personnel in all other countries except in Finland. In Norway nearly two third of the personnel had a background in social sciences. In Finland and in Sweden the R&D personnel represent a broad field of scientific fields. In Finland the most typical education is engineering, while the engineers have traditionally had a strong role in the field of workplace development in Finland. The share of psychologists working in the field is higher in other countries than in Finland. Instead, the share of workplace R&D personnel having a diverse educational background is highest in Finland.

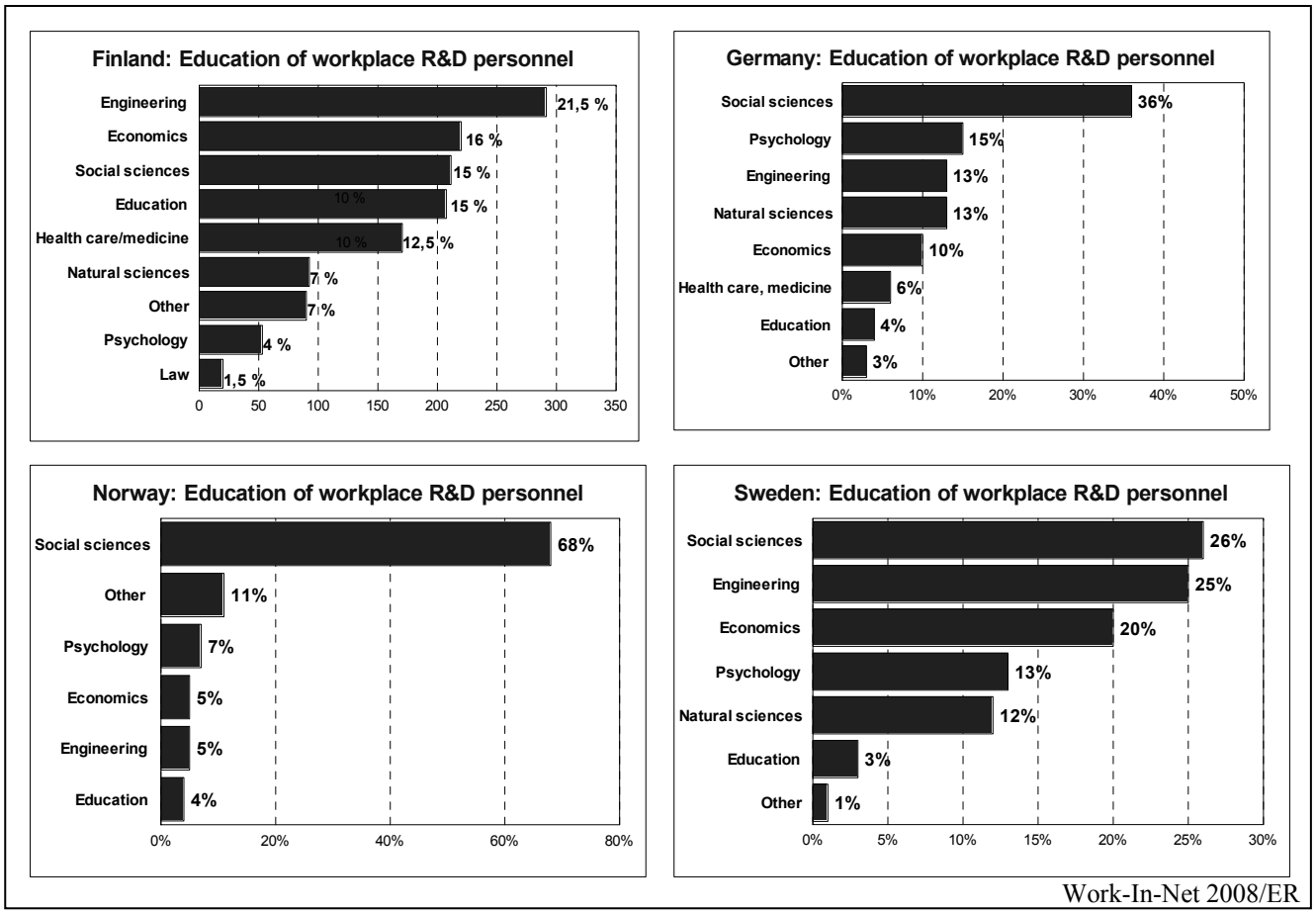


Figure 5. Education of R&D personnel of work-oriented innovations in Finland, Germany, Norway and Sweden.

Improvement of expertise

It is fundamental for R&D units to improve and update their expertise continuously. There exists different ways for improvement. For the Norwegian R&D personnel clearly the most important way is different types of research-oriented practice, such as researcher education, scientific seminars, writing and reading research, and also collaboration with national R&D units. The Finnish R&D personnel value most collaboration with other national R&D units. Both in Germany and Sweden the most important way to improve expertise is writing and reading research. Collaboration with international R&D units is valued most among the Swedish, and the least among the Norwegian R&D units.

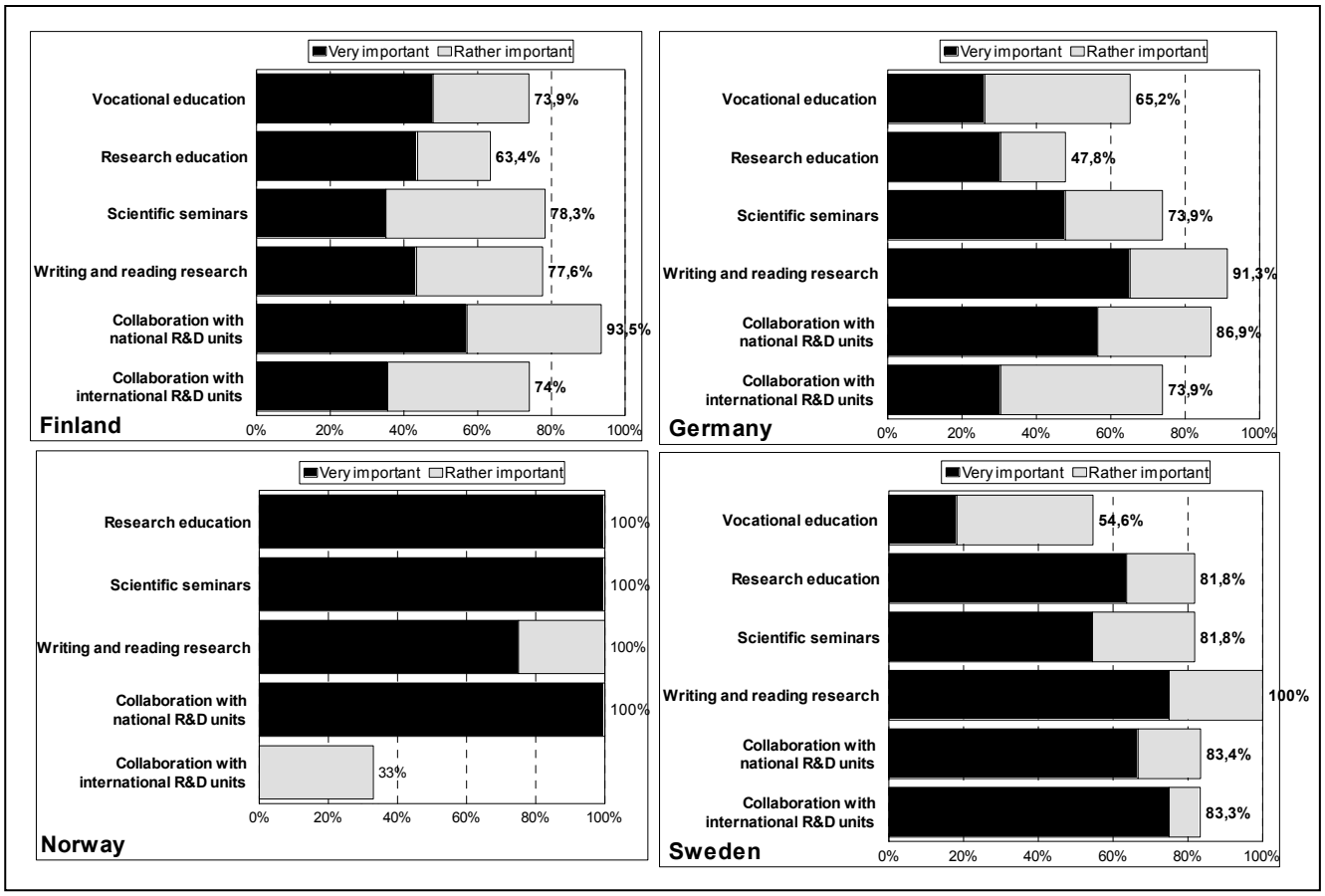


Figure 6. Improvement of expertise of R&D units in selected countries.

Level of knowledge base in the field

Measurement for the level of expertise in the field of work-oriented innovations included nineteen multiple-choice questions. The range was 1-4 (1=no knowledge – 4=very much knowledge). Figure 7 shows the areas in which the units considered themselves to have very high expertise (4=very much). Both the Finnish and German R&D units cited most often high expertise in management of work and learning at work, while 65 per cent of the R&D units assessed to have a very high expertise in these areas. The next best areas in Finland were personnel management and supervision, workplace atmosphere and job satisfaction, social relations and interaction. In Germany the next best areas were employee wellbeing and working capacity, organizing work, content and design of work, and occupational health. In Sweden the most important knowledge fields in descending order were the personnel management and supervision, organizing work, management systems and networking. The expert fields were somewhat different for the Norwegian R&D units compared to the other countries. In Norway all the R&D units assessed that they had a very high expertise in networking (100%) and rather high in the negotiation and participation systems, social relations and interaction, organizing work and gender equality.

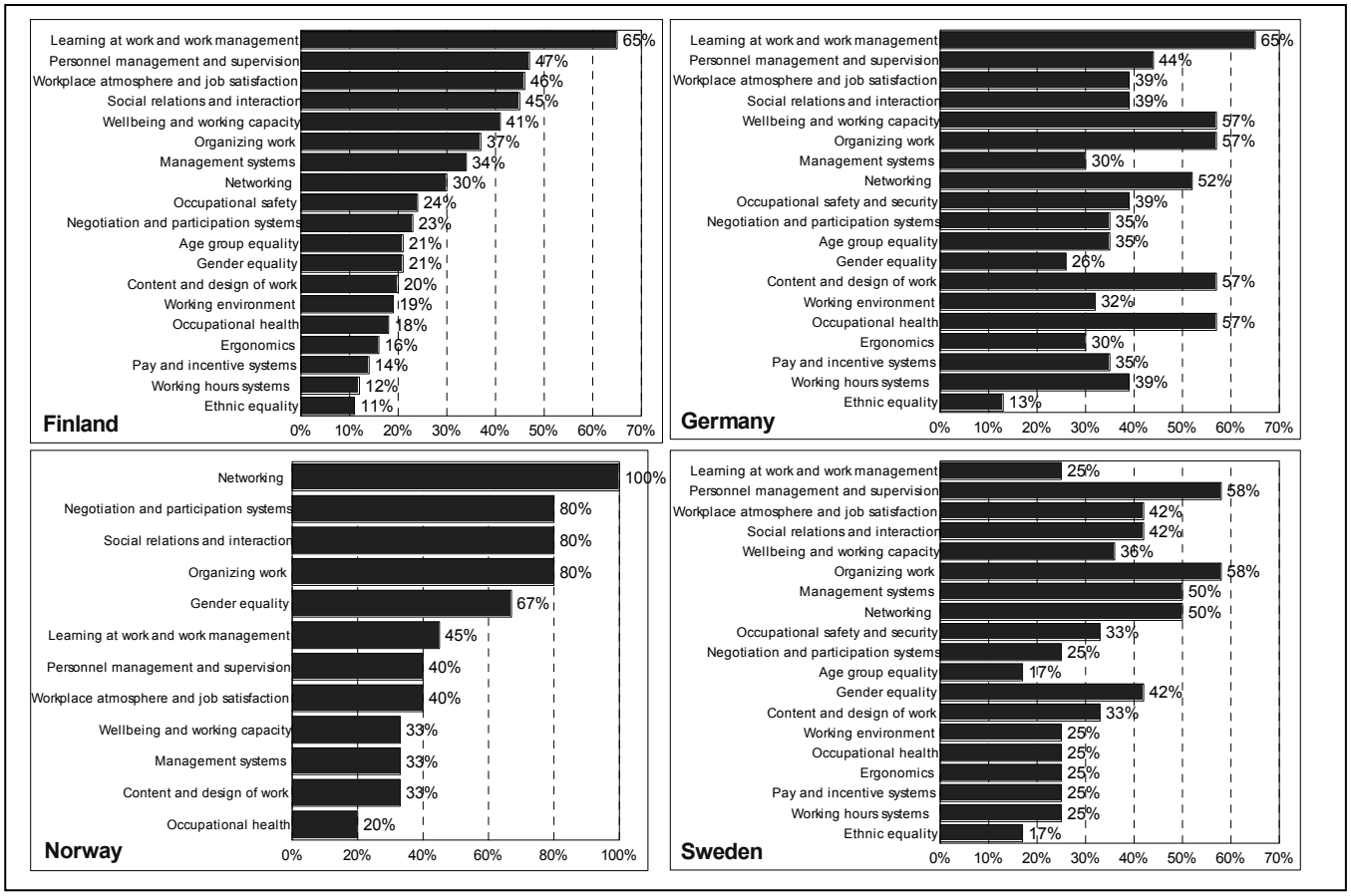


Figure 7. Level of knowledge fields of R&D units in selected countries.

Type of development activities

The respondents were asked to think about their typical workplace development project and describe the characteristics of their development activities. Three types of characteristics of development activities were measured with a help of multiple-choice questions: outcomes, participation and the role of research. The range was 1-5 (1=never – 5=always). In figure 8 the characteristics of development activities, which the R&D units considered to present their typical development project, in this case the answers 4=nearly always and 5=always, are shown. The two first ones consist of questions on typical “outcomes” of the development project. In Norway both productivity and quality of working life are always as targets in the projects simultaneously. In the other countries, and in particularly in Germany, the focus is more often on the “softer” side – in quality of the working life. The quality of working life refers to issues such as mental and physical wellbeing at work, ability to improve skills, social relations and working conditions.

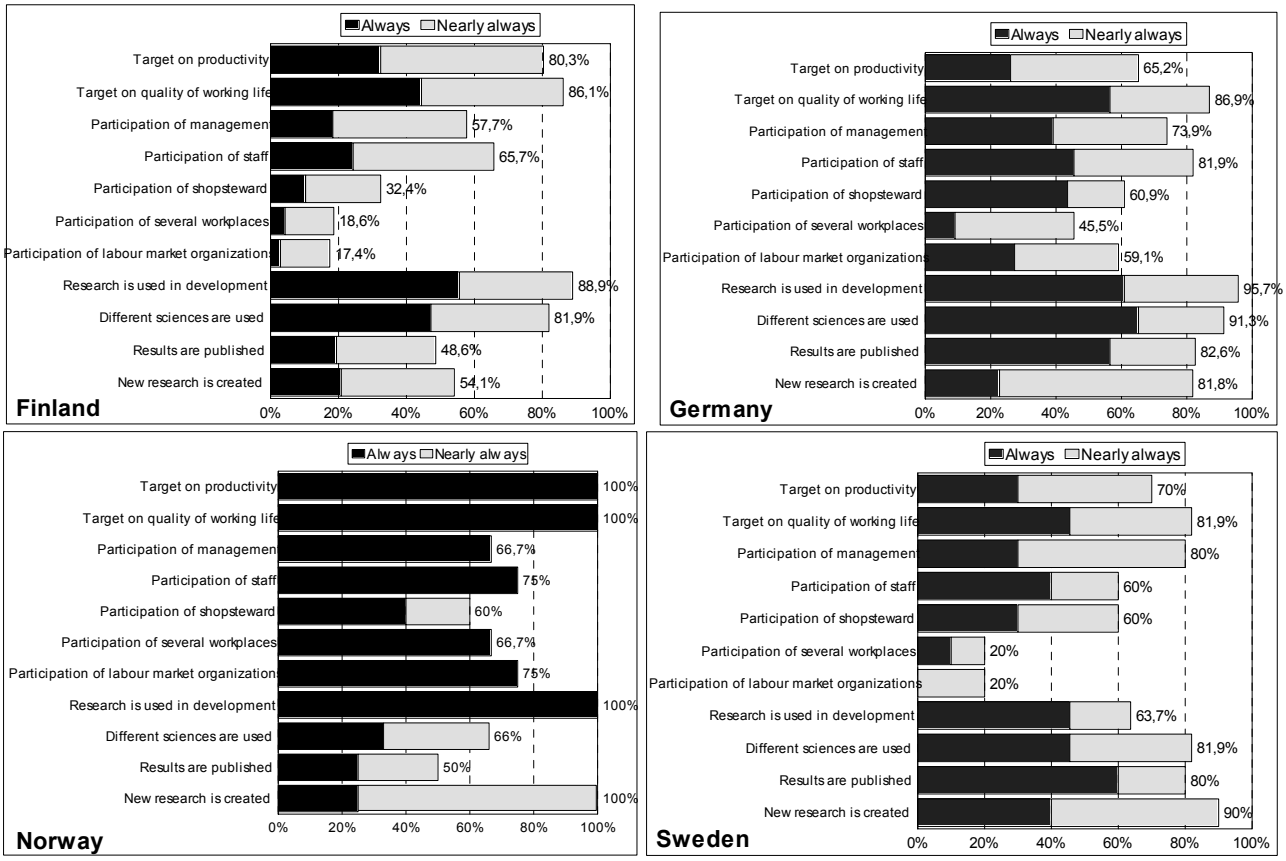


Figure 8. Characteristics of development activities of R&D units in Finland, Germany, Norway and Sweden.

The next five questions are related to the "participation" in the development process. The participation of staff is considered as the most important among the Finnish, German and Norwegian R&D units. In Sweden the participation of management is considered as the most typical, followed by the participation of staff and shop stewards. In Finland and Germany the participation of management comes right after the participation of staff. The role of labour market organizations in the development projects is the most typical for the R&D projects implemented by the Norwegian and German R&D units. Network projects consisting of several workplaces are also the most typical for the Norwegian and German R&D units.

The last four questions measured the "role of research" as a part of the development activities. The development projects by the Norwegian R&D units are the most research-oriented. They always both use and create new research as a part of the development project. In Finland and in Germany it is more typical to use research in the development activities, rather than create new research as an outcome of development project. Among the Swedish R&D units the situation is the other way round.

Development methods

In the inquiry several development methods were listed, of which the R&D units were asked to choose those development methods that they use in their development activities. Some of the methods were concrete tools, while others represented more theoretically grounded development approaches.

Characteristic of all R&D units were that they often use different types of analysis (e.g. competence analysis, SWOT) and evaluation of the results as a part of their development activities. Another shared character was that the development process was often based on participatory development, the use of development groups and action research. It has often been considered that participatory development is something that characterizes the Nordic countries, but the study shows that this type of development is important also for the German R&D units studied here.

There are also some differences across the countries. The Norwegian R&D units do not offer consulting services to workplaces, they seldom offer management training or standardized management approaches (such as knowledge management, balanced scorecard, total quality management) compared to R&D units in the other countries. Here again, we can see that the development methods by Norwegian units are more research- and process-oriented than design-oriented. Further, the socio-technical development approach is the most typical of the R&D units in Norway and Germany.

Table 4. The most typical development methods used by R&D units across different countries.

Finland	**Germany**	**Norway**	**Sweden**
Analysis (82%)	Analysis (83%)	Analysis (100%)	Analysis (100%)
Evaluation (70%)	Evaluation (78%)	Participatory development (100%)	Evaluation (64%)
Consulting (62%)	Participatory development (78%)	Action research (100%)	Management training (64%)
Management training (62%)	Consulting (78%)	Evaluation (80%)	Process analysis & development (55%)
Team building (61%)	Knowledge management (70%)	Benchmarking (75%)	Participatory development (55%)
Participatory development (61%)	Action research (65%)	Process analysis & development (67%)	Action research (55%)
Development groups (60%)	Management training (61%)	Sociotechnical development (67%)	Development groups (55%)
Benchmarking (53%)	Process analysis & development (61%)	Strategy work (67%)	Team building (46%)
Mentoring, tutoring (52%)	Team building (52%)	Development groups (45%)	Consulting (46%)
Development discussions (49%)	Development groups (52%)	Team building (40%)	Anticipation (46%)
Action research (47%)	Benchmarking (48%)	Management training (40%)	Knowledge management (36%)
Problem-based learning (44%)	Work guidance (46%)	Problem-based learning (33%)	Development discussions (36%)
Strategy planning (46%)	Creation of handbook (44%)	Meeting processes (33%)	Creation of handbook (36%)
Work guidance (46%)	ICT solutions (44%)	Anticipation (25%)	Problem-based learning (36%)
BSC (44%)	Socio-technical development (39%)		Strategy work (36%)
ICT solutions (43%)	Development discussions (39%)		ICT solutions (36%)
Knowledge management (40%)	Strategy work (39%)		TQM (27%)
Process analysis & development (40%)	Anticipation (35%)		
	ISO-standards (30%), TQM (30%) Mentoring, tutoring (30%)		

4.5 Relational resources

This section focuses on relational resources, which refer to both vertical and horizontal partners. At first we study the client organizations of R&D units and secondly the collaboration with other R&D units.

Client organizations

The R&D units in different countries offer services to clients in different sectors, which show that organizational development is not restricted to some specific sector. About 60 per cent of the

German units and half of the Swedish units inform that they have no specific focus area, but serve all sectors (figure 9). Among the Norwegian, German and Swedish R&D units the focus is somewhat more often on the private sector than on the public sector. In Finland both sectors are researched and developed in the same matter. Only few R&D units in Germany, Finland and Sweden offer services to third sector organizations.

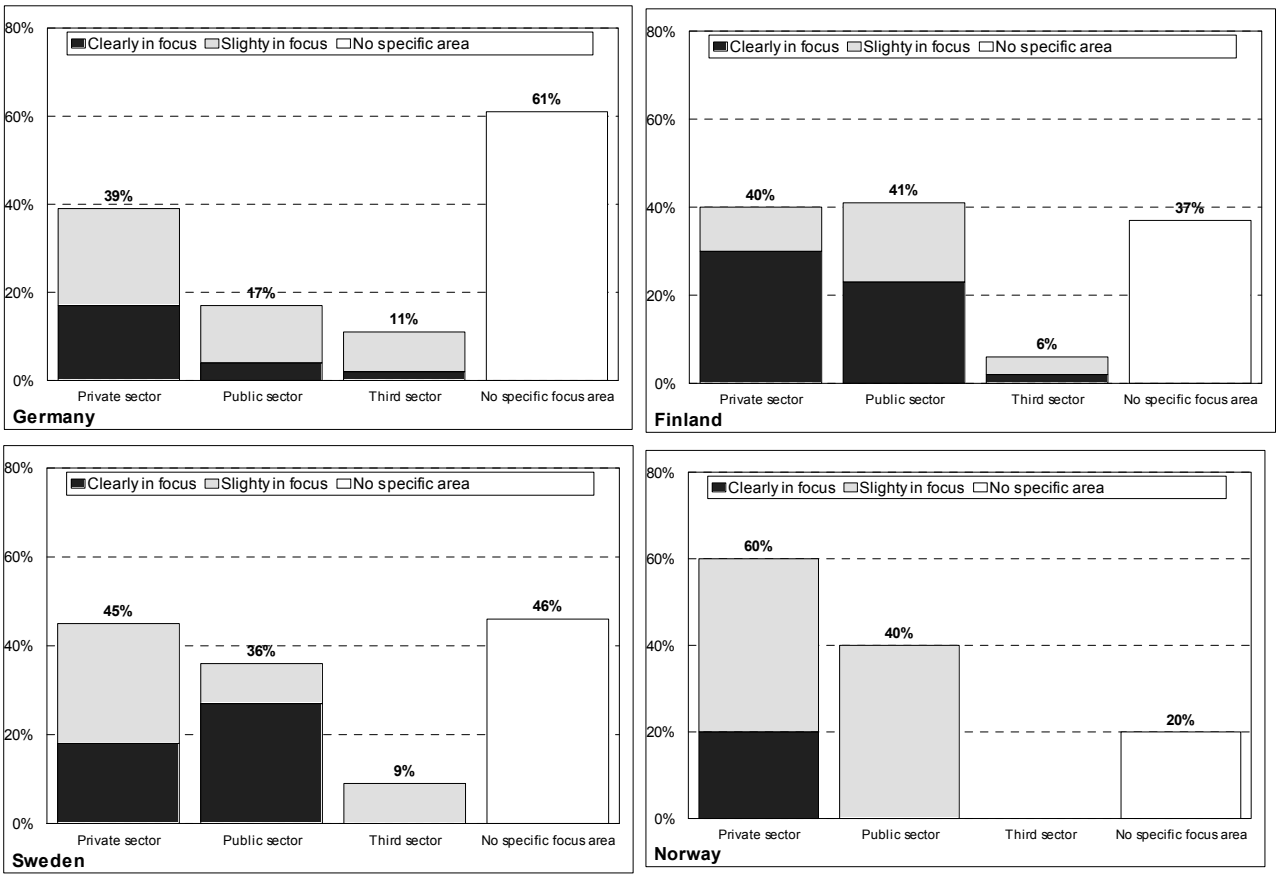


Figure 9. Client organizations of R&D units in selected countries.

Size of the client organization

Many of the R&D units inform that they have no specific focus area concerning the size of the client organization (figure 10). This is particularly the case among the Swedish, Finnish and German R&D units. In addition, among the Norwegian and Swedish R&D units the focus is somewhat more often on big client organizations, while in Finland and Germany the focus is more often on small and medium-sized organizations.

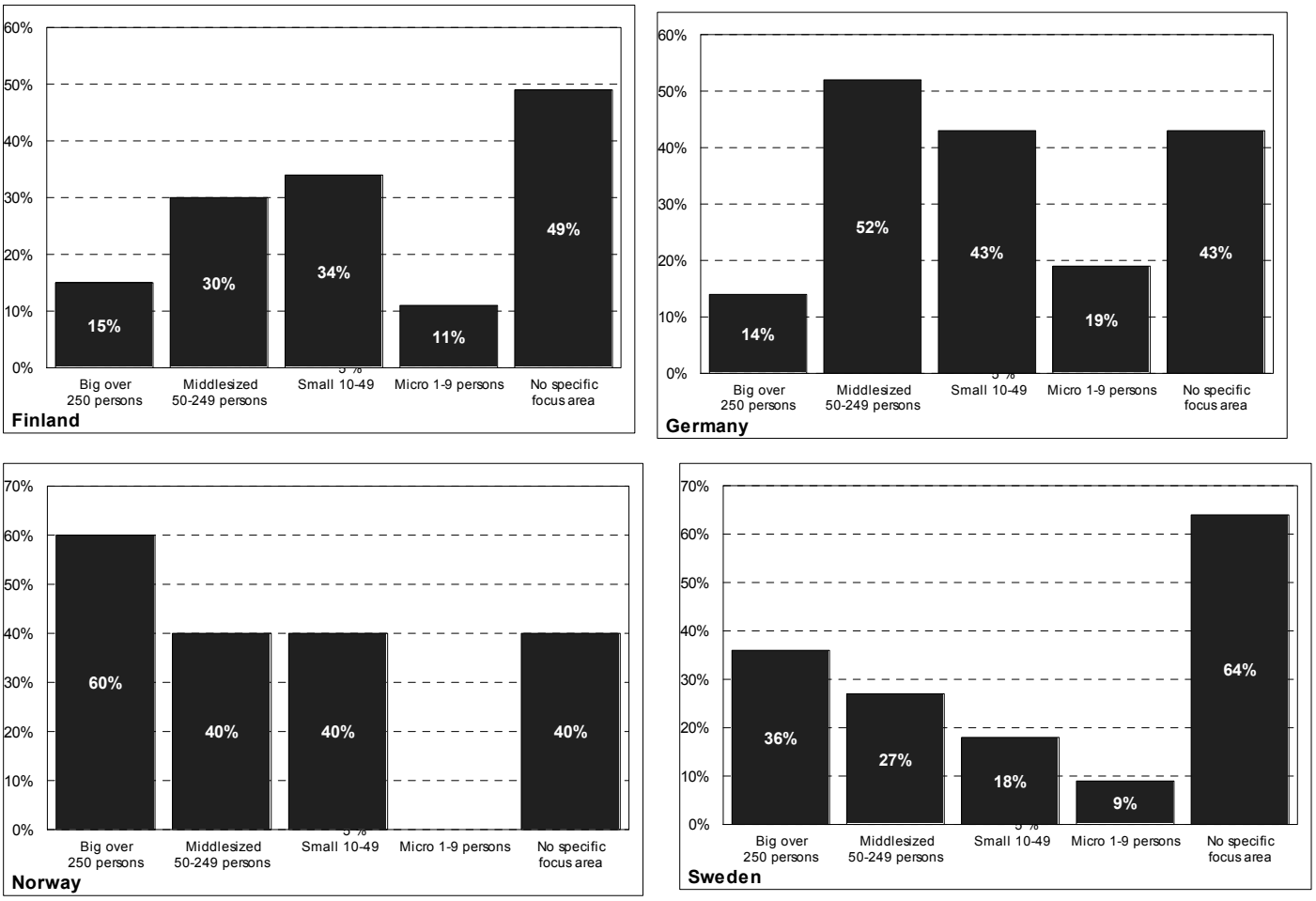


Figure 10. Size of the client organizations of R&D units in selected countries.

Workplace R&D collaboration

The R&D units in different countries differ clearly concerning their collaboration with other expert organizations in the field of workplace R&D. In figure 11 the partners with which the units have most often collaboration are shown (4=nearly always and 5=always). The Norwegian R&D units inform that their R&D activities are always or nearly always implemented in collaboration with other universities and labour market organizations. The Swedish R&D units collaborate most often with universities and research institutes and with labour market organizations. The collaboration of German R&D units is most versatile, while they collaborate often with both public R&D units and private consultancies, and also with labour market organizations. The collaboration of Finnish R&D units is also rather versatile, but the level of collaboration is lower, compared to the German R&D units.

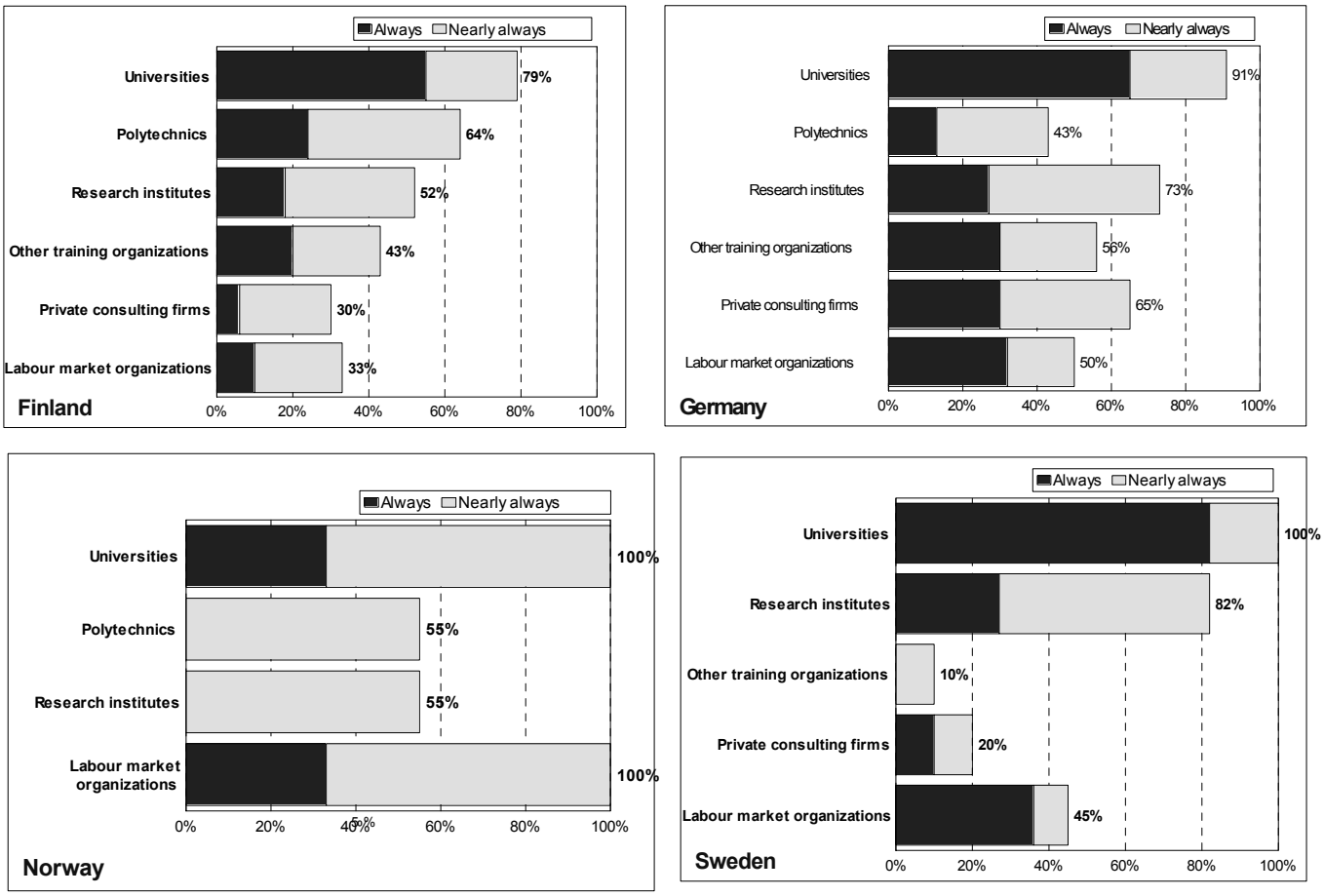


Figure 11. Workplace R&D collaboration.

4.6 Financial resources

R&D activities related to work-oriented innovations are financed more often from public sources than by private money coming from the sales of services in each country. Particularly among the Swedish R&D units public funding coming from national funds, programmes and from the government budget is very important. In Germany funding coming from the government budget is higher than in the other countries. In addition, German and Finnish R&D units finance their activities from structural funds coming from the European Commission more often than R&D units in Sweden or Norway. Norwegian units finance their activities either from national funds and programmes or from the sale of services.

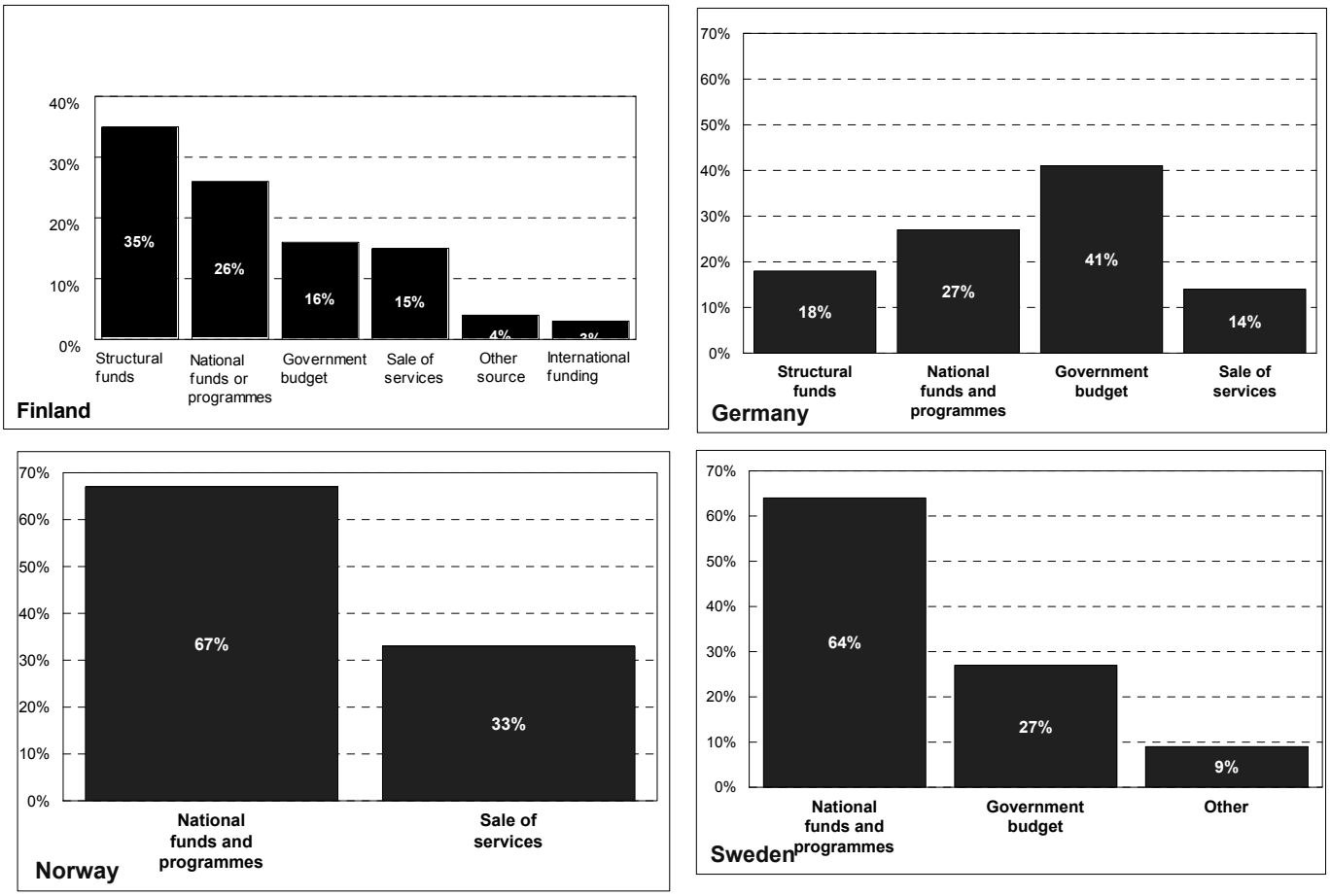


Figure 12. Finance of R&D units in Finland, Germany, Norway and Sweden.

As a conclusion, we summarize the most distinctive characteristics of resources of R&D units in the four countries in table 5. While studying the personnel resources of R&D units it seems that the Norwegian units have a rather good situation, while their units are the biggest and almost all R&D personnel have permanent job contracts. In contrast, the amount of R&D personnel in Sweden that have permanent job contracts is the smallest among the countries. Concerning the financial resources, the Swedish R&D personnel are highly depended on the finance coming from the government and other public programmes and funds, while they are not financing their activities through the sales of services. This might be one aspect to think of. In order to improve the situation of fixed-term R&D personnel, there is a need to improve the financial basis of the R&D units, e.g. by increasing the money coming from the sales of services and this way increase the amount of permanent job contracts.

Table 5. Resources of R&D units in four countries: Finland, Germany, Norway and Sweden.

	Finland	**Germany**	**Norway**	**Sweden**
1. Personnel resources	over half of the R&D personnel are women	over half of the R&D personnel are men	rather big units, over half of the R&D personnel are men, all have permanent job contracts	over half of the R&D personnel are women, only half have permanent job contracts
2. Knowledge resources: **a) education,** **b) knowledge base,** **c) type of development activities,** **d) methods used**	a) most versatile educational background, also students participate as experts, b) high expertise in management of work and learning at work, personnel management, atmosphere, job satisfaction, social relations, c) importance of QWL, participation of staff, d) use of analysis and evaluation, consulting, management training, team building, participatory development	a) highly educated, represent often social sciences, but also other sciences, b) high expertise in management of work and learning at work, wellbeing, organizing work, occupational health, content and design of work, c) importance of QWL, participation of staff and labour market organization, d) use of analysis and evaluation, participatory development, consulting, knowledge management, action research, management training	a) highest educated, mainly social scientists, importance of expertise development, b) high expertise in networking, negotiation and participation systems, social relations, organizing work and gender equality, c) importance of both productivity and QWL, participation of staff and labour market organizations and other workplaces, d) use of analysis and evaluation, participatory development, action research, benchmarking, process analysis, socio-technical development	a) highly educated, mainly social scientists, engineers, economics or psychologists, b) high expertise in personnel management, organizing work, management systems and networking c) importance of QWL, participation of management, d) use of analysis and evaluation, management training, process analysis, participatory development, action research, development groups, team building, consulting
3. Relational resources: **a) clients,** **b) other R&D units**	a) both private and public organizations, all sizes – somewhat more often SMEs b) versatile collaboration, the amount of collaboration is rather low	a) both private and public organizations, all sizes – somewhat more often SMEs b) most versatile collaboration; public, private and labour market organizations	a) private sector, big client organizations b) other universities and labour market organizations	a) all sectors, particularly private sector, big client organizations b) universities, research institutes and also labour market organizations
4. Financial resources	Finance comes from different sources: structural funds, national programmes, government budget, sales of services	Finance comes from different sources: government budget, national programmes, structural funds and sales of services	National programmes and sales of services	Mainly with national public money

While studying the knowledge resources of the units, we found that the Finnish R&D units were more versatile concerning the background of the institute, education, and knowledge base.

However, in the other countries the level of education of R&D personnel was higher than in Finland. Also the share of social scientists was higher in the other countries. Many of the differences in the results can be explained by the fact that the Finnish data consisted, in addition to universities and research institutes, also of polytechnics and vocational education institutes.

The development activities of Norwegian R&D units differed in a way that they are very research-oriented. This can be seen in the development of expertise by researcher education and scientific activities, but also in the development methods used by the Norwegian R&D units. In addition, the Norwegian R&D units have a clear focus on networking and on both productivity and quality of working life (QWL), while in the other countries the focus is somewhat more often on QWL issues. The Swedish R&D units are concerned particularly on management issues and methods directed to management. Among the Swedish R&D units also the participation of management is seen more important compared to the participation of employees, while in the other countries the situation is vice versa.

Concerning the relational resources, it is important for the small R&D units to collaborate with other organizations in order to strengthen their knowledge base. The German R&D units are the most versatile in a way that their clients come from different sectors and they also collaborate more with other expert organizations than the R&D units in the other countries. Similarly, also the clients of Finnish R&D units are rather versatile. The Norwegian and Swedish units are rather similar, while they focus most often to big private sector organizations and collaborate mostly with universities, research institutes and labour market organizations.

As mentioned earlier, the Finnish, German and Norwegian R&D units finance their activities with both private and public money, while the Swedish units are more dependent on the money gained from the government and the national programmes and funds.

5 Topics for further examination

This benchmarking report provides an analysis of the situation of work-oriented innovations at the systemic level as well as the performer level. The first part of the study examined the institutional structures at four different levels: government level, ministry level, programme/council level and performer level in four selected countries. The second part of the study focused on altogether 177 R&D units working in the field in Finland, Germany, Norway and Sweden. Summaries of the studies were presented after each analysis.

In this final chapter, few selected issues will be raised that came out by the partners in the workshop in Berlin, in the analyses of the innovation infrastructures or in the results of questionnaire. Also recommendations for future studies will be given for the participating countries in the WORK-IN-NET project and for the policy makers in the EU and other European countries.

Securing the resources of R&D units of work-oriented innovation

R&D units of work-oriented innovation play a crucial role, in addition to the creation of knowledge, also in the generation and diffusion of knowledge as they apply research-based knowledge for practical purposes at workplaces. The statistical analysis showed that most often R&D personnel of work-oriented innovations are employed on a project contract basis or part time and they often have other responsibilities. For employees this can be a rather disturbing and unsecure situation. Of the studied countries, the situation is best in Norway, where it has been possible to guarantee to almost all permanent jobs through R&D programmes and selling of services to workplaces. We find that it is important to better understand R&D and their conditions and resources in a country, because this has a deep impact on the way R&D works. Governments and R&D programmes/councils can play a critical role in the process of securing the resources of R&D units and emphasizing collaboration between R&D units and workplaces.

Building the R&D of work-oriented innovation perspective into innovation system and policy

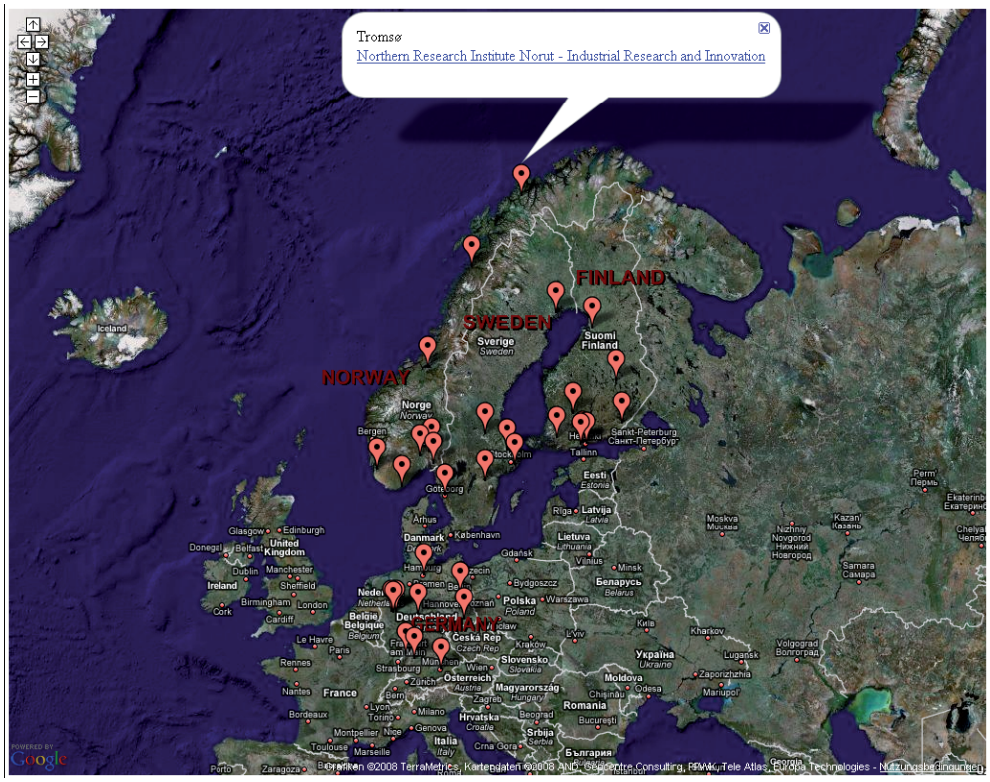
The structural analysis of innovation systems indicates that the focus in many countries is still mainly on technological innovations and the structures related to technology-oriented administrative bodies and funding institutes. Work-oriented innovation plays only a minor role in the innovation system and policy. It is argued that there is a need to broaden our understanding of innovation from technological to also work-oriented innovations, such as new organization forms and practices. The challenge is to build a work-oriented innovation perspective into the innovation system and develop

the existing innovation policies. This would enable a highly skilled labour force, long term strategic development and secure financial support of work-oriented innovations in a country. From the studied country Finland is preparing at the moment a national strategy for broad-based innovation policy including workplace development. It will be interesting to follow up the situation in Finland and how the strategy will work in practice in the future.

Improving the access to R&D units of work-oriented innovations

The study revealed several methodological difficulties, when trying to find the R&D units working in the field. In the future we need more systematically gathered data. In order to help with this issue, we serve here a suggestion for a database as a starting point. It provides information of the main units and their particular areas of interest and expertise together with links to more detailed profiles and contact information. The link to the present database conducted as a part of this study can be found in the following website: rdmaps.ath.cx (see below figure 13). Most of the R&D units took part in this particular study, while some of them are other important actors in the field. It is suggested that the database could help the clients and also other R&D units to search for experts and partners for national and cross-national collaboration, when building up joint research and development projects, e.g. the forthcoming joint call within the WORK-IN-NET project.

Figure 13. Database for R&D units of work-oriented innovation (Ramstad & Saarenpää).



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Editor:

Finnish Workplace Development Programme TYKES
Contact: Mr. Tuomo Alasoini, Ms. Elise Ramstad

P.O. Box 69, 00101 Helsinki, Finland
Tekes – Finnish Funding Agency for Technology and Innovation

Tel. + 358 10 191480
Fax + 358 9 694 9196
Internet: http://www.tykes.fi

Joint Secretariat of WORK-IN-NET

c/o Project Management Organisation at DLR
of the Federal Ministry of Education and Research
(Coordination)

Heinrich-Konen-Strasse 1
D - 53227 Bonn, Germany

Tel.: +49 (0)228 3821 131
Fax: +49 (0)228 3821 248
http://www.workinnet.org/

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