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Foreword

In the current economic situation, the EU Member States are faced with the challenge of alleviating the financial burden of the economic downturn and preparing their economies and labour markets to meet new demands and future changes. This being the case, it is of vital importance that enterprises are provided with support in developing the knowledge, skills and competences of their employees so that they may become innovative, in driving change and in ensuring innovative capacity.

Over the past few years, a number of Europe-wide analyses have emphasised the importance of investing in human resources. The Cedefop study, *Learning while working* (Cedefop, 2011) calls for stronger synergies between policies for innovation, research, enterprise development and training. It emphasises that innovation performance and the development of knowledge, skills and competences reinforce each other. Innovation and training policies should be combined. Efforts to support the innovative ability of enterprises through the development of employees' knowledge, skills and competences will increase business performance and contribute to the economic recovery.

Building on earlier work, this report addresses innovation and learning in enterprises and examines the role that vocational education and training (VET) and learning-conducive working environments play in fostering enterprises' innovative capacity. It covers the EU-27 plus Norway and is part of Cedefop's work on adult and workplace learning that aims to provide a fresh impetus for the policy debate on the role of skills development in fostering innovation.

Today, the potential of VET, including workplace learning, to foster innovation is not being fully exploited. To close the gap between Europe and the world's innovation leaders, the USA and Japan (European Commission, 2011), the EU has implemented an overarching innovation strategy, including the EU flagship initiative 'innovation union' as part of the Europe 2020 strategy (European Commission, 2010a). The Bruges Communiqué has identified work-based learning and innovation as one of the areas that require increased political attention and strategic action (European Commission, 2010b). As adult learning in the workplace makes a fundamental contribution to lifelong learning, this report also supports the renewed European agenda for adult learning.

We trust that this report will contribute to increased understanding, stimulate better policy-making and lead to further research on innovation and learning in enterprises with a view to exploiting more fully the potential of VET, including workplace learning, to foster innovation. We hope that it will inspire policy action both at European level and in the individual Member States.

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Acting Director

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This study is the result of a team effort. Cedefop experts Alexandra Dehmel and Grethe Haugøy were responsible for the overall direction and coordination of the research and the editing of this publication. The team from the Institute for Innovation and Technology (iit) as part of VDI/VDE Innovation und Technik GmbH – Ernst Andreas Hartmann, Andrea Repen, Michael Huch and Marie Wahls – together with experts from the FiBS Institute for Education and Socio-Economic Research and Consulting – Dieter Dohmen, Birgit Cleuvers and Rocio Ramirez-Rodriguez – carried out most of the research on which this report is based ([1]).

Valuable support was provided by other Cedefop experts, in particular Ernesto Villalba-Garcia, Giovanni Russo, Antonio Ranieri and Mara Brugia (Head of Area Enhanced Cooperation in VET and LLL), who offered comments and suggestions. Silke Gadji provided the technical support for the drafting of this publication.

The study took into account the findings of the discussions held and the feedback received during Cedefop's workshop on 'Innovation and learning in enterprises', which took place on 10 and 11 November 2011 in Thessaloniki and was attended by experts from academia, practice, international organisations and governments. Many thanks are due to the workshop participants and also to all the interviewees who participated in the research.

([1]) The work was carried out under Cedefop's service contract No AO/ECVL/RLAR/Skill-Innovation/012/10.

Table of contents

List of figures, tables and boxes

Figures

Tables

Boxes

Executive summary

This study examines the links between learning-intensive forms of work organisation, learning and innovation. It is based on research that covers the EU-27 and Norway and is mainly concerned with two sets of impacts:

(a) the impacts of learning-intensive forms of work organisation and learning on innovation in enterprises, as reflected in innovation performance at national level;

(b) the impacts of publicly funded innovation programmes on the innovative ability of organisations, including the effects on human capital (development of employees' knowledge, skills and competences), structural capital (learning-intensity of workplaces and work organisation) and relational capital (external relations); in addition, an overview of the programme portfolios in the various countries is provided.

Impact of work organisation and learning on innovation

To investigate the first set of impacts, secondary quantitative data from the third and fourth European working conditions survey (EWCS), the third continuing vocational training survey (CVTS) and the innovation union scoreboard (IUS) were analysed using regression and cluster analyses, with due account also being taken of previous studies in this field. The main results are set out below.

The findings suggest that relationships exist between work organisation, learning and innovation. There seem to be significant positive correlations between learning-intensive forms of work organisation and innovation performance, at least at country level. Countries showing higher levels of learning-intensive forms of work organisation tend to rank higher in innovation performance. This is consistent with theoretical assumptions that opportunities for learning at the workplace constitute a major component of innovative ability. A closer inspection of two main characteristics of learning-intensive forms of work organisation – task complexity and autonomy of employees – shows that task complexity seems to have a stronger impact on innovation performance than the other characteristics.

The analyses indicate that formal, non-formal and informal learning in enterprises – measured, among other things, as the proportion of companies providing training, employee participation in training and the costs of continuing vocational training (CVT) as a percentage of total labour costs (all part of the

'human capital formation factor' referred to in this study) – correlates positively with innovation performance. Accordingly, the results suggest that task complexity and human capital formation in enterprises are the two main driving factors for innovation performance.

The findings indicate that participation in CVT – including formal, non-formal and informal learning – might be an equally important or even better predictor of innovation performance than participation in higher education (HE), the latter being a frequently used indicator of a country's innovative ability. VET – in a broad sense – seems to be underrepresented and underestimated as a core prerequisite for innovative ability and, ultimately, for innovation performance, both in research and in innovation reporting systems and scoreboards.

If we group European countries (EU-27 and Norway) according to learning-intensive forms of work organisation, learning and innovation, we find five clusters:

(a) the first cluster, called 'high', scores highly in all three dimensions: very learning-intensive forms of work organisation with a high prevalence of learning and high innovation performance. Cluster members include Denmark, Germany and Sweden;
(b) the second cluster, called 'solid', scores similarly, with only moderate values for learning and moderate to high values for innovation. Cluster members include Austria, Belgium, Finland, Luxembourg and the Netherlands;
(c) the first of the 'intermediate' clusters – called 'moderate 1: high learning, moderate innovation' – combines high values for work organisation and medium values for learning with moderate innovation performance. Cluster members include Estonia, Malta and Norway;
(d) the second of the 'intermediate' clusters – called 'moderate 2: low learning, moderate innovation' – shows very similar innovation performance to moderate 1 but combined here with much lower values for work organisation and learning. Cyprus, the Czech Republic, France, Greece, Ireland, Italy, Portugal, Slovenia, Spain and the United Kingdom are all included in this cluster;
(e) finally, the 'low' cluster, consisting of Bulgaria, Latvia, Lithuania, Hungary, Poland, Romania and Slovakia, scores low on all variables.

Programme portfolios and impact of programmes on innovation

The second set of impacts that was explored in this study concerns the effects of publicly funded programmes on the innovative ability of organisations. Previous research on innovation has identified a set of prominent components of

innovative ability. Among these are learning-intensive forms of work organisation and learning, the participation of organisations in networks and the immediate promotion of cooperative research and development and innovation (R&D&I).

Based on these theoretical considerations, five types of publicly funded programmes were distinguished in this study by the ways in which they promote innovative ability:

(a) programmes that invest directly in human capital – in the knowledge, skills and competences of employees (for example through VET);
(b) programmes that address structural capital – organisational structures and processes – with a focus on the workplace level, aimed at more learning-intensive forms of work organisations and, accordingly, higher intensities of workplace learning;
(c) programmes that focus on structural capital – organisational structures and processes – at a level across the whole work organisation, beyond the workplace level, e.g. business development programmes;
(d) programmes that are geared towards relational capital, the involvement of organisations in (regional) clusters and networks;
(e) and finally, programmes that invest directly in R&D&I.

In total, 1 030 publicly funded programmes implemented in the EU-27 and Norway were analysed on the basis of the European database ERAWATCH. This analysis showed that there are extremely few programmes that address the workplace level (0.7%), while programmes that focus on R&D&I (31%) and on the work organisation (24%) are most frequent. It appears that the more advanced countries tend to rely on substantial proportions of R&D&I programmes in their portfolios. An analysis of the distribution of the five types of programmes in the countries' programme portfolios shows the following clusters:

(a) the 'cooperative R&D&I' cluster. The countries in this cluster show the highest proportion of R&D&I programmes and structural capital-related programmes with a focus on the workplace in their portfolios. Cluster members include Austria, Denmark, Finland, Germany, Hungary, Luxembourg, the Netherlands, Norway, Spain and Sweden;
(b) the 'structural capital – business development' cluster. This cluster is characterised not only by a high percentage of structural capital-related programmes with a focus on work organisation but also by the lowest percentage of human capital-related programmes and the lowest percentage of 'other approaches'. Cluster members include Belgium, the Czech Republic, France, Latvia, Malta, Portugal, Slovenia and Slovakia;
(c) the 'human capital – low cooperative R&D&I' cluster. This cluster is characterised by two features: a high proportion of human capital-related

programmes and a very low proportion of R&D&I programmes. Cluster members include Greece, Cyprus, Lithuania, Poland and the United Kingdom;

(d) the 'relational capital' cluster. This cluster shows a high percentage of relational capital-related programmes and a low proportion of structural capital-related programmes with a focus either on the workplace or on work organisation (type 2). It consists of only two countries: Ireland and Romania;

(e) the 'other approaches' cluster. This cluster has a high proportion of programmes which are not related to any of the approaches to fostering innovative ability discussed in this study. Its members are Bulgaria, Estonia and Italy.

To gain further insight into the impact of publicly funded programmes on the innovative ability of enterprises, qualitative data were gathered across Europe by means of computer-assisted telephone interviews (CATIs) with programme managers and programme owners. In these interviews, the expected and actual effects of such programmes on subdimensions of human, structural and relational capital were considered. Further, 10 case studies were set up to take a closer look at specific programmes and to consider them in a wider context. Some of these case studies not only consider the programmes but also include detailed analysis at project level.

The analysis of these qualitative data generally shows that the programmes are geared towards and have an impact on the dimensions (human, structural, relational capital) for which they are designed. Additionally, most programmes address and have an impact across all three dimensions.

In some cases, the actual effects fall short of expectations. This specifically relates to impacts that are crucial, albeit difficult to achieve, on product and process innovation or changes in organisational structures. On the other hand, some programmes seem to have achieved more than expected. For example, the structural capital and work organisation programmes that focus on organisational structures and processes show values that are higher than expected in most subdimensions of human capital, notably in the cases of personal and social skills and CVT. Further, R&D&I-oriented programmes show values that are higher actual than expected in almost all human capital subdimensions, e.g. initial and continuing VET and continuing HE. Interestingly, the analysis reveals that, in programmes exclusively geared towards small and medium-sized enterprises (SMEs), both the expected and actual impacts are greater than those of the other, non-SME-specific programmes.

Recommendations

The study's findings lead to a number of policy recommendations, including:

(a) the effects of publicly funded programmes aimed at enhancing innovative ability should be monitored in a more thorough and systematic way (e.g. using the dimensions of human, structural and relational capital); further, European innovation programme databases should be maintained and improved;

(b) VET-related indicators should be integrated in R&D&I reporting systems and cover the three dimensions of human, structural and relational capital. Specifically, the inclusion of relevant indicators referring to CVT and learning-intensive forms of work organisation should be ensured, and relational capital indicators should be revised, particularly with a view to widening the scope of R&D&I cooperation so as to include cooperation in the fields of education and training (e.g. between enterprises, HE and VET institutions);

(c) workplace-centred programmes should be developed and implemented; they should be used to raise awareness of and focus attention on the importance of learning-intensive forms of work organisation and workplace learning for innovation, as this awareness seems to be lacking in many European countries; further, core design features such as accompanying measures (e.g. conferences and seminars) and the active involvement of the social partners and other stakeholders should be considered;

(d) the involvement of the social partners, professional and industrial organisations and other intermediaries should be further increased and developed in all types of programmes, with particular regard to workplace-centred programmes. Among these intermediary organisations, those employing widely-accepted methods and standards of work design should receive special attention.

CHAPTER 1.

Introduction

1.1. Background

Over the past few years, a number of Europe-wide analyses have emphasised the importance of investing in knowledge, skills and competences (KSC) to support future economic growth, innovation and business performance in response to the fast-growing challenges of the business environment. The recent Cedefop study on *Learning while working* (Cedefop, 2011) shows that KSC development and innovation reinforce each other. The development of new products and services, the adoption of technological innovations and the introduction of major changes in work processes and organisation stimulate enterprises' awareness of training needs and the demand for training. Increasing employees' KSC makes it easier for companies to adapt to change and to compete in new markets. Employees' ability to stimulate and implement innovation might be increased. Therefore, innovation and training policies should be combined. There is a need for increased synergies between strategies that support innovation and business development and for policy measures that promote learning in enterprises, even in its most informal forms.

KSC development can be stimulated in various ways, not only, for example, through formal education and training but also informally through learning while working. The importance of workplace learning and its potentials are being increasingly recognised (Cedefop, 2011; Council of the EU and the European Commission, 2010). For example, the EWCS considers the extent to which workers can broaden their competences at work, i.e. on the job (e.g. by having to solve unforeseen problems, carrying out complex tasks and teamwork, having a certain degree of autonomy) (Eurofound, 2007). Learning while working implies that the work environment is organised in certain ways. With regard to innovation, learning and KSC development in enterprises, some crucial questions are: how can the working culture be transformed into one which stimulates learning processes and produces benefits at company level in terms of innovation? How can workplaces that are conducive to learning and innovation be developed? What are the links between work organisation, workplace learning and innovation? Do policy initiatives and programmes that combine innovation and KSC development in enterprises exist in Europe, how do they operate and how successful are they? How do the various Member States approach learning and innovation in enterprises?

The present report on *Learning and innovation in enterprises* provides some answers to these questions by examining the links between learning-intensive forms of work organisation, workplace learning and innovation. It covers the 27 EU Member States and Norway and explores the impact of learning-intensive forms of work organisation and learning on innovation in enterprises, as reflected in innovation performance at national level. Further, it identifies and reviews policy frameworks and publicly funded programmes that foster innovation in enterprises. Special attention is paid to the introduction of work organisation structures and processes in enterprises that can best stimulate business performance and innovation, while enabling employees to develop their KSC on-the-job.

1.2. Logic and structure of the report

This study is guided by the following assumptions:

(a) the likelihood of actual innovation in organisations depends on the innovative ability of these organisations;

(b) innovative ability is constituted by the absorptive capacity (Cohen and Levinthal, 1990) of organisations. Absorptive capacity can be described and operationalised using the construct of intellectual capital. Intellectual capital includes the three dimensions of human, structural and relational capital of organisations (ibid.; Edvisson and Malone, 1997); they can be used as indicators of innovative ability;

(c) a specific aspect of innovative ability in the domain of structural capital – learning-intensive forms of work organisation – promotes workplace learning:

  (i) within these learning-intensive forms of work organisation, the core job dimension (Hackman and Oldham, 1974) of task variety or task complexity is specifically important for innovative ability and innovation performance because this job dimension is closely linked to learning demands inherent in the workplace (Bergmann et al., 2004; Richter and Wardanjan, 2000);

  (ii) within these learning-intensive forms of work organisation, the core job dimension of autonomy (Hackman and Oldham, 1974) is specifically important for innovative ability and innovation performance because this job dimension is closely linked to the degree of freedom in learning activities inherent in work processes and to learning demands inherent in the workplace;

(d) in the domain of human capital, formal, non-formal and informal learning contribute to innovative ability and innovation performance (Cohen and Levinthal, 1990; Mertins et al., 2008):
    (i) provision of and participation in formal and non-formal types of lifelong learning are conducive to innovative ability and innovation performance;
    (ii) informal workplace learning is also conducive to innovative ability and innovation performance (OECD, 2010a);
(e) publicly funded R&D&I programmes have a positive effect on innovative ability by addressing one or more dimensions of intellectual capital (human, structural, relational) or by promoting R&D&I itself, as R&D&I increases innovative ability;
(f) the programme portfolios implemented in the various countries differ across Europe.

These assumptions were investigated in several stages, using quantitative as well as qualitative methods:

(a) the impact on innovation performance of different types of work organisation (more or less learning-friendly) and, more specifically, of task complexity-related and autonomy-related aspects of work organisation was analysed at country (not organisational) level using secondary data from the EWCS and the IUS;
(b) the impact of CVT and, more specifically, of workplace learning was also analysed, using secondary data from the CVTS and the IUS;
(c) European countries were clustered into five groups with respect to learning-intensive forms of work organisation, learning and innovation, using EWCS, CVTS and IUS data;
(d) the programme portfolios of European countries were qualitatively analysed with respect to the five main methods used to promote innovative ability: these directly concern human capital (type 1), structural capital with a focus on the workplace (type 2a), structural capital with a focus on the whole organisation (type 2b), relational capital (type 3) and R&D&I (type 4). Over 1 000 programmes were analysed on the basis of the ERAWATCH database;
(e) in a second cluster analysis, countries were grouped according to types of programme portfolios. This cluster structure – called portfolio clusters – was compared to the cluster structure based on work organisation, learning and innovation to investigate relationships between the various countries' innovation type and policies;

(f) the expected and actual impacts of publicly funded R&D&I programmes were examined in a survey across the EU-27 and Norway. These impacts relate to intellectual capital (human, structural and relational) and include the basic impact on learning-relevant characteristics of workplaces. Data were gathered by means of computer-assisted telephone interviews, using modified versions of established questionnaires (IndiGO – indicators of gains in organisational competence – and FLMA – questionnaire on the workplace characteristics relevant for learning – translation from German: *Fragebogen zu lernrelevanten Merkmalen der Arbeitsaufgabe*, Richter and Wardanjan, 2000);

(g) in 10 case studies, programmes across Europe were analysed. In some of these case studies, the analysis was carried out not only at programme level but also at the level of individual projects within the programmes. Embedded case studies were conducted at project level. In these embedded case studies, the effects at workplace level, as perceived by project managers and employees themselves, were recorded.

The report is structured as follows:

(a) Chapter 1 sets out the subject of, background to and purpose of the study and places it in the wider context of Cedefop's work and the European Union's policy on KSC development and innovation;

(b) Chapter 2 defines the key terms used and describes the theoretical framework and the methodology. The framework links individual learning to organisational learning and, ultimately, to innovation;

(c) Chapter 3 discusses the quantitative secondary data analyses regarding the interrelations between learning-intensive forms of work organisation, learning and innovation performance. In addition, this chapter presents the results of a cluster analysis, performed by grouping into clusters ('innovation clusters') countries with similar scores regarding learning-intensive forms of work organisation, learning and innovation;

(d) Chapter 4 investigates the impacts of publicly funded programmes on enterprises' innovative ability. It discusses the analysis of the programme portfolios of the EU-27 and Norway and further cluster analyses, performed by grouping countries according to their programme portfolios ('portfolio clusters') and linking them with the 'innovation clusters' to investigate the relationships between policies and innovation type. Chapter 4 also presents the results of the analysis of the impacts of publicly funded programmes on innovative ability;

(e) Chapter 5 summarises the findings and draws conclusions, on the one hand, about the links between learning-intensive forms of work organisation,

workplace learning and innovation and, on the other, about the impact of publicly funded programmes on innovative ability and performance. Further, it presents a number of recommendations for policy-makers and researchers based on the results of the study.

It is important to emphasise that the core issues addressed in this study – relationships between learning-intensive forms of organisation, learning and innovation – are embedded in a wider context, i.e. a complex set of other factors and phenomena, all of these interacting with our core issues in various ways. They include the specific histories and traditions of VET in the respective countries and regions, learning cultures at national, regional and organisational levels, economic structures such as the relative importance of economic sectors within national economies, political traditions and national styles of R&D&I policies, and specific features of regional and national innovation systems. Some of these contextual factors are identified in the case studies and, to a lesser extent, in the regression analyses of secondary data. It is, however, beyond the scope of this study to present, at European level, general information about the interrelationships between these phenomena and the factors explored in more detail in this study. Accordingly, only findings concerning these core factors are presented, although the authors are fully aware that only limited consideration is given to many important contextual factors.

1.3. European policy background

The European Union's prosperity depends on the skills of its workforce and the innovativeness and competitiveness of its enterprises. Global competition in the fields of innovation and economic development is fierce, and the European Union (EU) seems to be facing a significant innovation gap compared to other world economies such as the USA and Japan. According to the IUS, these two countries achieve substantially higher levels of innovation performance as compared to the average scores of the EU. However, the IUS also reveals that there are great differences between the EU Member States. Some (e.g. Sweden) perform well above the EU-27 average, whereas others (e.g. Bulgaria) perform well below that level (European Commission, 2011). One of the eight dimensions used in the IUS to measure innovative capacity and to monitor progress in the EU-27 is human resources (HR), thus indicating the importance of a skilled workforce.

At European level, a broad approach to innovation policies has been taken to stimulate innovation and to address the innovation gap (Dehmel, 2013). An important milestone in EU innovation policy was the 2000 Lisbon Strategy, which aimed to make the EU the most competitive and dynamic knowledge-based

economy in the world and defined innovation, education and research as key drivers for growth (Council of the EU, 2000). This goal has been emphasised since then and has led to the development of an overarching innovation policy. The Lisbon Council initiated the setting up of the European innovation scoreboard (EIS) (renamed the innovation union scoreboard in 2010) to monitor innovation policies in the EU Member States (Esser et al., 2007); its data are used in this study. The 2003 communication on *Innovation policy: updating the Union's approach in the context of the Lisbon strategy* (European Commission, 2003) reinforced innovation as a cornerstone of the Lisbon strategy. It emphasised the need for a broader view to be taken of innovation and – most importantly – lay the foundation for overarching innovation strategies that cover different policy areas and go beyond mere research and technological development issues.

In 2005, the Commission reviewed the progress that had been made and set out a renewed Lisbon action programme (European Commission, 2005a). It defined 'knowledge and innovation for growth' as one of the three key areas of action, thus putting innovation high on the agenda (ibid., 2005a; 2005b). The initiative PRO INNO Europe has been set up as the focal point for innovation policy analysis and cooperation with a view to contributing to the development of innovation policies ([2]). Its work includes, *inter alia*, the analysis of major innovation trends (INNO Policy TrendChart) and has also been used as a source for this study.

In 2008, the European Institute of innovation and technology (EIT) was established to pursue cooperation within the 'knowledge triangle', i.e. representatives of tertiary education, research and industry, to boost both entrepreneurship in Europe and the successful application of research findings to encourage innovation in industry (EIT, 2011). The year 2009 was declared the 'European year of creativity and innovation', contributing to further awareness-raising and action (Council and European Parliament, 2008).

The follow-up to the Lisbon strategy, 'Europe 2020' (European Commission, 2010b), specifies the goals and priorities for the next decade (2010-20), setting five ambitious objectives, of which two concern innovation and education. They are addressed by seven flagship initiatives. Two of these focus on action related to increasing innovation and a more skilled workforce. The 'innovation union' outlines a strategic approach to innovation, also emphasising the role of education and training and the need to increase skill levels to foster innovation (European Commission, 2010a). The communication on *An Agenda for new skills and jobs* (European Commission, 2010c) highlights the importance of increased participation in lifelong learning. The need to stimulate learning is also mirrored in

([2]) http://www.proinno-europe.eu/.

the ‘Education and training 2020’ target of reaching a 15% average participation rate of adults in lifelong learning by 2020 (Council of the EU, 2009).

‘Education and training 2020’ is an integrated policy framework for European cooperation in education and training. One of the four strategic goals for the decade 2010-20 is ‘enhancing creativity and innovation, including entrepreneurship, at all levels of education and training’ (Council of the EU, 2009). It addresses the topic from two main angles, to promote the acquisition of KSC that foster innovation (e.g. entrepreneurship) and to ensure a fully functioning knowledge triangle (e.g. partnerships between the world of enterprise and the various levels and sectors of education and training).

As an integral part of ‘Education and training 2020’, the ‘Bruges Communiqué on enhanced European cooperation in vocational education and training’ has been launched as a strategic framework to foster excellence and cooperation in VET (Council and EC, 2010). It calls for innovation in VET and encourages partnerships for innovation. At EU-level, a VET business forum focuses on the role of VET in the knowledge triangle (education, research and innovation). There is a growing awareness that innovation and learning are closely linked and reinforce each other. The Bruges Communiqué also emphasises the role of C-VT, including learning at the workplace and – in a broader sense – adult learning, in lifelong learning.

Adult learning has always been considered to be a vital component of lifelong learning, but it has received more widespread attention since 2006, particularly through the communication on adult learning (European Commission, 2006a) and the launch of the ‘action plan on adult learning’ (European Commission, 2007) and the renewed ‘European agenda for adult learning’ (Council of the EU, 2011). Its role is also increasingly emphasised in the field of VET, for example in the Bruges Communiqué and the recent Communication on a new impetus for European cooperation in vocational education and training (European Commission, 2010d). This study recognises the role of adult learning and builds on the assumption that adult learning in the workplace is a ‘fundamental contribution to lifelong learning strategies, flexicurity and employment policies; it also supports policy measures for increasing enterprises’ capacity for innovation, competitiveness and adaptation to sectoral changes’ (Cedefop, 2011).

Despite the initiatives and strategies outlined above, there is a need for greater and more comprehensive coordination across policies and measures for innovation, research, development and education and training. Although, in recent years, EU policy has focused on attaining the Lisbon goals and enhancing VET in general, there is room to expand activities connected with innovation in the workplace and workplace learning.

CHAPTER 2.

Definitions, theoretical framework and methodology

In this chapter, innovative ability and its key determinants are introduced as a theoretical framework for the study. In addition, a definition is provided of innovation and workplace learning and a general overview given of the methodology used.

2.1. Theoretical framework: innovative ability and its key determinants

For the purpose of this study, the concept of absorptive capacity by Cohen and Levinthal (1990) has been adapted and serves as the theoretical framework for describing and determining the innovative ability of organisations.

2.1.1. The concept of absorptive capacity

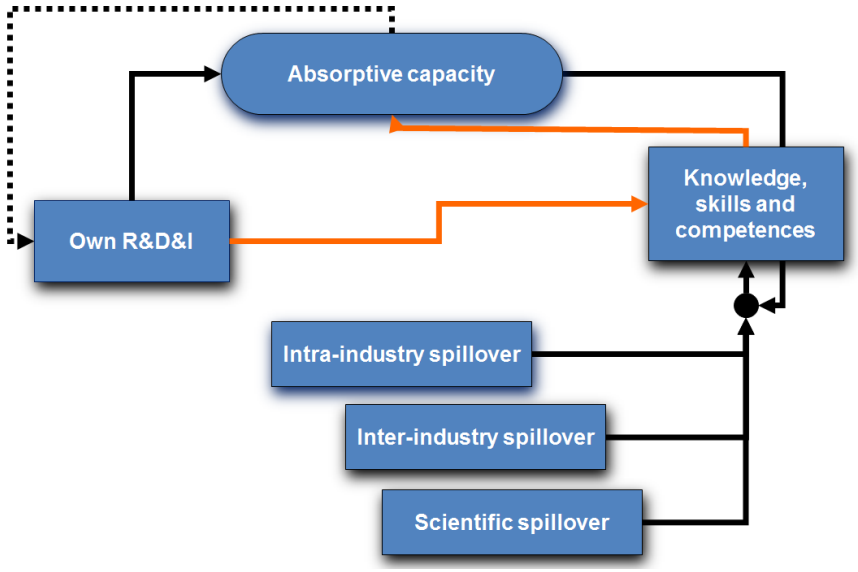
Cohen and Levinthal (1990) define absorptive capacity as the 'ability to recognise the value of new information, assimilate it and apply it to commercial ends' (ibid.). It is considered to be one of the most crucial aspects of an organisation's innovative ability and refers to the organisation's general ability to use external information and opportunities (e.g. new technologies or new forms of organisation) for its own innovative purposes.

Figure 1 shows the relationships between absorptive capacity, external knowledge and a company's own research, development and innovation activities as well as knowledge, skills and competences within the company ([3]). The absorptive capacity of an organisation determines the extent to which it is able to recognise and use external information from:

([3]) In the original article, the term 'technical knowledge' is used. From today's perspective, this concept is far too narrow, especially when we take account of Cohen and Levinthal's own arguments which rely heavily on 'learning to learn' abilities. Today, they would probably be referred to as 'competences', as defined by Erpenbeck and Heyse (2007).

(a) the same industry (intra-industry spillover),
(b) other industries (inter-industry spillover), and/or
(c) scientific research (scientific spillover) ([4]).

Figure 1 **Absorptive capacity in relation to knowledge, skills and competences**



Source: Adapted from Cohen and Levinthal (1990), with modifications suggested by Zahra and George (2002) and Schmidt (2005).

Absorptive capacity itself reflects the level of relevant KSC in the organisation. This refers not only to specialised 'gatekeepers' watching external developments but to all individuals working within the organisation (Cohen and Levinthal, 1990).

Absorptive capacity also stimulates own R&D&I activities within the company, and this, in turn, has a positive effect on absorptive capacity. Another positive feedback loop concerns interdependencies between absorptive capacity and KSC development: the higher the absorptive capacity, the more learning potential is available for building up expertise (KSC). High levels of KSC again boost absorptive capacity. These positive feedback loops may constitute dynamics in organisational innovative ability which may spiral up or down: the more innovative ability there is, the easier it becomes to secure further development in innovative ability, and, conversely, the less innovative ability there is, the harder – and more unlikely – it is to secure gains in innovative ability.

([4]) The new economic growth theory (Romer, 1986; Lucas, 1988; Sala-i-Martin, 1996) follows a similar line of reasoning.

Learning-intensive work processes and work environments have a key role to play in the development of KSC (see Section 2.3). KSC are crucial for an organisation's ability to identify and apply relevant external information and to be innovative. For example, competence includes the ability to submit existing work processes, work systems, etc. to a critical analysis. This is a prerequisite for 'bottom-up' innovation processes, driven by input from individuals or groups of workers, as in continuous improvement processes, for example. It is assumed that the higher the level of KSC, the greater the ability of an organisation to be innovative. Accordingly, the development of human capital and its KSC is important. In addition to innovation-related effects, KSC development and the concepts of workplace learning, learning-intensive work processes and work organisations are discussed from various perspectives, including the following:

(a) individual perspective: humanisation of work. Opportunities to develop KSC are considered to be a core aspect of human-centred work design (Baitsch and Frei, 1980; Ulich et al., 1980);
(b) organisational perspective: intellectual capital. The KSC of organisation members are part of the intellectual capital of the organisation (Pawlowsky et al., 2001);
(c) political perspective: informal learning pathways as a complement to traditional forms of education and training (Bjørnåvold and Colardyn, 2004).

The second dimension of intellectual capital links in with the discussion on absorptive capacity as set out above. Intellectual capital can be seen as a determinant of absorptive capacity and as a product of the learning processes implied in the concept of absorptive capacity. Intellectual capital is used to operationalise further the concept of absorptive capacity in this study.

2.1.2. The concept of intellectual capital

Intellectual capital is considered to be an intangible asset that includes, *inter alia*, investment in research and development (R&D) activities, software, marketing and organisation as well as business practices. According to Edvisson and Malone (1997), companies tend to invest mainly in knowledge and competence development and in the development of information technologies. Investing in intellectual capital may sometimes reduce the short-term value of the company, but it actually constitutes the main investment for sustainable competitiveness (see Villalba, 2006). A common distinction between concepts relating to intellectual capital refers to three components (see, for example, Edvisson and Malone, 1997; see also Alwert, 2005; Stewart, 1998; Sveiby, 1997):

(a) human capital: KSC, motivation and other performance-related aspects of the members of an organisation. Direct investment in human capital leads

predominantly to formal or non-formal forms of learning, under the umbrella of corporate personnel development and CVT;

(b) structural capital: the organisational and technological structures and processes allowing the sustained operation and innovation of the organisation. Investment in structural capital may imply creating and/or implementing learning-intensive forms of organisation or technology (Brandt et al., 2003; Hartmann, 2005), leading to informal and non-formal forms of learning at the workplace. Organisational capital is considered to be a part of structural capital (Edvisson and Malone, 1997);

(c) relational capital, also called customer capital (ibid.), includes relations to all relevant groups outside the organisation, such as stakeholders, customers, suppliers, associations, etc., which enable the organisation to absorb external input. Investment in relational capital may imply the creation of new opportunities for external communication, cooperation and learning. It leads predominantly to informal and non-formal forms of learning, but might also result in more formal modes of learning where relations between industrial organisations and educational institutions are concerned.

These three aspects of intellectual capital may be regarded as determinants of absorptive capacity and thus innovative ability. The more an organisation is geared towards maintaining, identifying, internalising and developing KSC with respect to its employees, the organisation itself and the networks of which the organisation is part, the more it is able to use its KSC in generating innovation (Mertins et al., 2008). Conversely, R&D for product, process, marketing and organisational innovations are important aspects of structural capital (see Table 1). In this study, the concept of intellectual capital with its three components (and their various subdimensions) is used to measure the impact of publicly funded innovation programmes on the innovative ability of enterprises.

The focus of the study is on human and structural capital. With regard to human capital, the provision of and participation in more formal types of learning will be considered as well as non-formal and informal learning at the workplace, with a special emphasis on the latter ([5]). Investment in structural capital may increase learning-intensive forms of organisation. The characteristics of those forms of organisation have been researched and described in various contexts. Hackman and Oldham (1974) distinguish five core job dimensions: skill variety, task identity, task significance, autonomy and feedback. In Europe, this work has

([5]) However, it is important to remember that there are 'hybrid' formats combining workplace learning and more formalised learning settings. These forms are also highly relevant for the innovative ability of organisations (Hartmann and Light, 2010).

been taken up on the basis of the Dresden approach to work and organisational psychology, founded by Winfried Hacker and continued by Peter Richter and Bärbel Bergmann (Bergmann et al., 2004). A useful source of data regarding these job dimensions is the EWCS series undertaken by the European foundation for the improvement of living and working conditions (Eurofound). These databases are used in the empirical analyses (see Chapter 3).

Table 1 **Human, structural and relational capital as determinants of innovative ability**

Intellectual capital		
Human capital	**Structural capital**	**Relational capital**
Domain-related KSC	Organisational culture	Relations to customers
Practical experience	Cooperation and communication within the organisation	Relations to suppliers
Social skills and competences	Equipment relating to information technology, software and other technological systems	Relations to investors/shareholders
Motivation	Knowledge transfer and storage	External cooperation with educational institutions
Leadership skills	R&D infrastructure for product innovation	External knowledge acquisition
Personal skills and competences	R&D infrastructure for process innovation	Social engagement/corporate social responsibility (CVTS)
CVT	Organisational structure	Image of company/brand
IVET	Organisational processes	Engagements in associations and public relations
Continuing HE	Use of modern information and communications technologies (ICT)	
School and HE	Learning-intensive forms of organisation	

Source: Alwert, 2005, modified version.

2.1.3. Types of investment in innovative ability

The various aspects of intellectual capital that have been presented here and its contribution to the absorptive capacity of an organisation imply that there are a number of ways in which an organisation might invest in its innovative ability. Innovation policies pursued by governments or other public or societal bodies may relate to any of these options. Table 2 shows a typology of programmes,

based on the various ways in which investment in innovative ability might be made:

(a) direct investment in human capital, e.g. (vocational) education and training;
(b) investment in structural capital:
    (i) investment aimed at improving work organisation and workplace design so as to maximise learning potentials of the workplace. This would have an impact on structural capital at workplace level;
    (ii) investment focused on organisational innovation and business development, either directly or indirectly concerning KSC development. This would have an impact on structural capital at organisational level;
(c) investment in relational capital. This type of programme focuses on clusters/cluster building, combining industry, research, educational and other public institutions, thereby addressing relational capital;
(d) investment in technological R&D&I. This can lead to a higher level of KSC, which will boost absorptive capacity and also increase the probability of more R&D&I in the future. In other words, investment in innovation increases innovative ability.

The focus of this study is predominantly on type 2a – the creation of learning-intensive forms of organisation – i.e. on informal and non-formal workplace learning.

2.2. Innovation

This study uses the Oslo manual definition of innovation, developed jointly by Eurostat and the Organisation for Economic Cooperation and Development (OECD). The manual provides guidelines for collecting and interpreting data on innovation and uses a definition of innovation that goes beyond the traditional technological definition (innovation as the technological development of new products and production processes). Innovation is defined as 'the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations' (Eurostat and OECD, 2005) and is categorised into four different types: product, process, marketing and organisational innovation:

(a) product innovation: 'the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended issues. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics' (ibid.);

(b) process innovation: ‘the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software’ (ibid.);
(c) marketing innovation: ‘the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing’ (ibid.);
(d) organisational innovation: ‘the implementation of a new organisational method in the firm’s business practices, workplace organisation or external relations’ (ibid.). It involves, among other things:
    (i) the improvement of learning and knowledge-sharing within the firm as well as the implementation of practices for employee development and improving worker retention;
    (ii) the distribution of responsibilities and decision-making among employees and the granting of greater autonomy to employees in the division of work (and organisational units) as well as the implementation of new concepts for the structuring of activities;
    (iii) the establishment of new types of collaborations with research organisations or customers, the implementation of new methods of integration with suppliers and the outsourcing or subcontracting of business activities.

Product, process and marketing innovations are related to the introduction of new or significantly improved goods or services, methods of production or delivery, or methods of marketing. Organisational innovations are related to changes and improvements within an organisation that might lead to the other types of innovation. Innovations may be based on the use of new knowledge or technologies, on a new use of existing knowledge or technologies or on a combination of both. The introduction of programmes, projects and strategies for enhancing the innovative capability of enterprises may concern one or more of the four innovation types. However, investment and changes in at least one type of innovation may implicitly or explicitly influence other areas of innovation. For the purposes of this study, all four types of innovation will be regarded as dimensions of innovation performance. Marketing and especially organisational innovations will also be regarded as improvements in innovative ability in the areas of relational and structural capital respectively.

Table 2 **Typology of programmes**

Type of investment in innovative ability	Focus of programme/service	Modes of addressing KSC development
1. Human capital	Mostly formal basic or continuing (vocational) training; programmes may fund the development and provision of education and training services or support individual learners by providing funds to pay education fees, etc.	KSC always explicitly addressed
2a. Structural capital, focus on the workplace	Work organisation and workplace design, including learning potentials of the workplace	Integrated
		Dedicated strands/accompanying activities
2b. Structural capital, focus on the organisation	Organisational innovation and business development	Integrated
		Dedicated strands/accompanying activities
3. Relational capital	Cluster/regional innovation systems, programmes and initiatives	Integrated
		Dedicated strands/accompanying activities
4. Stimulation of R&D&I investment in shared-budget programmes	Technological ([6]) R&D&I	Integrated
		Dedicated strands/accompanying activities

Source: Authors.

2.3. Workplace learning

Learning may be fostered in various ways, ranging from more formalised forms of CVT (e.g. courses) to less formal types of learning. Alternative forms of learning do not compete with more formal forms of training, which enterprises may organise, but rather complement them (Cedefop, 2010b). Analyses of changing patterns of working, learning and career development confirm that informal learning is a central component of KSC development at work (Council and EC, 2010; see also others, e.g. Billet, 2001; 2006; Eraut, 2004). In this connection, workplace learning plays a crucial role (Cedefop, 2011). There is an increasing

([6]) In addition to technological R&D&I, services may also be at the core of those programmes and projects. In fact, many innovation programmes are aimed at 'hybrid' technology/service innovation (e.g. the European transnational Ambient Assisted Living Joint Programme – AAL JP).

body of research on workplace learning (e.g. Billet, 2001; 2008; Billet et al., 2006; Evans et al., 2006; Felstead et al., 2009; Malloch et al., 2011; Rainbird et al., 2004). The following section defines workplace learning as discussed in this study.

2.3.1. Definition

There is no single definition of workplace learning but rather a wide variety of perceptions about its meaning. The concepts range between two opposite poles, from the idea that it concerns off-the-job training based on workplace-relevant topics to approaches that define workplace learning as learning on-the-job, i.e. at the workplace. The definition used for the purpose of this study is closer to the latter: workplace learning encompasses both informal and non-formal learning embedded in the workplace, in job-related processes and tasks (Cedefop, 2011). It may, for example, be fostered through job rotation, coaching, task variety or challenging work tasks. It is part of CVT but is not necessarily intentional or intentionally fostered, i.e. organised. It might take place unintentionally while working. Workplace learning may involve watching, imitating, helping or simulating the observed procedures (Dehnbostel et al., 1992, Dehnbostel, 2007). It occurs through direct involvement in working tasks and working requirements, through a repetition of the given tasks as well as through exploratory action (Sonntag and Stegmaier, 2007; Cedefop, 2011). Workplaces have the potential to offer a rich and relevant learning environment for the acquisition of theoretically-grounded and practically-oriented KSC.

2.3.2. Prerequisites for effective, innovation-oriented learning at the workplace

To stimulate learning and thereby foster the innovative ability of an enterprise, the determinants of learning-conducive working environments need to be considered. What are the characteristics of learning-conducive workplaces, and how can learning be fostered?

The occurrence, outcome and effectiveness of workplace learning depend on various interrelated factors such as professional guidance at the workplace, work organisation and tasks, and the motivation of the learners. Workplace learning may be fostered through a variety of measures, which often mutually support each other. They include not only factors that are inherent in the work organisation and work task but also other, supporting factors, such as mentoring. Some of these factors are outlined below. It is important to emphasise that they have the potential to enhance innovation not only through fostering KSC development but also by creating situations which might be conducive for

innovation. For example, working in cross-functional teams might stimulate innovation because it allows for heterogeneous responses to problems.

2.3.2.1. *Task complexity and task variety*

For the purpose of this study, we focus on task complexity and task variety as well as on autonomy. They are considered to be important factors for workplace learning (Hackman and Oldham, 1974; Bergmann et al., 2004; Richter and Wardanjan, 2000; Eurofound, 2001, Eurofound, 2007). During work, the employee needs to interact and deal with various tasks and purposes which require a wide variety of actions to complete the assignments successfully. Processes of planning and organising as well as feedback loops and correcting phases are also included (Molzberger et al., 2008). This holistic approach allows the employee to understand fully the work processes involved. It has been found that frequent changes and new tasks and requirements at work support knowledge growth. If employees are involved in a variety of tasks that give them novel or challenging work situations, workplace learning is fostered. Further, competition in the company increases the intensity of learning on-the-job (Cedefop, 2002). In a complex work environment, the need for reflection and thinking processes grows, (implicitly) motivating employees to acquire the necessary KSCs. This subsequently also leads to an increased ability to transfer their KSCs to new potential problems.

2.3.2.2. *Autonomy*

Autonomy may be characterised by the employees' scope for action and decision. Autonomy means the freedom to exercise control over work processes (e.g. the ability to choose or change the order of tasks, the method of work and the speed or rate of work), as well as the choice of working patterns. In cases where task autonomy is low, the employee has very little or no control over how a task is to be performed. In cases where it is high, the employee is free to select methods and processes and, to some extent, the work task itself. It is assumed that a high level of autonomy fosters workplace learning.

2.3.2.3. *Teamwork*

Working together with others plays an important role in workplace learning. Employees may learn new skills while working in teams, such as project teams. Such teams tend to be rather flexible. At the end of an assignment, they may well be dissolved and re-formed, depending on the expertise required by a new project. An atmosphere of trust and cooperation, together with a well-evolved group identity, improve the team's cohesion. This leads to increased knowledge

exchange between its members and, hence, collective organisational learning (Poell and van Woerkom, 2011). In the process of working as a team, employees may observe and learn new practices. At the same time, they are confronted with new perspectives. This encourages them to challenge and reflect on their own routines and practices.

2.3.2.4. *Mentoring*

Mentoring may influence working conditions, increase motivation, promote learning and, as a result, may contribute positively to workplace learning. Mentoring describes a trusted one-to-one relationship between a professional, more senior person – the mentor – and a less experienced employee, the mentee. The mentor supports the mentee for purposes of skills development, acquisition of knowledge and improving performance at individual, team or organisational level by providing advice, feedback and the voice of experience and by creating learning opportunities (Ellinger et al., 2011). Mentoring arrangements are particularly important, since they provide an option to direct the learning process. Improper workplace practices and routines may be identified and, as a result, the acquisition of KSC may be improved. This, in turn, leads to an enterprise having a higher absorptive capacity.

2.3.2.5. *Learning climate and culture*

To apply the above-mentioned options effectively, the company needs to establish suitable hierarchies and administrative structures, and it must encourage an organisational culture marked by principles of transparency, openness and cooperative leadership (Hundt, 2001). This leadership style is essential for workplace learning. The more open a company is and the more it is characterised by egalitarian power, the more eager the employee is to apply his/her skills to the work and to deal with challenging tasks; this, in turn, increases learning and the organisation's innovative ability (Cedefop, 2002; Marsick and Watkins, 2003; Roßnagel, 2011). Further, the development of a feedback culture is important. The employee should be given feedback, and any negative feedback must be viewed as constructive criticism with the aim of correcting false approaches and seeking new solutions. This may well lead to greater autonomy and increased participation in the process of working and innovation. A company's organisational problems may also have negative effects on workplace learning. These may take the form of high workloads and work pressure. By offering autonomy and time as the most significant resources for learning, a company may increase individual motivation (Cedefop, 2002).

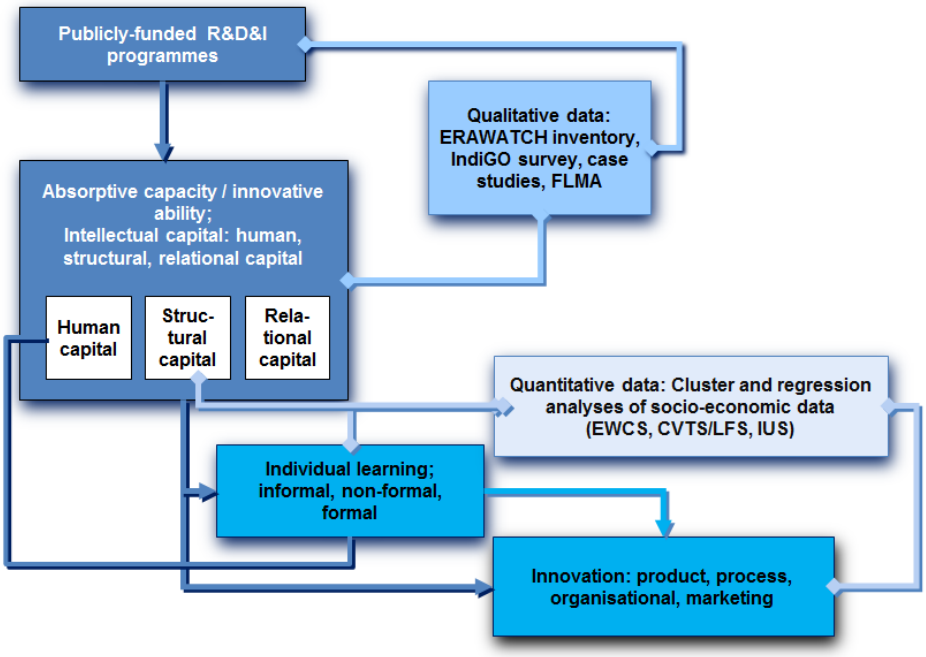
2.4. General methodology

Based on the theoretical considerations presented in the previous paragraphs, this study is led by the assumptions outlined in Section 1.2. Figure 2 relates the methodology to the core phenomena addressed. In methodological terms, the study is divided into two parts:

(a) quantitative analyses of secondary data;
   (i) analysis of the relations between work organisation (EWCS), learning (CVTS) and innovation performance (IUS) at national level;
   (ii) regression analysis of the relationship between selected framework conditions and various aspects of learning and work organisation;

(b) qualitative analyses of the impacts of publicly funded programmes on innovative ability, with two subgroups;
   (i) identification of programmes and analysis of countries' programme portfolios with regard to specific ways of investing in intellectual capital, based on secondary data on European R&D&I programmes from the ERAWATCH inventory. ERAWATCH is an EU information service dedicated to the European Research Area (ERA). It provides information on European, national and regional research systems, policies and programmes in the EU and other European countries to promote a Europe-wide common research policy;
   (ii) analysis of intended and actual effects of programmes on innovative ability, as described in terms of intellectual capital (human, structural, relational). In a survey of programmes across the EU-27 and Norway, the IndiGO methodology is employed. IndiGO is an instrument for CATI, addressing intended and actual effects of programmes on intellectual capital. IndiGO is also used – at both programme and project level – for case studies of selected programmes. In addition, the FLMA serves as an instrument for the gathering of data on the impacts of learning-intensive forms of work organisation at workplace level. The IndiGO and FLMA are described in the next chapter.

Figure 2 General methodology of the study



Source: Authors.

Accordingly, a multimethod approach is used, reflecting data availability, feasibility and appropriateness of methods across the various phenomena to be analysed. More specifically, it shows two core characteristics: a combination of quantitative and qualitative data, and multilevel analysis. The latter is required because the supposed causal relations refer to different levels of phenomena: individual persons (learning), individual workplaces (specific aspects of learning-intensive forms of work organisation at workplace level), organisations (specific aspects of learning-intensive forms of work organisation at organisational level) and countries (socio-economic indicators, including innovative ability and innovation performance).

CHAPTER 3.

Quantitative data analysis: data on organisation, learning and innovation

This chapter presents four main analyses of quantitative secondary data at country level:

(a) the relationship between different forms of work organisation and innovation performance (see Section 3.1);

(b) the relationship between innovation performance and provision of and participation in CVT, including the impact of training within and outside the enterprises (see Section 3.2);

(c) the clustering of countries with similar scores regarding learning-intensive forms of work organisation, learning and innovation (see Section 3.3);

(d) regression analyses that show the relationship between framework conditions and different aspects of work organisation and workplace learning such as work autonomy and complexity of tasks as well as participation in training (see Section 3.4).

In Section 3.1, we refer to data provided by an OECD study that focuses on the relationship between the various forms of work organisation and the innovative ability of countries (OECD, 2010a). It indicates that certain levels of autonomy and work complexity at the workplace combined with teamwork and flat hierarchies are the best work environment conditions for fostering learning at the workplace.

To investigate whether learning at the workplace contributes to improving the innovative ability of organisations, in Section 3.2 data from the third CVTS (2005 data) on participation in and provision of vocational training in enterprises are correlated with the 2006 summary innovation index (SII) of European countries (EIS 2006) ([7]). These data allow us to differentiate between types of training and their impact on innovation ability. The analyses suggest that internal training has a stronger correlation to innovation ability than external training. This might be because of its direct relation to the work tasks and, consequently, to the absorption and transfer of information in organisations.

([7]) As data on the CVTS4 are not available yet, the correlations are measured between participation in training based on the CVTS3 (2005) and its impact on innovation according to the SII 2006.

In Section 3.3, the European countries are clustered into five groups based on data relating to forms of work organisation, learning and innovation. This clustering provides the basis for the survey and the choice of case studies carried out in this study.

The considerations resulting from the analyses led to further analyses in Section 3.4. Regression analyses on various framework conditions (such as gross domestic product (GDP) per capita, R&D expenditure, the proportion of tertiary education and the proportion of workers in a country's tertiary sector) were carried out to measure the extent of their influence on innovation. These framework conditions were employed as control variables for extracting the value of the relevant variables in this study: participation in and provision of CVT, learning, forms of work organisation and, more specifically within the domain of work organisation, autonomy and task complexity.

3.1. Learning-intensive workplaces and innovation indicators

In the OECD study *Innovative workplaces: making better use of skills within organisations* (OECD, 2010a), data on the learning intensity of workplaces and learning-related forms of work organisation are correlated with data on innovation in organisations across the EU. The study refers to empirical work based on a methodology provided by Lorenz and Valeyre (2005). With regard to indicators of workplace learning, the empirical results of the OECD study rely on the 2000 and 2005 editions of the EWCS carried out by Eurofound for the EU-15 and EU-27 respectively (OECD, 2010a). They used 15 binary variables (see Table 3) derived from the 2000 edition of the EWCS. The variables were taken from three scales of the EWCS: cognitive factors, work organisation and work intensity. Regarding the core job dimensions as defined by Hackman and Oldham (1974), the items taken from the cognitive factors scale correspond to task complexity and variety, while the items taken from the work intensity and work organisation scales correspond to autonomy. Table 3 shows the relations to job dimensions and EWCS scales ([8]).

([8]) Lorenz and Valeyre do not refer to the job dimensions (task variety/complexity and autonomy, as proposed by Hackman and Oldham, 1974). These concepts are introduced here because they will be important for our own more detailed analyses based on the work of Lorenz and Valeyre, as described below (Section 3.4).

Table 3 **Variables**

Variable	EWCS scale	Job dimension
Learning new things in work	Cognitive factors	Task complexity/variety
Problem-solving activities	Cognitive factors	Task complexity/variety
Complexity of tasks	Cognitive factors	Task complexity/variety
Discretion in fixing work methods	Work organisation	Autonomy
Discretion in setting work rate	Work organisation	Autonomy
Horizontal constraints on work rate	Work intensity	Autonomy
Hierarchical constraints on work rate	Work intensity	Autonomy
Norm-based constraints on work rate	Work intensity	Autonomy
Automatic constraints on work rate	Work intensity	Autonomy
Team work	Work organisation	Autonomy
Job rotation	Cognitive factors	Task complexity/variety
Quality norms	Cognitive factors	Task complexity/variety
Responsibility for quality control	Cognitive factors	Task complexity/variety
Monotony of tasks	Cognitive factors	Task complexity/variety
Repetitiveness of tasks	Cognitive factors	Task complexity/variety

Source: Authors.

Based on the 15 binary variables, factor and cluster analyses were carried out to identify types of work organisation. These types of work organisation represent different environments for learning opportunities (OECD, 2010a; Lorenz and Valeyre, 2005; Lam, 2005). The four types of work organisation are:

(a) 'discretionary learning', which corresponds to work organisation relying on the expertise of individual professionals and using project structures to temporarily fuse the knowledge of these experts into creative project teams that carry out innovative projects, often on behalf of its clients;

(b) 'lean production' or the 'J-form' organisation, a relatively bureaucratic form that relies on formal team structures and rules of job rotation to embed knowledge within the collective organisation, geared towards incremental innovation;

(c) the hierarchically structured 'taylorist' form, which is characterised by task repetitiveness and task monotony. 'It is a kind of work where the required

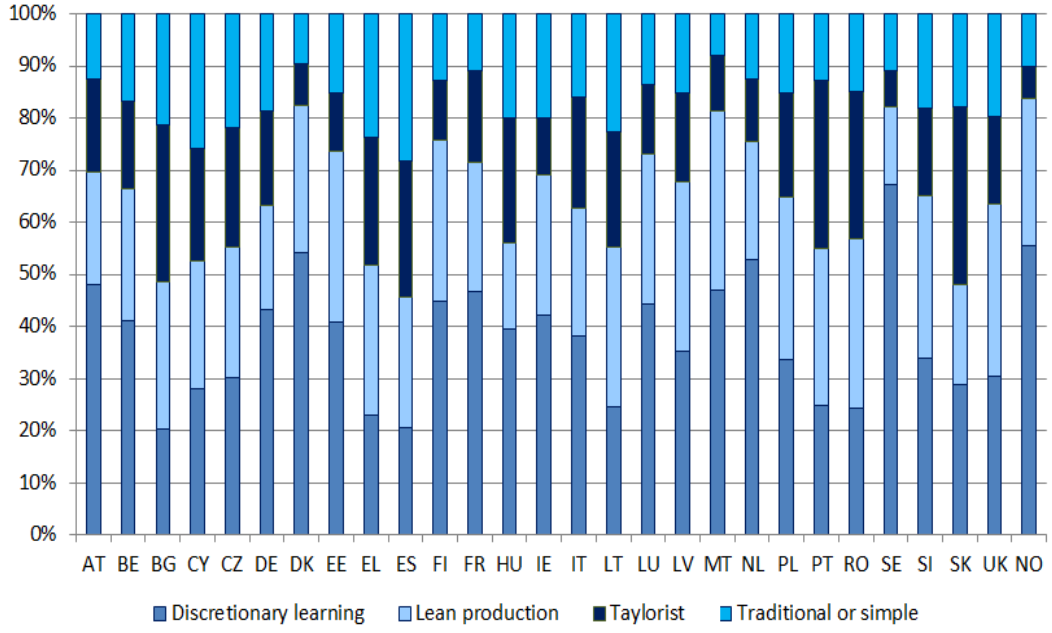
qualifications are limited and the worker can easily be substituted by another worker or by a machine' (Arundel et al., 2007);

(d) the 'traditional' organisation based on a simple management structure which involves less complex problems. 'It is more individualistic than all the other categories and less monotonous than lean production and taylorism' (OECD, 2010a).

The first two forms of work organisation are considered to be more learning-intensive, while the latter two are assumed to be less learning-intensive (OECD, 2010a). For the purpose of this study, the 'discretionary learning' type is later used as the best proxy for workplace learning.

Figure 3 shows that there are marked differences between European countries with regard to these forms of work organisation. A high percentage of employees (over 40%) in discretionary learning environments can be found in Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Luxembourg, Malta, the Netherlands, Norway and Sweden.

Figure 3 **National differences in forms of work organisation for the EU-27 and Norway in 2005: weighted percentage of employees by type of work organisation**



Source: Authors' presentation based on OECD data (OECD, 2010a).

As a next step in the analysis, these types of work organisation were correlated with types of innovative organisation at country level. The OECD built on categories of innovators developed by Arundel and Hollanders (2005) which identify different modes of innovating. The categories of innovators are:

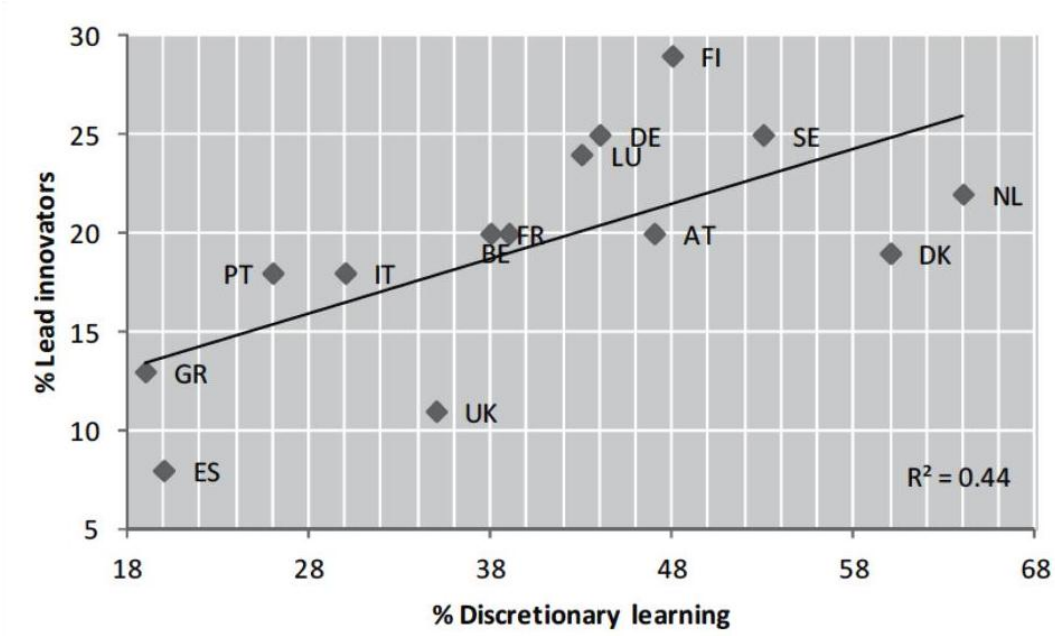
(a) lead innovators: for these firms, creative in-house innovative activities form an important part of the firm's strategy. All firms have introduced at least one product or process innovation developed at least partly in-house, perform R&D at least on an occasional basis and have introduced a new-to-market innovation. These firms are also likely sources of innovations that are later adopted or imitated by other firms;

(b) technology modifiers: these firms primarily innovate by modifying technology developed by other firms or institutions. None of them performs R&D on either an occasional or continuous basis. Many firms that are essentially process innovators that innovate through in-house production engineering will fall within this group;

(c) technology adopters: these firms do not develop innovations in-house, with all innovations acquired from external sources. An example is the purchase of new production machinery (OECD, 2010a);

(d) non-innovators.

Figure 4 **Relation between discretionary learning and percentage of lead innovators**



Source: OECD (2010a).

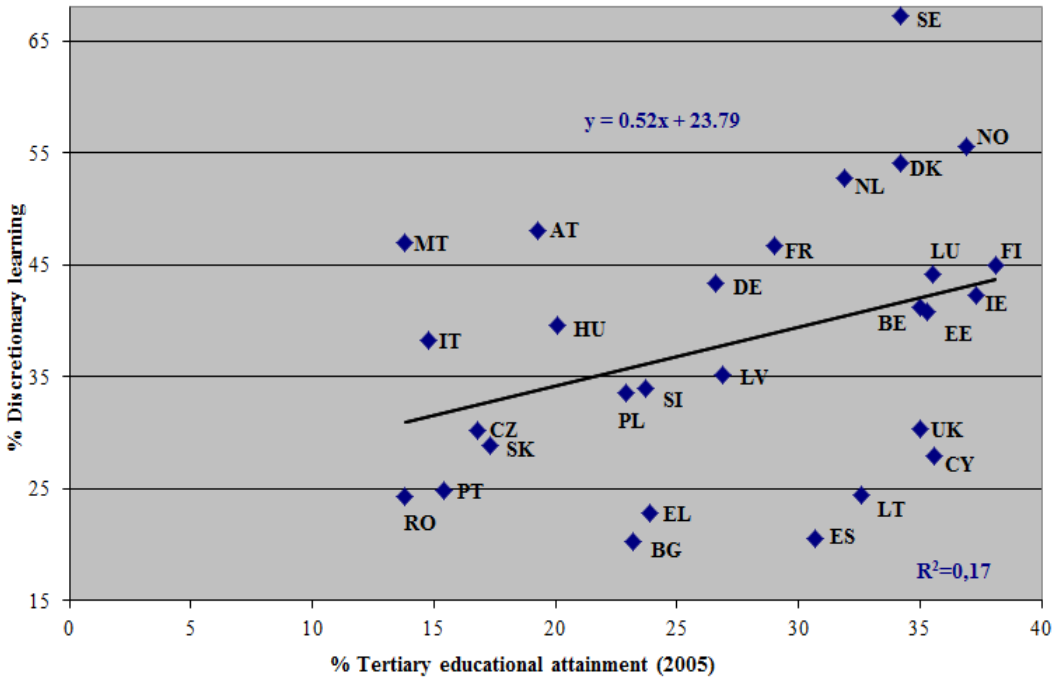
As might be expected from theories on learning and innovation, the percentage of lead innovators is higher for those countries with a high percentage of individuals working in discretionary learning environments (Figure 4). However, it must be taken into account that the data used for the clustering are aggregated data from countries. Accordingly, these analyses are carried out at system level rather than at enterprise level. In consequence, these clusters can be biased by the proportion of enterprises surveyed in a certain sector, the economic structure of countries and regions, and the sectoral focus of businesses as well as the education and training systems. These factors, which are outside the organisational structure of enterprises, influence the analysis; in addition, lead innovator countries are those with the strongest economies (e.g. GDP per capita).

For lean production, the correlation with lead innovators is negative. This is only to be expected, since this form of work organisation is geared more towards incremental process innovation and less towards 'genuine' product innovation (new-to-the-market products), which is typical for lead innovators. In a similar way, the correlation is also negative for the type of innovator referred to as modifiers, a form of work organisation which, similar to lean production, is closely linked to Kaizen-style (continuous improvement process) incremental process innovation (ibid.).

Accordingly, there seems to be a positive correlation between work organisation, workplace learning and innovation. It is important to remember, however, that causal relationships cannot be established based on these correlational analyses. Therefore, regression analyses that seek to identify possible influencing variables, such as GDP per capita of a country, R&D expenditure and proportion of persons with tertiary education, will be described in the following sections.

As a further step of analysis, the OECD study also looks into the relations between education and training, on the one hand, and forms of work organisation on the other. To provide a more recent overview of how these variables relate to one another, the following graphs were replicated for the purpose of our study, using data on the share of tertiary educational attainment in 2005 (Eurostat, 2011) and the share of enterprises providing VET in the same year (CVTS3) (Eurostat, 2006).

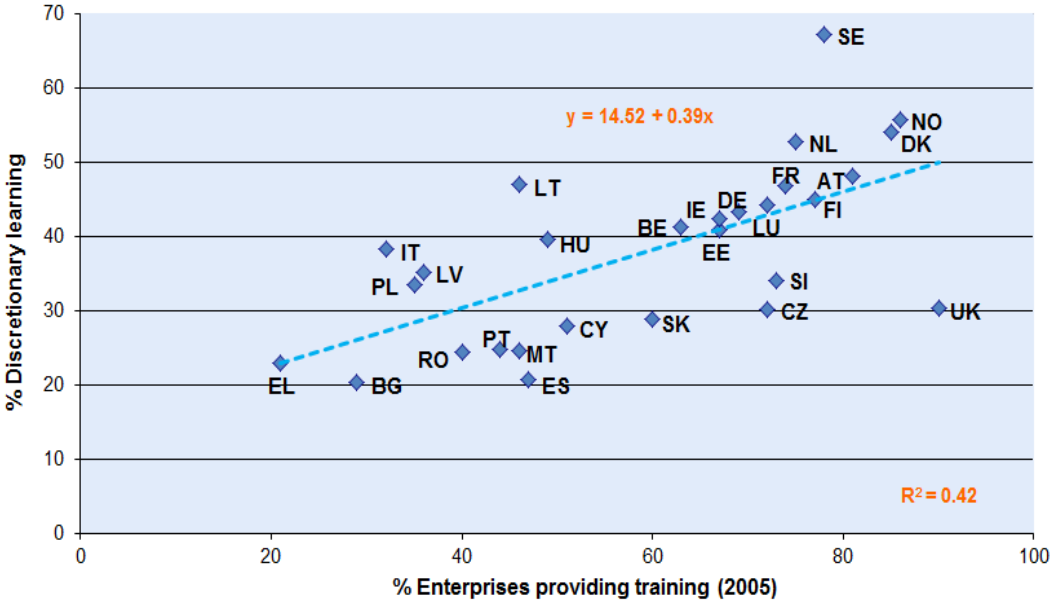
Figure 5 **Relation between tertiary educational attainment and percentage of employees in discretionary learning environments in 2005**



Source: Authors' presentation based on OECD and Eurostat data (OECD, 2010a; Eurostat, 2011).

Figure 5 illustrates that there is a slight correlation between tertiary educational attainment and the discretionary learning type of work organisation, but, interestingly, the correlation between the proportion of enterprises providing CVT for their employees and the discretionary learning type of work organisation is stronger (see Figure 6). This observation is consistent with the one made in the OECD study, where the goodness-of-fit measures of the similar graphs using data from 1999 (share of enterprises providing vocational training) and 2000 (share of tertiary educational attainment) diverged even more. These findings lead to an interpretation that is in line with that of the OECD (OECD, 2010a). It cannot be argued that tertiary education does not play a crucial role in developing more learning-intensive work organisations and innovative capacity; however, given the differences between the indicators of CVT provision and tertiary education, the bottleneck seems to be not at the level of tertiary education but at the level of firm-specific CVT. The OECD supports this further by emphasising that Greece, Italy, Portugal and Spain rank lowest on the discretionary learning scale, although they have made important steps in tertiary education (a considerable increase in the number of science and engineering graduates); all of them stand out, however, because of low levels of investment in CVT (ibid.).

Figure 6 **Relation between percentage of enterprises providing vocational training and percentage of employees in discretionary learning environments in 2005**



Source: Authors' presentation based on OECD and Eurostat data (OECD, 2010a; Eurostat, 2006).

The question as to what extent different learning organisations as well as provision of and participation in training in its different forms – internal and external – affect innovation is important. These issues are addressed in the following subsections.

3.2. VET in enterprises and innovation

In this subchapter, a closer look is taken at the 2006 innovation index (MERIT, 2006) ([9]) and innovation performance by country. These levels are compared with the performance of enterprises' provision of training and employees' participation (Eurostat, 2006; 2011).

([9]) The summary innovation index (SII) was renamed in 2010 as the innovation union scoreboard by the introduction of the EU 2020 strategy and its flagship initiative 'innovation union' in 2010. These indices measure the average innovation performance using a composite indicator based on data for 25 indicators, ranging from a lowest possible performance of 0 to a maximum possible performance of 1. For the purpose of better comparability with the CVTS3 statistics on enterprises' VET provision and participation, values were rescaled to a range between 0 and 100. For methodological information about the calculation of the innovation index, see UNU-MERIT, 2011.

According to the innovation index (MERIT, 2006), the Member States can be classified into four performance groups:

(a) innovation leaders: Denmark, Germany, Finland and Sweden all show a performance well above that of the EU-27;
(b) innovation followers: Belgium, Estonia, Ireland, France, Cyprus, Luxembourg, the Netherlands, Austria, Slovenia and the United Kingdom all show a performance close to the EU-27 average;
(c) moderate innovators: Czech Republic, Spain, Greece, Italy, Hungary, Malta, Poland, Portugal and Slovakia are below the EU-27 average;
(d) modest innovators: Bulgaria, Latvia, Lithuania and Romania, where performance is well below that of the EU-27.

The best-performing countries have common characteristics. For instance, expenditure on business R&D and other innovation indicators related to firm activities is particularly high in most of the innovation leaders' countries (UNU-MERIT, 2011). However, the innovation index does not include rates of (enterprises') provision of training and (employees') participation in training as an indicator for measuring the innovation level of a country.

At this point, it seems important to analyse how innovation leaders and followers perform on the provision of training at enterprise level. The outcomes show that the most innovating countries are the same countries that show the highest rates for enterprises' provision of training (see Figure 7). This confirms the results of the previous subchapter. The provision of training seems to be directly related to innovative performance and therefore plays a crucial role.

Figure 7 also points to a possible divide between countries in southern and eastern Europe and those in central and northern Europe. The first are characterised by both low levels of training provision and low innovation performance, while the latter show relatively high levels of training provision and innovation performance. Interestingly, some of the best-performing countries in innovation (above the EU-27 average) show less growth between 2006 and 2010 than several countries below the EU-27 average. These countries also present a decrease in employers' provision of training between 1999 and 2005 (except for the United Kingdom and Austria). On the other hand, the proportion of enterprises providing training has increased noticeably in southern, central and eastern Europe between these two points in time. Particularly Slovenia, Portugal and Romania saw remarkable improvements in the performance of employers' provision of training and, at the same time, greater innovation growth. This supports the conclusion that training provision plays a crucial role.

Box 1 **Measurement of innovation**

Measurement of innovation

In this study, the innovation ability and performance of countries is measured using the IUS. The 2010 IUS distinguishes between three main types of indicators: the enablers, firm activities and outputs. These indicators include eight innovation dimensions which capture, in total, 25 different indicators (UNO-MERIT, 2010).

The enablers cover the main drivers of innovation performance external to the firm by differentiating between three innovation dimensions:

(e) human resources dimension: the availability of a highly skilled and educated workforce;

(f) new open, excellent and attractive research systems dimension: the international competitiveness of the science base;

(g) finance and support dimension: the availability of funding for innovation projects and the support of governments for R&I activities.

Firm activities record the innovation efforts at firm level by differentiating between three innovation dimensions. This indicator includes the following dimensions:

(h) firm investments dimension: R&D and non-R&D investments that firms make to generate innovations;

(i) linkages and entrepreneurship dimension: entrepreneurial efforts and collaboration efforts among innovating firms and with the public sector;

(j) intellectual assets dimension: various forms of intellectual property rights (IPR) generated as a throughput in the innovation process.

Outputs register the effects of firms' innovation activities through two innovation dimensions:

(k) the innovators dimension: the number of firms that introduced innovations to the market or within their organisations, covering both technological and non-technological innovations and the presence of high-growth firms. The indicator for innovative high-growth firms corresponds to the new EU 2020 headline indicator, which will be completed within the next two years;

(l) the economic effects dimension: the economic success of innovation in employment, exports and sales as a result of innovation activities.

In Chapter 3, the innovation output-related indicator of the IUS 2010 is used as a dependent variable for different statistical regressions to explore the impact of independent variables, such as work organisation, workplace learning, work complexity and autonomy in the workplace, on innovation.

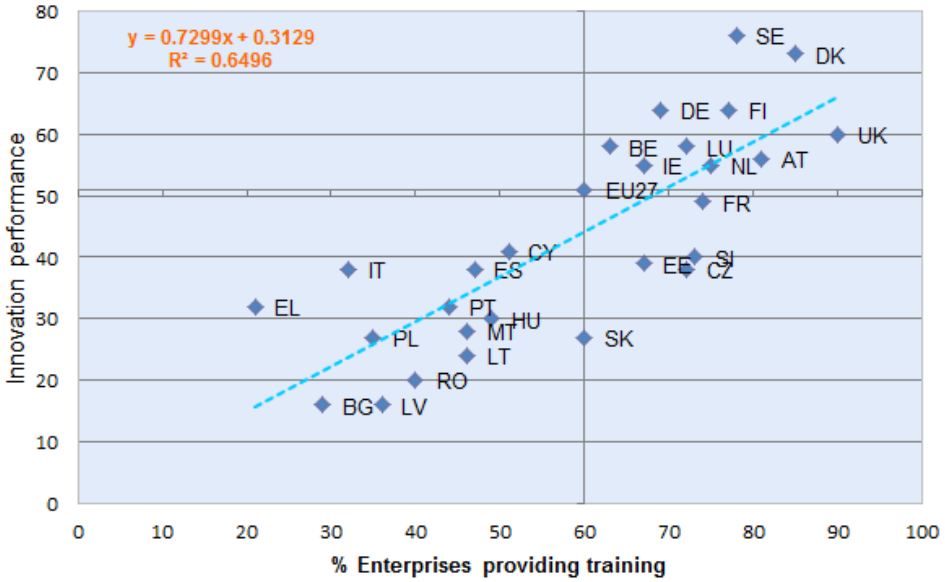
Innovation performance may be influenced not only by the provision of training itself but also by the type of training in which employees participate. The CVTS3 presents separate data on employees' participation rates for:

(a) internal CVT courses: principally designed and managed by the enterprise itself;

(b) external CVT courses: principally designed and managed by a third-party organisation;

(c) any other form of training: on-the-job-training, planned learning through job rotation, exchanges, secondments or study visits, attendance at learning/quality circles, self-directed learning, attendance at conferences, workshops, trade fairs and lectures.

Figure 7 **Relation between training enterprises as a percentage of all enterprises and innovation performance**



Source: CVTS3 (Eurostat, 2011); innovation index 2006 (MERIT, 2006).

Table 4 shows the participation rates for internal CVT, external CVT and any other form of training compared to the innovation indices for all countries. Calculation of the correlations between the various participation rates and the innovation index makes it possible to draw first conclusions on the relevance of each training type for innovation performance. Whereas participation in external CVT and the innovation index has a rather small positive correlation (0.28), the one for internal CVT (0.49) and any other kind of CVT (0.68) is clearly higher. This might be explained by the characteristics of the various kinds of training. The fact that participation in external training correlates the least with innovation performance might be because external training is not necessarily firm-specific and might not, therefore, directly contribute to the innovation performance of an enterprise, i.e. it might, for example, have less influence on innovation during the work process. In line with this argument, the reason why 'any other forms of training' correlates most strongly with the innovation index might be explained by the fact that it includes, to a large extent, learning at the workplace and is, therefore, more firm-specific. Accordingly, it may have a stronger influence on innovation.

The impact of training varies not only depending on the type and content of the training, or the number of hours, but also on the extent to which employees may apply the KSCs acquired at the workplace. Accordingly, enterprises should not only provide training and other activities that are job-related but also create,

implement and adapt programmes that lead them to use the KSC acquired by employees in-house and outside the enterprise.

Table 4 **Summary innovation index 2006 and type of training and innovation index 2005 (CVTS3)**

	Type of training and innovation index			
Country	Summary innovation index 2006	Internal CVT 2005	External CVT 2005	Any other form of training 2005
SE	0.76	0.62	0.93	0.60
DK	0.73	0.64	0.96	0.61
DE	0.64	0.72	0.90	0.66
FI	0.64	0.43	0.94	0.56
UK	0.60	0.67	0.81	0.86
BE	0.58	0.62	0.87	0.55
LU	0.58	0.63	0.87	0.64
AT	0.56	0.43	0.96	0.71
IE	0.55	0.66	0.87	0.59
NL	0.55	0.36	0.95	0.52
FR	0.49	0.44	0.92	0.44
NO	0.43	0.66	0.79	0.79
CY	0.41	0.31	0.94	0.27
SI	0.40	0.51	0.95	0.60
EE	0.39	0.40	0.94	0.50
IT	0.38	0.48	0.86	0.20
CZ	0.38	0.66	0.80	0.59
ES	0.38	0.44	0.88	0.38
EL	0.32	0.38	0.82	0.13
PT	0.32	0.50	0.82	0.36
HU	0.30	0.39	0.94	0.41
MT	0.28	0.63	0.82	0.43
PL	0.27	0.43	0.95	0.27
SK	0.27	0.37	0.88	0.49
LT	0.24	0.34	0.95	0.42
RO	0.20	0.49	0.74	0.33
LV	0.16	0.22	0.97	0.27
BG	0.16	0.58	0.80	0.24
Correlation between type of training and innovation index		0.49	0.28	0.68

Source: MERIT, 2006; Eurostat, 2006.

3.3. Clustering countries based on data regarding organisation, learning and innovation

So far, the analyses have shown the relevance of discretionary learning as a form of work organisation that promotes learning in enterprises. They have also dealt with the relationship between training and innovation performance and shown that 'other forms of learning in enterprises' in particular seem to play an important role. To provide a comprehensive overview of European countries regarding the three dimensions of key interest – learning-oriented work organisation, learning and innovation – and thereby to prepare a framework for the analysis of policies and practices across European countries, a partition cluster analysis (k-means clustering) was performed to cluster the 28 European countries into groups with comparable scores. The following variables (as described in more detail in Section 3.4) were used:

(a) the learning-orientation of work organisation,
(b) the other forms of learning in enterprises index, and
(c) the innovation index.

A consistent and highly interpretable solution was found for five clusters (see Table 5). The five clusters show the following characteristics:

(a) the cluster called 'high' scores high in all three dimensions: very learning-intensive forms of work organisation go along with high prevalence of other forms of learning and high innovation performance;
(b) the cluster called 'solid' has similar scores, with only moderate values for other forms of learning and moderate to high scores for innovation;
(c) the first of the 'intermediate' clusters – called 'moderate 1': high learning, moderate innovation – combines high values for work organisation and medium values for other forms of learning with moderate innovation performance;
(d) the second of the 'intermediate' clusters – called 'moderate 2': low learning, moderate innovation – shows very similar innovation performance as compared to moderate 1, but here combined with much lower scores for work organisation and learning;
(e) finally, the cluster 'low' scores low on all variables.

The data basis for the cluster analysis can be found in Annex 4. This cluster structure was used as a reference framework for the qualitative data analyses regarding publicly funded R&D&I programmes within this study. The CATIs with programme managers within the cross-European survey (see Section 4.5) as well as the case studies of specific programmes (see Annex 6) were selected so as to represent these five clusters adequately. The programme portfolio analyses also refer to this cluster structure (see Section 4.4).

Table 5 **Cluster solution for five clusters with cluster centres for the respective variables in brackets**

High	Solid	Moderate 1: high learning, moderate innovation	Moderate 2: low learning, moderate innovation	Low
Work organisation high (0.680) Other forms of learning high (0.132) Innovation high (0.729)	Work organisation high (0.659) Other forms of learning moderate (0.072) Innovation moderate to high (0.591)	Work organisation high (0.700) Other forms of learning moderate (0.074) Innovation moderate (0.413)	Work organisation low (0.585) Other forms of learning low (0.042) Innovation moderate (0.461)	Work organisation low (0.580) Other forms of learning low (0.048) Innovation low (0.187)
Denmark	Belgium	Estonia	Czech Republic	Bulgaria
Germany	Luxembourg	Malta	Ireland	Latvia
Sweden	Netherlands	Norway	Greece	Lithuania
	Austria		Spain	Hungary
	Finland		France	Poland
			Italy	Romania
			Cyprus	Slovakia
			Portugal	
			Slovenia	
			United Kingdom	

Source: Authors.

3.4. Regression analyses

In this chapter, further analysis is carried out of the significance of training for innovation performance in which other influencing factors, such as the level of education, R&D expenditure and the number of workers in tertiary sector

activities, are controlled for. To analyse the relation between individual learning and innovation performance at country level, the following data are used ([10]):

(a) indicators of innovation (performance), based on data extracted from the 2010 IUS (UNU-MERIT, 2011);
(b) different forms of work organisation of enterprises (OECD, 2010a);
(c) work organisation at the level of autonomy in the workplace and cognitive factors such as the degree of task complexity (Eurofound, 2011);
(d) workplace learning and participation in CVT (CVTS, 2005);
(e) framework conditions such as GDP per capita (in 2010), R&D expenditure (in 2009), level of education (labour force survey (LFS), 2009) (Eurostat, 2011).

The analyses in the previous chapter showed that there are differences in innovation performance, organisational structures in enterprises, work organisation (in the sense of the level of autonomy and monotony of tasks), complexity of work and participation in VET among the various European countries. With reference to work organisation types, Section 3.1 introduced 15 variables used by Lorenz and Valeyre (2005) in their study. These variables are now used in the regression analyses. We use more recent data (Eurofound, 2010) and exclude the teamwork measure (level of group autonomy). Further, we differentiate between two aspects of work organisation: task-complexity aspects (cognitive factors) and autonomy-related aspects (work organisation). Table 3 sets out the allocation of the work organisation types used by Lorenz and Valeyre to these two aspects of work organisation. The variables are shown in Table 6 and explained in greater detail in Annex 2. Six of the regression variables are indices which summarise data on multiple underlying components.

([10]) The variables used for the analysis are taken from the latest possible source. The difference with regard to the reference years is not considered to be problematic (see Annex 2).

Table 6 **Statistical data used for analysis ([11])**

	Variable name	Source and index composition
Innovation performance	Innovation index (2010)	IUS, MERIT, UNU-MERIT; index composition: data from throughput and output parameters of the IUS (see Annex 2)
Forms of work organisation	Discretionary learning (2005)	OECD
	Lean production (2005)	OECD
	Taylorist (2005)	OECD
	Traditional or simple (2005)	OECD
Work organisation	Work organisation index (2010)	Own calculations using EWCS data; index composition: data from eight EWCS questions on autonomy-related aspects of work organisation (see Annex 2)
Cognitive factors	Cognitive factors index (all years ([12]))	Own calculations using EWCS data; index composition: data from five EWCS questions on task-complexity aspects of work organisation (see Annex 2)
Participation and provision of CVT	Other forms of learning in enterprises index (2005)	Own calculations based on CVTS data; index composition: data on 'other forms of training in enterprises' (CVT in work situation; job rotation, exchanges or secondments; learning/quality circles; self-learning) (see Annex 2)
	Employee participation in CVT courses (2005)	CVTS
	Costs of CVT as % of total labour cost (2005)	CVTS
	Participation in AL (2009)	LFS
	HR index (2009)	Own calculations using European company survey (ECS) data; index composition: data from seven questions measuring HR practices and work organisation (see Annex 2)
	Share of training enterprises as % of total (2005)	CVTS
Framework variables	Workers in tertiary sector (2010)	LFS
	Labour productivity per hour (2009)	Eurostat

([11]) Further data and explanations can be found in Annex 2.

([12]) 'All years' refers here to the time frame 1995-2010 (data measured in the five-year intervals 1995, 2000, 2005 and 2010).

	Share of tertiary education (2005)	Eurostat
	GDP per capita (2010)	Eurostat
	R&D/GDP (2009)	Eurostat/OECD

Source: Authors.

Table 7 shows the average values from the most relevant variables on work organisation, learning and innovation performance for each country. Countries with high rates of discretionary learning introduced in Section 3.1 (such as the Nordic countries highlighted in blue) also demonstrate high values for work organisation, cognitive factors, learning, workers in the tertiary sector and the share of population with tertiary education and, therefore, innovation. Table 7 shows that, although there are some differences in the positions of a country within different variables, mostly the same countries are above the European average, particularly the Nordic countries Denmark, Finland, Norway and Sweden. However, Norway also ranks below average with regard to three variables: cognitive factors, innovation and innovation output. This may serve as a first indication of the importance of cognitive factors for the innovation performance of a country.

3.4.1. Interpretation of bivariate and multivariate estimation results

The following analysis investigates the assumptions introduced in Section 1.2 and seeks to explore the extent to which differences in forms of work organisation, autonomy-related and task-complexity-related aspects (cognitive factors), workplace learning and indicators of participation in and provision of CVT in the EU and Norway affect innovation performance. To investigate the strength of linear relationships between these variables, bivariate estimates are used. In addition, given the strong (likelihood of) endogeneity and spurious correlations in bivariate regression results, multivariate regression results are also used.

Table 7 **List of values for variables on work organisation, learning and innovation of the EU-27 and Norway**

Discretionary learning	
SE	0.67
NO	0.56
DK	0.54
NL	0.53
AT	0.48
MT	0.47
FR	0.47
FI	0.45
LU	0.44
DE	0.43
IE	0.42
BE	0.41
EE	0.41
HU	0.40
IT	0.38
Average	0.38
LV	0.35
SI	0.34
PL	0.34
UK	0.30
CZ	0.30
SK	0.29
CY	0.28
PT	0.25
LT	0.25
RO	0.24
EL	0.23
ES	0.21
BG	0.20

Work organisation	
FI	0.67
DK	0.66
NO	0.64
MT	0.64
NL	0.62
EE	0.62
LV	0.60
SE	0.60
IE	0.57
UK	0.56
SI	0.56
LU	0.55
Average	0.55
PL	0.54
BE	0.54
RO	0.53
HU	0.53
EL	0.53
IT	0.53
CZ	0.52
LT	0.51
AT	0.51
ES	0.51
FR	0.50
PT	0.50
CY	0.50
DE	0.49
BG	0.47
SK	0.44

Cognitive factors	
SE	0.80
DK	0.80
AT	0.78
NL	0.77
FI	0.74
DE	0.73
LU	0.72
BE	0.71
FR	0.69
UK	0.68
IE	0.68
IT	0.66
PT	0.62
Average	0.62
ES	0.60
EL	0.59
EE	0.57
MT	0.57
SI	0.56
CZ	0.55
LV	0.54
PL	0.53
HU	0.53
SK	0.51
RO	0.50
NO	0.48
LT	0.47
CY	0.47
BG	0.4646

Other forms of learning in enterprises	
DK	0.12
DE	0.11
CZ	0.11
SE	0.10
NO	0.10
BE	0.09
LU	0.09
ES	0.08
SI	0.08
MT	0.07
EE	0.06
SK	0.06
Average	0.06
FI	0.06
NL	0.05
RO	0.05
LT	0.05
HU	0.05
AT	0.05
PL	0.05
BG	0.04
IT	0.04
PT	0.03
CY	0.03
FR	0.03
LV	0.03
EL	0.02
UK	
IE	

Innovation	
DE	0.76
DK	0.74
SE	0.68
FI	0.64
BE	0.61
AT	0.60
LU	0.60
CY	0.54
UK	0.53
NL	0.51
IE	0.51
FR	0.47
EE	0.46
SI	0.46
PT	0.46
IT	0.45
Average	0.44
CZ	0.43
EL	0.42
NO	0.39
MT	0.39
ES	0.34
HU	0.27
SK	0.23
PL	0.19
RO	0.18
BG	0.16
LT	0.15
LV	0.14

Innovation output	
DE	0.39
LU	0.35
IE	0.32
FR	0.30
DK	0.30
CY	0.30
CZ	0.30
BE	0.29
UK	0.29
ES	0.28
SE	0.28
AT	0.27
FI	0.27
IT	0.27
MT	0.27
SI	0.26
PT	0.26
Average	0.26
EE	0.25
HU	0.23
NL	0.23
RO	0.23
SK	0.22
EL	0.22
NO	0.21
PL	0.20
LV	0.16
BG	0.15
LT	0.15

Workers in tertiary sector	
FI	0.42
IE	0.42
BE	0.41
LU	0.39
CY	0.39
UK	0.38
EE	0.37
LT	0.37
DK	0.36
SE	0.36
NL	0.35
ES	0.35
NO	0.34
FR	0.33
Average	0.30
LV	0.30
DE	0.29
EL	0.28
SI	0.28
PL	0.28
BG	0.27
HU	0.23
AT	0.22
SK	0.19
MT	0.19
CZ	0.18
IT	0.18
PT	0.17
RO	0.17

Source: Authors.

Multivariate estimations allow us to separate the effect of a particular independent variable on innovation, while seeking to identify other factors which could also play an important role in explaining innovation performance. Framework conditions, such as the GDP of a country, the share of investment in R&D, the share of population with a tertiary education level and the number of employees working in the tertiary sector (services) also help explain national differences in innovation performance. It should be noted that we use employees working in the tertiary sector as a control variable for differences in the structure of the economy ([13]). Further, cognitive factors may also be viewed as an (or as a

([13]) A breakdown of GDP by sector was considered but rejected, as data were either unavailable or too detailed to be suitable for a country-level comparison.

proxy for an) indicator of the structure of the economy in the sense that countries with a higher share of low-skilled labour and/or at a lower stage of technological development are likely to have lower than average levels of work complexity. This shows that, in addition to framework conditions, our main aspects of interest may also be included as control variables in multivariate regressions.

Given the small number of observations in our sample (28), only a limited number of control variables may be used, and this implies that these must be selected carefully. In addition to constraining the analysis and increasing the likelihood of endogeneity, this small number of observations implies that results are likely to change considerably when some observations are removed. The wide differences between European countries as shown earlier lend further support to this assumption. That being the case, bivariate as well as multivariate estimation results must be interpreted with care, however robust they may appear.

As enterprise-level data are not readily available for almost all indicators, we have to rely on country-level performance data. The underlying assumption is that figures relating to country-level data are also valid for enterprises, which are the core entity when it comes to workplace learning and innovation. The method of ordinary least squares (OLS) is used in our regression analyses. The estimation results illustrated in all tables are sorted by their respective independent variable and in descending order based on their goodness-of-fit measure (R^2). This provides a clear overview of the strength of correlations between one or multiple variables, whereby the relationship with the strongest correlation in each variable group is always shown first.

3.4.2. Framework conditions

Table 8 presents the correlation coefficients obtained in the bivariate regressions including framework condition variables.

We observe a very high and significant correlation between R&D/GDP and the innovation index (2010) – the highest of all framework conditions analysed. This correlation is lower and less significant when the innovation output index (UNU-MERIT, 2011) is used. This suggests that, while a large part of the positive correlation between R&D/GDP and innovation appears to reflect the correlation of R&D/GDP with output-related innovation, firms in European countries with higher R&D expenditure in relation to their GDP devote more time and effort to innovation activities.

Table 8 **Estimations of framework conditions**

Bivariate estimation results		
Dependent	**Independent**	**Correlation coefficient**
Innovation index (2010) ([14])	R&D/GDP (2009)	0.81***
Innovation index (2010)	Labour productivity per hour (2009)	0.66***
Innovation index (2010)	GDP per capita (2010)	0.61***
Innovation index (2010)	Share of tertiary education (2005)	0.49*
Innovation index (2010)	Workers in tertiary sector (2010)	0.40*
Innovation output index (2010)	GDP per capita (2010)	0.63***
Innovation output index (2010)	R&D/GDP (2009)	0.52**

*p < 0.05 (significant).
**p < 0.01 (highly significant).
***p < 0.001 (extremely significant).

Source: Authors.

Estimation results that include GDP per capita as an independent variable might indicate whether economic power affects innovation performance in the countries studied. However, one has to be aware that the effect may act in either of the two possible directions: economic power could have a positive effect on innovation performance, but innovation performance could also have a positive effect on economic power. Generally speaking, the link between GDP per capita and innovative performance is interesting to explore because it represents an output variable rather than an input variable such as R&D/GDP. Regression results confirm the strong output relation of GDP per capita, as the correlation between GDP per capita, overall and output-related innovation is very similar. In general, the correlation between economic power and innovation performance seems to be high and significant.

The correlation between the share of labour productivity per hour and innovation performance also appears to be high and significant. As expected, the analysis shows a positive correlation between the share of tertiary education and innovation performance. The association between workers in the tertiary sector and innovation performance is also positive, although it is the weakest among the indicators listed above. A possible explanation is that the service sector might not contribute as strongly to the innovation performance of European economies as

([14]) As stated above, both innovation performance indicators exclude enabler indicators such as the share of tertiary education in their calculation, so that regressions which include these variables have unbiased coefficients in this respect.

other sectors, such as industry. Generally speaking, the service sector is very broad, and a more differentiated analysis would provide a clearer picture.

All in all, the observations of this subsection have shown that important links exist between many framework conditions and innovation performance. This implies that it is important to seek to identify these framework conditions.

3.4.3. Innovation factors

To determine which are the most important innovation drivers, those consisting of multiple variables (the variable groups work-organisation forms and participation in and provision of learning) are collapsed into factors (see Annex 2). The factor analysis serves as a tool to test whether the variables grouped together truly represent a homogenous construct or not, i.e. whether each one contributes in the same direction to innovation performance. If we include factors in a multivariate regression equation together with other aspects of interests in single variable form, we are able to infer which of the aspects contribute(s) most to innovation performance while using a much smaller number of variables. Moreover, given the rather small sample size of 28 countries, endogeneity is further limited by using factors instead of the single variables.

Prior to running the final multivariate regression analysis, variables insignificantly correlated with innovation performance (lean production and work organisation, as portrayed by the bivariate estimation results in Annex 2) were excluded from the analysis. Although insignificantly correlated with innovation performance, the work-organisation form variable, traditional or simple was excluded from the analysis, as it showed strong and significant correlations with many other variables connected with innovation performance, including discretionary learning and taylorist forms of work organisation. Cyprus was excluded from the analysis, as this small country represents a clear outlier in the multivariate model tested. Table 9 shows that all work-organisation forms included in the analysis collapse into one factor which explains 80.79% of the variance ([15]).

Factor 1 (work organisation) includes discretionary learning, taylorist and traditional work organisation type. Given the majority of variables linked either negatively or not at all to innovation (taylorist (2005), traditional (2005)), this factor mainly represents work organisation forms which do not promote

([15]) As well as not correlating with innovation performance, lean production (2005) did not correlate with any of the other variables used in the analysis and, hence, also failed to load on Factor 1.

innovation ([16]). This explains why the traditional and taylorist work organisation types have positive loadings (correlate strongest among the three underlying variables) and discretionary learning has a negative loading (correlates negatively with the other two variables). Overall, all the variables have high loadings.

Table 9 **Factor 1. Work organisation**

Work organisation	Components (factor loadings)
	1
Discretionary learning (2005)	-0.959
Taylorist (2005)	0.892
Traditional (2005)	0.842

Source: Authors.

As demonstrated, all variables representing participation in and provision of learning can be collapsed into one factor explaining 66.59% of the variance.

Factor 2 (human capital formation) includes training enterprises, employee participation in CVT courses, firms' investment in CVT, participation in AL, any other forms of learning in enterprises and human resource practices.

Table 10 **Factor 2. Human capital formation**

Human capital formation	Components (factor loadings)
	1
Participation in AL (2009)	0.799
Share of training enterprises as % of total (2005)	0.916
Employee participation in CVT courses (2005)	0.848
Other forms of learning in enterprises index (2005)	0.764
HR index (2009)	0.735
Costs of CVT as % of total labour cost (2005)	0.821

Source: Authors.

3.4.4. Multivariate regression analysis including factors

In the next step, a multivariate regression with respect to innovation performance is carried out. In addition to the two factors introduced in Section 3.4.3, task-

([16]) See bivariate estimation results in Annex 2.

complexity aspects of work organisation (cognitive factors), GDP per capita and the share of tertiary education are included as independent variables. If we include the share of tertiary education as a single variable rather than group the framework conditions into one factor, we are able to compare whether tertiary education contributes more to innovation performance than our aspects of interest. We are also able to assess whether the focus of the IUS on tertiary education (rather than human capital formation) is supported by our data. Estimation results do not change if both framework conditions are collapsed into one factor or if R&D/GDP (2009) is substituted for GDP per capita (2010) and outliers are removed. The rationale for using the factors and the composition of the two factors are explained in Section 3.4.3.

Table 11 **Multivariate regression analysis including all innovation factors**

Dependent	Independent	Beta coefficient	R^2
Innovation index (2010)	Factor 1 (work organisation)	0.11	0.84
	Factor 2 (human capital formation)	0.27*	
	GDP per capita (2010)	0.03	
	Cognitive factors (all years)	0.78***	
	Share of tertiary education (2005)	-0.004	

*p < 0.05 (significant).
**p < 0.01 (highly significant).
***p < 0.001 (extremely significant).

Source: Authors.

The estimation results suggest that task-complexity aspects of work organisation and human capital formation contribute to innovation performance. In our analyses, task-complexity aspects of work organisation seem to be the most crucial factor for innovation performance. The very significant effect of this variable on innovation performance observed in the analyses in Annex 2 holds even after controlling for various other variables strongly linked to innovation. Despite the fact that the other aspects of interest (work organisation, GDP per capita and the share of tertiary education) show significant correlations with innovation performance in bivariate analysis, their effects are insignificant in the multivariate model tested. Interestingly, the data used for the analysis suggest that tertiary education seems not to contribute significantly to innovation performance. These results (and those of Annex 2) highlight that focusing on

tertiary education in the IUS might restrict the role of education and training with regard to innovation. CVT in companies, including workplace learning, seems to be an important factor that is sometimes neglected. Accordingly, as discussed in more detail in Annex 2, a recommendation is to carry out further research into these aspects (also concerning possible reasons why such indicators are not included, e.g. data availability, reliability, etc.), to include overarching CVT-indicators in the IUS and to use the potential that CVT, including workplace learning, has to offer when it comes to fostering innovation.

The results of this study confirm assumption (c)(i) (see Section 1.2), demonstrating that task-complexity aspects of work organisation have a positive effect on innovation. They show that task complexity seems to be an important driver of innovation. Further, assumption (d)(i) (see Section 1.2, positive link between provision of and participation in learning and innovation) proves to be sound: company provision of and employee participation in learning and CVT seem to contribute significantly to innovation performance. This is suggested both by the results of the multivariate model tested in this section (significance of the human capital formation factor) and the results of Annex 2. Two of the variables which mostly influence the human capital formation factor (share of training enterprises, costs of CVT to firms) are linked to training provision in companies (see Table 10). In addition, employees' participation in CVT has the second-highest loading. This supports the assumption that CVT is an important driver for innovation.

The 'other forms of learning in enterprises index (2005)' loads positively onto the human capital formation factor but, of all underlying variables, contributes the least to an explanation of this significant indicator. Further, the data analyses portrayed in Annex 2 are unable to find any relationship between the single variable 'other forms of learning in enterprises' and innovation performance, despite a positive and significant correlation ([17]). It must be taken into account that the 'other forms of learning in enterprises index' used in this analysis covers only very specific, intermittent incidents of learning at or near the workplace, such as quality circles or self-organised learning. Many important aspects of workplace learning referring to workplace learning-intensity factors are much better accounted for by the task-complexity aspects of work organisation (cognitive factors). If we accept these cognitive factors as a proxy of informal work-inherent learning ('learning while working'), then assumption (d)(ii) (see Section 1.2, positive link between informal workplace learning and innovation) may also be regarded as supported by the findings.

([17]) Checks confirmed that this was not driven by outliers.

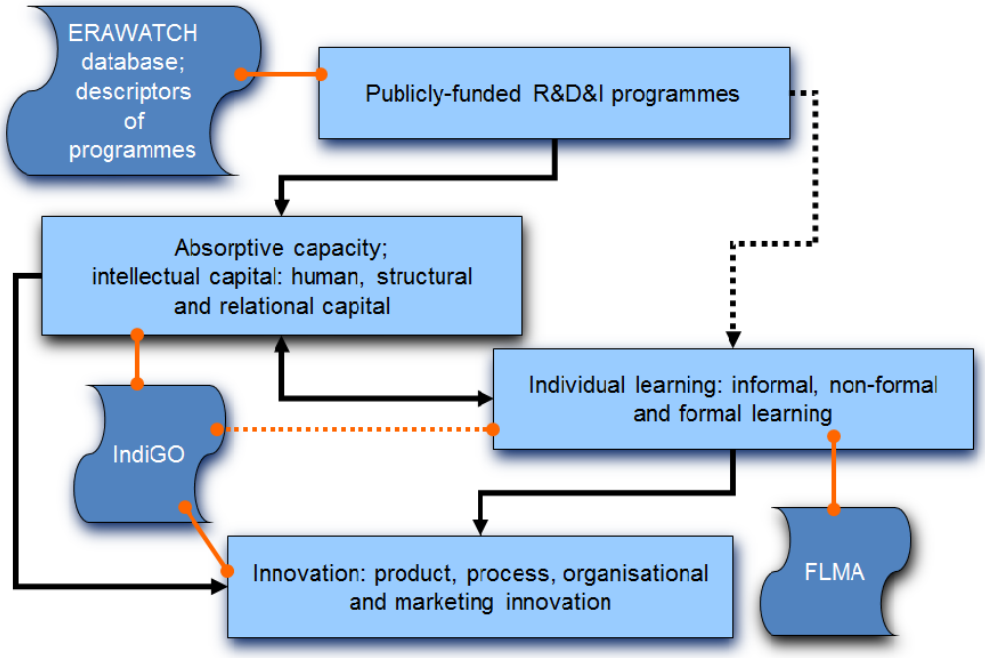
CHAPTER 4.

Qualitative data analysis: effects of publicly funded programmes on innovative ability

4.1. Methodological considerations in the qualitative analyses

This study investigates the relationships between publicly funded R&D&I programmes, absorptive capacity of organisations, learning and innovation. The following figure shows the basic relationships among these phenomena which are relevant for this study.

Figure 8 **Basic structure of phenomena and instruments**



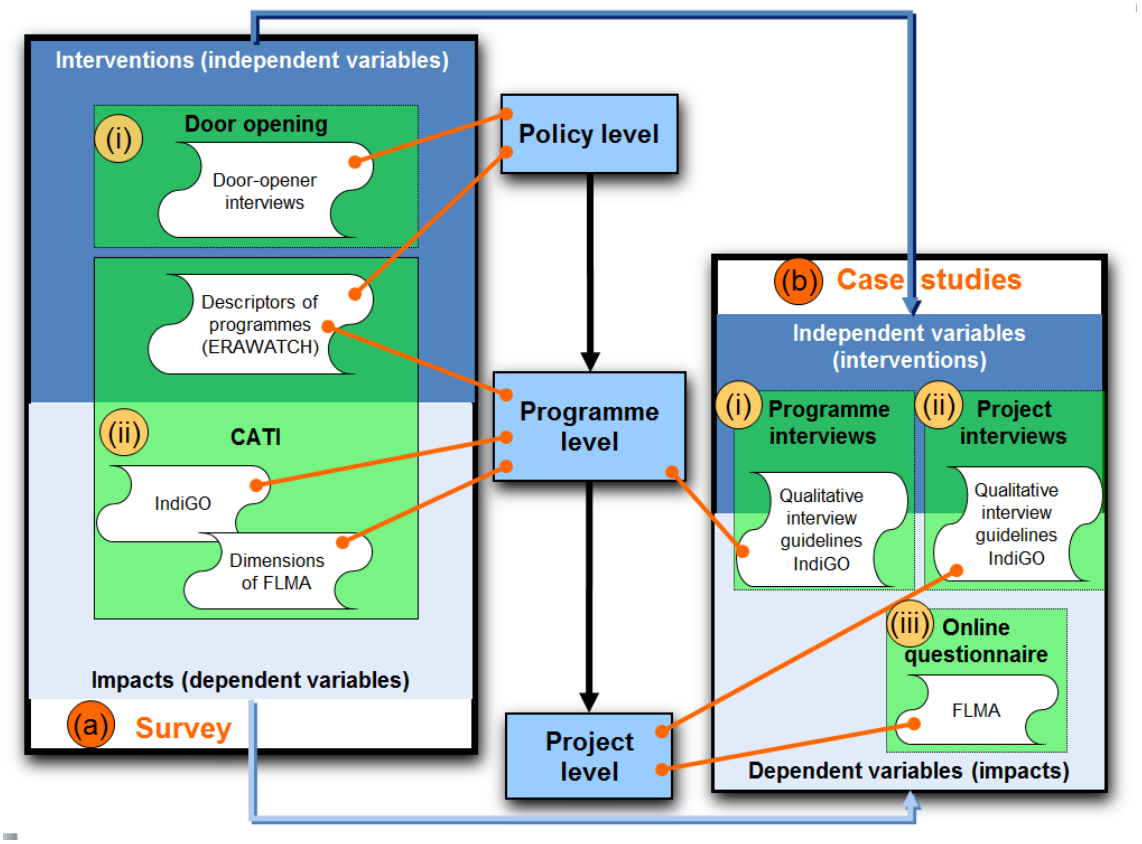
Source: Authors.

The methodology is based on the assumption of the following chain of effects: policies constitute a sort of framework for the design of publicly funded R&D&I programmes. These programmes usually consist of a number of projects. Each project is assumed to influence organisations' absorptive capacity as well as individual learning – either explicitly or implicitly. Effects on absorptive capacity

and individual learning are understood to exert influence on innovative ability and innovation performance.

The effects of publicly funded programmes on absorptive capacity may be achieved by organisational changes stimulated by the programme or by related technological developments. Where these changes at the level of the organisation as a whole also modulate individual learning opportunities (by creating more learning-intensive forms of work organisation), this leads to informal learning in the workplace. Additionally, non-formal or formal learning programmes might also be set up at organisational level to cope with changes. Further, publicly funded programmes might directly address learning at individual level. Finally, the organisational and individual learning processes could foster actual innovations. Figure 8 also refers to specific tools (FLMA and IndiGO) for analysing the respective phenomena. Figure 9 describes in greater detail the methodological approach applied in the study and shows that it consists of two interrelated parts: a survey and case studies.

Figure 9 **Methodological approach**



Source: Authors.

4.1.1. Survey

During the initial survey phase, two different kinds of interviews were conducted:

(a) 'door-opening' interviews: experts at innovation agencies and other contact points across Europe (see list of contact points, Annex 3) were interviewed to identify relevant programmes and the respective programme managers or other relevant persons to be interviewed in depth. Background information was gathered on national policies (innovation, R&D, education and training) and innovation systems. The guideline for the semi-structured interviews consisted of the following parts:

  (i) general information on purpose, contracting authority and background of the study;

  (ii) questions to identify suitable interview partners for main interviews;

  (iii) questions regarding the policy background in the country and programmes affecting organisational and individual learning and innovation;

  (iv) general remarks and background information.

  Additional information on relevant programmes was drawn from ERAWATCH and INNO Policy TrendChart ([18]) country reports and profiles.

(b) CATIs: based on the results of the door-opening interviews and desk research, programme data were gathered by conducting 52 CATI-interviews (see Annex 3) with programme managers, programme directors and other relevant persons ([19]). The CATI survey was validated through various test interviews ([20]). The CATIs consisted of three parts:

  (i) assessment of programme information: basic descriptors of the programme, at policy as well as at programme level (budget, objectives, duration, target groups, etc.);

  (ii) assessment of expected and actual effects of the programme on the different dimensions of absorptive capacity/innovative ability, using an

([18]) While the focus of ERAWATCH is on research policies and programmes at European, national and regional level, the INNO Policy TrendChart mainly provides information on major innovation policy trends at national and regional levels across Europe.

([19]) The survey of programmes was conducted as CATI, implemented in IBM® SPSS® DATA COLLECTION. There are several advantages to using computer-assisted surveys: for example, the interviewer reads out the questions and enters the data, transferring them directly into the analysis software so that there is no loss of information; moreover, the sequence of the questions, the filter questions and any missing or incorrect responses are automatically recorded.

([20]) On the basis of the feedback from the respondents and interviewer, the sequence of questions and filter questions were modified.

adapted version of the IndiGO (the IndiGO is the core part of the questionnaire). The IndiGO is a questionnaire that focuses on aspects of human, structural and relational capital (see Table 1) and, specifically, the intended and actually achieved effects of (publicly funded) programmes on these aspects of human, structural and relational capital. Within the scope of this study, expected effects could be retrieved only ex post, i.e. after programmes and projects had started. While an ex-ante survey analysing the expectations would not have been feasible, the chosen approach poses the potential problem that interviewees may retrospectively adjust their expectations to actually observed outcomes according to desirability. Therefore, the questionnaire was structured so as not to ask about the expected and actual effects in strict sequence, but to ask first about the expected effects of all aspects and then about all actual effects. The results show that actual effects often lag behind expectations; this indicates that expectations were not retrospectively adjusted;

(iii) assessment of effects on workplace characteristics relevant for learning, using an adapted version of the FLMA, which is an instrument to capture characteristics of workplaces that are relevant for informal learning at the workplace. For the purpose of this study, the FLMA core dimensions of autonomy and task completeness, task and skill variety, and transparency were used.

4.1.2. Case studies

In the selection of the 10 case studies, particular care was taken to ensure that not only the country clusters but also the relevant types of programmes were covered. The case studies are characterised by a more qualitative, descriptive and evaluative methodology and take account of two levels: cases studies of programmes and case studies of projects within the programmes.

The analysis is based on CATI interviews with programme and project managers. Further, at project level, the full (online) FLMA questionnaire was used in two ways to identify effects related to learning at the workplace at individual level: employees' own perception of the situation at the beginning of the project (assessed retrospectively) and currently, and managers' perception of their employees' situation at the beginning of the project (assessed retrospectively) and currently. Its use, however, was dependent on the support received from the programme and project managers. By including the project and the enterprise level, we were able to investigate the connections between innovation and skills development at the level where they actually occur.

In the survey phase of this study, it was difficult to identify, make contact with and secure the commitment of programme and project managers, especially in countries outside northern and western Europe. There are several possible explanations for this observation. Language barriers might be to blame, although communication problems persisted in some countries where respondents were interviewed by native speakers. Terminological problems might also have played a role, since most of the interviewees are accustomed to thinking and acting in innovation policy environments, and are therefore less familiar with concepts and terminology from the educational or organisational sciences. Observations made during the survey phase confirmed this.

4.2. Programme typology

The ERAWATCH database was used ([21]) to identify relevant publicly funded programmes across the EU-27 and Norway. All programmes included in the ERAWATCH database were systematically classified based on the three capital dimensions: human, structural and relational capital (see Section 2.1.3). The following information was derived from the data stored in the database:

(a) the name of the programme,
(b) the main objective(s) of the programme,
(c) the SME beneficiary situation,
(d) whether the programme is currently running or not (to avoid counting follow-up programmes twice).

This information – most importantly, the programme objectives – makes it possible to classify programmes into a typology according to the main focus of the programme. The main objectives of the different programme types are (see also Table 2):

(a) to invest in human capital (programme type 1) directly, which will predominantly lead to formal or non-formal forms of learning, under the umbrella of corporate personnel development and continuing (vocational)

([21]) Although the ERAWATCH database is the most comprehensive overview available of innovation support programmes in all EU Member States, the information provided is partially incomplete or not up to date. This is especially true for information on the financial volume of individual programmes. Accordingly, it was decided that financial information would not be considered during this analysis. This limits the scope of the analysis somewhat, as information on the financial volume of the support measures would have been an important indicator of the strength of the programme within the country's programme portfolio and would also have been an important factor in the comparisons made among countries.

training; programmes may, for example, fund the development and provision of education and training services;

(b) to invest in structural capital, with a focus on the workplace (programme type 2a), which would imply creating and/or implementing learning-intensive forms of work organisation and workplace design. This will predominantly lead to informal and non-formal forms of learning at the workplace and (indirectly) concerns human capital patterns such as domain-related KSC, practical experience, motivation and social skills in the context of work and work design;

(c) to invest in structural capital, with a focus on the organisation (programme type 2b), which would mainly lead to organisational innovation and business development, for example through the implementation of organisational and technological structures and processes that enable the sustained operation and innovation of the organisation;

(d) to invest in relational capital (programme type 3), which would imply the creation of new opportunities of external communication, cooperation and learning (for example, through network-building) with relevant groups outside the organisation (e.g. customers, suppliers, research institutions). This will also predominantly lead to informal and non-formal forms of learning. It might also lead to more formalised modes of learning, if relationships between industrial organisations and educational institutions are involved;

(e) to promote technological R&D&I (programme type 4) that is performed either by a single entity or in a collaborative way (for example, by supporting thematic or horizontal R&D&I activities). Programmes of this type often aim at product or process innovation at company level. As the objectives of programmes of this type rarely seek to increase organisational learning – which they probably do in an indirect way – they are listed separately for the purposes of the analysis;

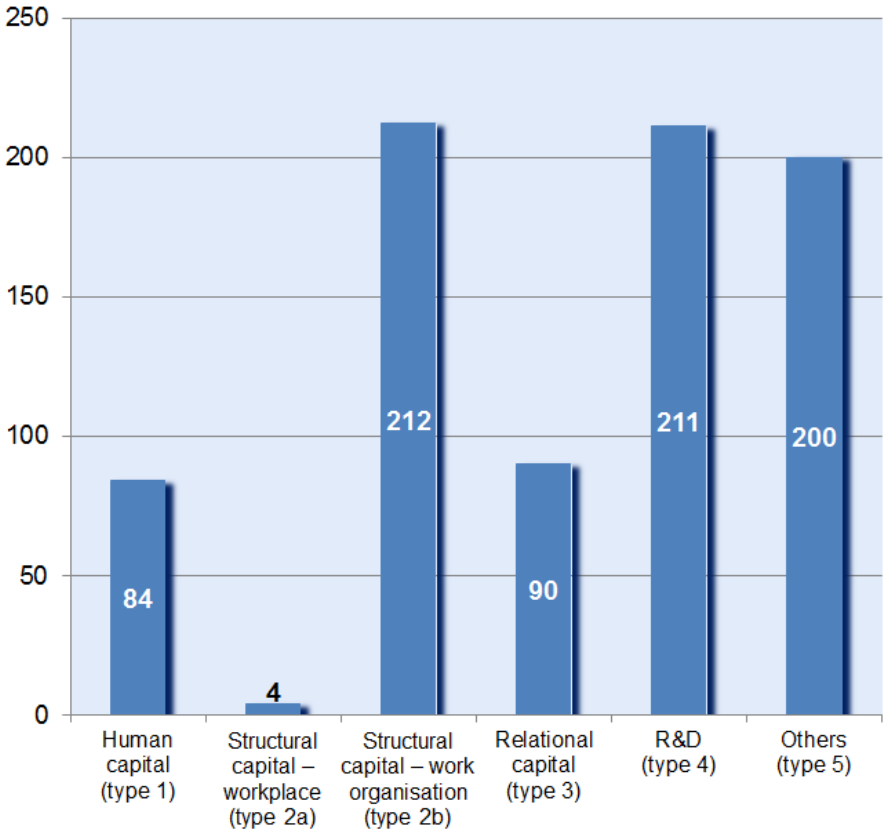
(f) to promote other types of programmes (type 5 programmes) that address the innovative ability of enterprises in other ways than types 1 to 4 (e.g. general investment in R&D&I infrastructure, such as technology centres, access to finance, etc.). These programmes fall outside the scope of the study but are listed to provide a complete picture of the programme portfolio.

Although some programmes fall into more than one category, every programme is ultimately assigned to one type only to keep the programme portfolio clear and distinct. The final decision as to the category in which to place a programme was taken based on an analysis of the detailed information for each support measure and an expert opinion on the programme's main objective.

4.3. Programme portfolios

The final database, which includes all entries from the ERAWATCH database and the (added) CATI programmes, contains a total of 1 030 programmes, 811 of which are still running (2011). The graphic representation below of the ongoing programmes reveals that programmes in support of R&D&I (type 4) are at the top of the list, closely followed by measures that target the structural capital dimension of enterprises (type 2b) and the more general type 5, in which category various programmes have been placed. Type 2a programmes are (still) very rare.

Figure 10 **Ongoing programmes according to typology position**



Source: Authors.

Table 12 shows a breakdown of the same information for each of the 28 European countries analysed. The total number of programmes per country ranges from nine for Cyprus to more than 80 in Belgium. In most cases, the

programmes reported are applied at national level; programmes with a regional dimension are rarely found ([22]).

Table 12 **Ongoing programmes per country according to typology position**

Country	Programme type						Total
	Human capital (type 1)	Structural capital – workplace (type 2a)	Structural capital – work organisation (type 2b)	Relational capital (type 3)	R&D&I (type 4)	Others (type 5)	
AT	2	1	6	3	18	8	**38**
BE	8		34	9	23	9	**83**
BG	2			2	3	10	**17**
CY			3	1		5	**9**
CZ	1		12	3	6	4	**26**
DE	4	1	8	5	10	3	**31**
DK	2		3	3	11	7	**26**
EE	2		3	2	2	9	**18**
EL	3		4	1	1	7	**16**
ES	13		6	4	15	12	**50**
FI	2		9	1	21	6	**39**
FR	6		13	6	9	7	**41**
HU	4		10	1	9	9	**33**
IE	6		4	7	6	11	**34**
IT			3	2	5	7	**17**
LT	6	1	9	4	2	8	**30**
LU	2		4	2	5	7	**20**
LV	1		6	2	4	3	**16**
MT	2		13	3	5	1	**24**
NL	2		7	3	10	8	**30**

([22]) Again, this does not necessarily mean that they do not exist, but rather that they are not reported to ERAWATCH.

NO	4		3	4	16	9	**36**
PL	4		11	2	3	11	**31**
PT			11	2	7	7	**27**
RO			1	5	1	5	**12**
SE	3	1	3	5	17	7	**36**
SI	1		9		5	2	**17**
SK			4	3	1	2	**10**
UK	4		13	5	6	16	**44**
Total	**84**	**4**	**212**	**90**	**221**	**200**	**811**

Source: Authors.

If we look at the programme portfolios for each of the five country clusters distinguished (see Table 5), we can observe a relatively high proportion of type 4 programmes in the two leading clusters and of type 5 programmes in the 'moderate 2' and 'low' clusters (see Figure 11). A possible explanation is that programmes which specifically aim to support R&D&I activities in industry, using either a topical ('top-down') or open ('bottom-up') approach ([23]), require an industrial base that is capable of performing R&D&I tasks. Countries that lack such an industrial base need to invest in its creation, and, as a result, type 5 programmes, which include, for example, investment in R&D&I infrastructure, are more commonly found in these countries.

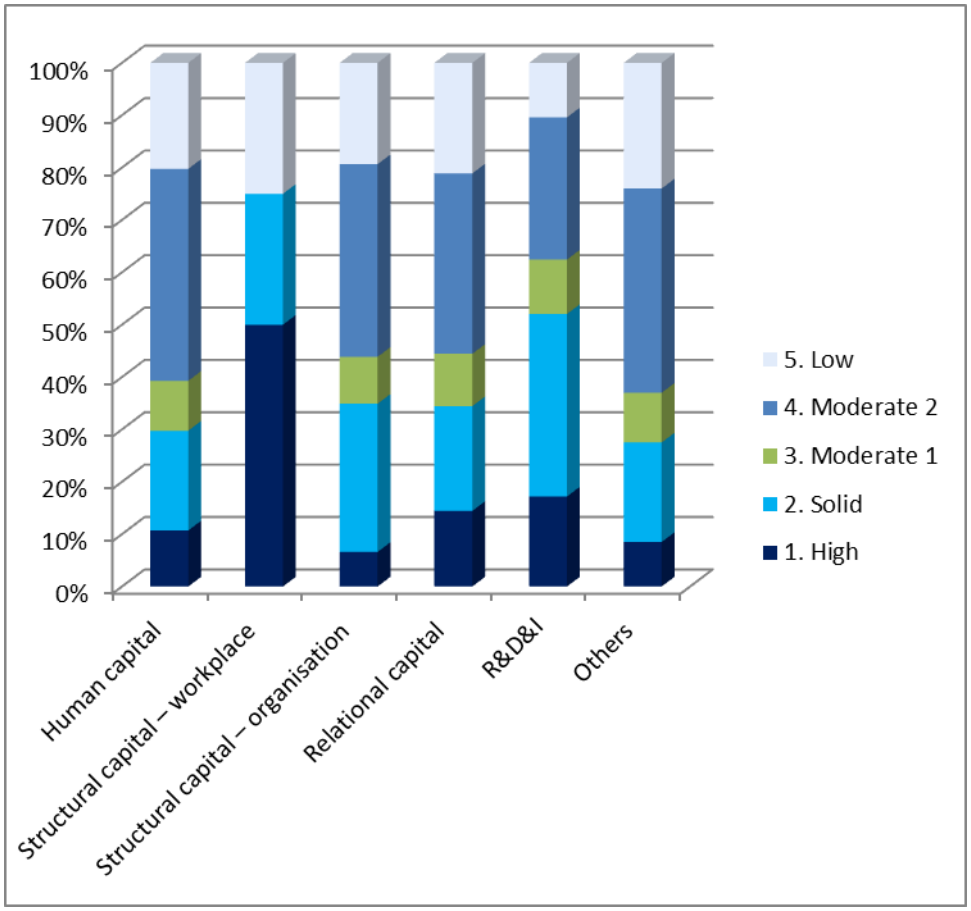
4.4. Linking innovation types to country programme portfolios

In Section 3.3, European countries were clustered according to specific patterns of work organisation, learning and innovation performance. Subsequently, the programme portfolios of these countries were analysed to take account of the various ways in which the programmes seek to promote innovative ability. In the following subchapter, these two approaches are combined to illustrate the relationship between programme portfolios and innovation types of countries. As

([23]) Programmes are essentially used to provide support for R&D&I in two different ways. The 'vertical' or 'top-down' programmes have pre-defined programmatic areas: beneficiaries have to respond to the topics as specified in the call for proposals. 'Horizontal' or 'bottom-up' programmes do not specify a topic in advance.

a first step in this analysis, a second partitioning cluster analysis was performed, this time using the percentage of programmes allocated to each of the categories 1 to 5 as descriptive variables. Five clusters were found (see Annex 4).

Figure 11 **Composition of the programme portfolios for the five 'innovation type' clusters**



Source: Authors.

Table 13 **Portfolio clusters (cluster centres are indicated in top row; highest/lowest value for each variable is underlined)**

Cooperative R&D&I	Structural capital – business development	Human capital – low cooperative R&D&I	Relational capital	Other approaches
Type 1 medium to high (0.1047)	Type 1 low (0.060725)	Type 1 high (0.12148)	Type 1 moderate (0.08825)	Type 1 low (0.0762333)
Type 2a high (0.00864)	Type 2a low (0.00000)	Type 2a high (0.00666)	Type 2a low (0.00000)	Type 2a low (0.00000)
Type 2b moderate (0.17827)	Type 2b high (0.4302125)	Type 2b high (0.30672)	Type 2b low (0.10045)	Type 2b low (0.1144)
Type 3 low (0.09399)	Type 3 moderate (0.124275)	Type 3 low (0.097)	Type 3 high (0.3113)	Type 3 moderate (0.1154333)
Type 4 high (0.38246)	Type 4 moderate to high (0.2298875)	Type 4 low (0.07248)	Type 4 low (0.1299)	Type 4 moderate (0.1939)
Type 5 low (0.2319)	Type 5 low (0.154875)	Type 5 high (0.39564)	Type 5 high (0.3701)	Type 5 high (0.50000)
Austria, Denmark, Finland, Germany, Hungary, Luxembourg, Netherlands, Norway, Spain, Sweden	Belgium, Czech Republic, France, Latvia, Malta, Portugal, Slovenia, Slovakia	Cyprus, Greece, Lithuania, Poland, United Kingdom	Ireland, Romania	Bulgaria, Estonia, Italy

Source: Authors.

The first cluster may be referred to as ‘cooperative R&D&I’, as these countries show the highest proportion of type 4 programmes in their portfolios. In this cluster, we find not only countries from northern and western Europe but also Hungary and Spain. This cluster has the highest percentage of workplace-centred type 2a programmes, but this should be interpreted with caution because of the small numbers involved.

The second cluster is characterised by a high percentage of type 2b programmes and might, therefore, be referred to as ‘structural capital – business development’. In this cluster, there is the lowest percentage of human capital-

oriented type 1 programmes and the lowest percentage of 'non-specific' type 5 programmes. Its members are countries from across Europe, apart from northern Europe.

The third cluster is characterised by two features: a high proportion of type 1, human capital-related programmes, and a very low proportion of type 4, cooperative R&D&I programmes. The five cluster members come from across Europe, apart from northern Europe. This cluster is referred to as 'human capital – low cooperative R&D&I'.

The fourth cluster, consisting of only two countries, Ireland and Romania, shows a high percentage of relational capital-related type 3 programmes and a low proportion of structural capital-related type 2 programmes. Accordingly, this cluster is referred to as 'relational capital'.

In the last cluster, referred to as 'other approaches', we find a high proportion of type 5 programmes which are not related to any of the approaches to fostering innovative ability discussed here. Its members are Bulgaria, Estonia and Italy.

Table 14 **Cross-tabulation of innovation clusters and portfolio clusters**

		Innovation clusters				
		High	Solid	Moderate 1	Moderate 2	Low
Portfolio clusters	Cooperative R&D&I	DE, DK, SE	AT, FI, LU, NL	NO	ES	HU
	Structural capital – business development		BE	MT	CZ, FR, PT, SI	LV, SK
	Human capital – low cooperative R&D&I				EL, CY, UK	LT, PL
	Relational capital				IE	RO
	Other approaches			EE	IT	BG

Source: Authors.

Table 14 shows a cross-tabulation of innovation clusters versus portfolio clusters. All members of the 'high' cluster and four out of the five members of the 'solid' cluster are found in the 'cooperative R&D&I' portfolio cluster. There seems to be a tendency for countries with high learning intensity and high innovation performance to rely predominantly on (targeted) R&D&I programmes, thereby

promoting specific innovation output – actual innovations – and innovative ability at the same time.

Conversely, many of the 'low' or 'moderate 2' countries can be found in the third cluster, which is characterised by a low proportion of cooperative R&D&I programmes. However, even more (six as compared with five) countries are members of the 'Structural capital – business development' cluster, which scores second highest in the proportion of type 4 programmes in the respective portfolios, albeit significantly lower than the 'cooperative R&D&I' cluster.

In summary, it seems that countries with high levels of learning and innovation also show a strong tendency to have a substantial proportion of cooperative R&D&I programmes in their portfolios. For countries with lower levels of learning and innovation, the converse relationship is not as clear-cut. These comparisons relate the quantitative analyses, which focused on the relationships between work organisation, learning and innovation (see Chapter 3), to the qualitative analyses, and explore the effects of policies and programme portfolios on innovative ability. The latter will be described in more detail in the following sections.

4.5. Intended and achieved effects of programmes on the innovative ability of companies – results from the survey at programme level

4.5.1. Introduction

As explained in Chapter 2, the effects of programmes on the innovative ability of companies – as defined by the three dimensions of intellectual capital (human, structural and relational capital) – were recorded using CATIs with programme managers. In connection with these interviews, the IndiGO instrument was used to assess intended and actual effects on the three dimensions of intellectual capital as outlined in Table 1 'Human, structural and relational capital as determinants of innovative ability'. The analysis allows us to determine the intended outcomes of the programmes implemented and to identify which (perceived) outcomes they actually achieved. Further, a detailed assessment was carried out of the learning effects on the individual, based on the three FLMA core dimensions: autonomy and task completeness, task and skill variety, and transparency. The number of programmes investigated varies for each programme type (see Chapter 2).

In the following, the results are discussed for the five types of programmes (1, 2a, 2b, 3 and 4), with a special emphasis on programme type 2a (structural

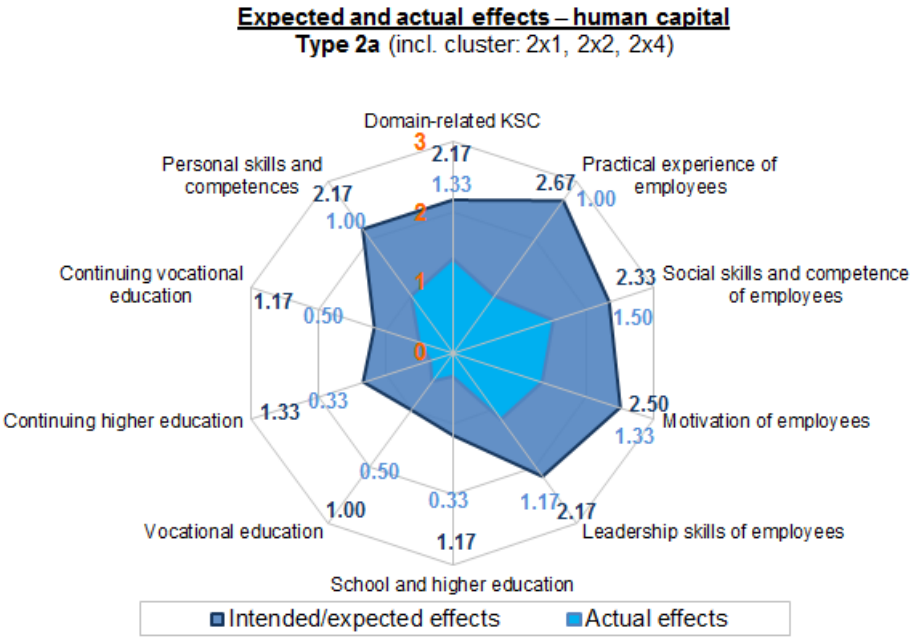
capital – workplace), since this is the main focus of the study. The complete findings and accompanying graphs are presented for this programme type only; this also allows us to illustrate how the analysis was conducted. For the other programme types, the findings are presented in an aggregated form. In conclusion, a summary is provided and some comparisons are drawn between the different programme types. It is important to remember that all data presented here are qualitative data, i.e. opinions of the experts involved (programme and project managers) rather than quantitative measurements.

4.5.2. Programmes centred on structural capital in terms of workplace organisation and design (type 2a)

These programmes are related to structural capital development, focusing on workplace organisation and design leading to workplace learning (see Section 4.2). Very few of these programmes exist in Europe – there were only seven among the more than 1 000 programmes analysed. They seem to be more prevalent in the more advanced countries. The following analyses are based on six programmes in six countries: two from countries in each of the innovation clusters 1, 2 and 4 (see Table 5). The data are presented in a form which is usually reserved for quantitative data analysis. The reason for this is to provide a consolidated overview of the individual assessments. For the various factors that influence human, structural and relational capital, the dark-blue line in the following graphs represents the range of values for expected effects (no effect (0), minor effects (1), moderate effects (2) and major effects (3)), while the light-blue line indicates programme managers' assessment of actual effects. Accordingly, dark-blue areas represent greater expected than actual effects.

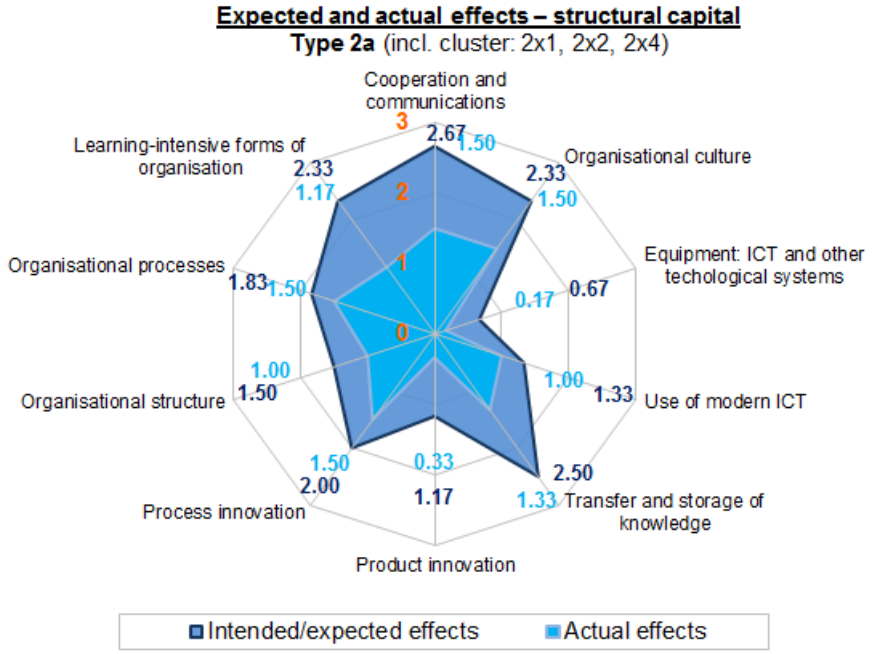
Type 2a programmes are designed to have a wide range of effects in the human capital dimension, with greater emphasis being placed on informal skills development than on formal VET or HE. It is interesting to note that the intended effects are consistently rated substantially higher than the actual effects. Accordingly, in terms of human capital development, the expectations were greater than the actual results. It is rather striking that the intended effects on human capital for this type of programme are generally greater than for human capital-oriented type 1 programmes. Although actual effects are rated lower than expected, the outcomes are still higher than for type 1 programmes. Intended and actual effects on human capital are also rated higher than for the other programme types. A possible explanation for these differences, particularly with regard to type 1 programmes, might be the role of the more developed countries; however, this would require further investigation.

Figure 12 **Human capital, type 2a programmes**



Source: Authors.

Figure 13 **Structural capital, type 2a programmes**

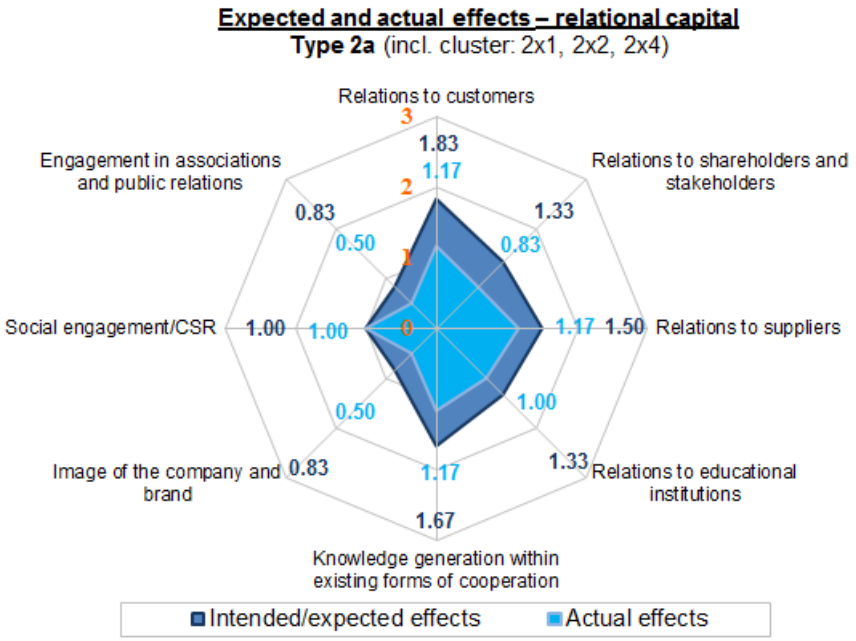


Source: Authors.

In the area of structural capital, there is also a wide range of intended effects, with actual effects falling somewhat short of expectations, especially with regard to learning-intensive forms of work organisation, cooperation and communications, and corporate culture. If we compare the effects with those of other programme types, particularly type 2b, it seems that they are perceived as being complementary. While type 2a programmes focus far more on organisational advancement, type 2b programmes focus more on product and process innovation. Another difference is that, although type 2a programmes are expected to result in a greater 'transfer and storage of knowledge', the impact of type 2b programmes is slightly higher.

Type 2a programmes address many subdimensions of relational capital. Actual values are lower than intended ones but to a lesser extent than for human and structural capital.

Figure 14 **Relational capital, type 2a programmes**

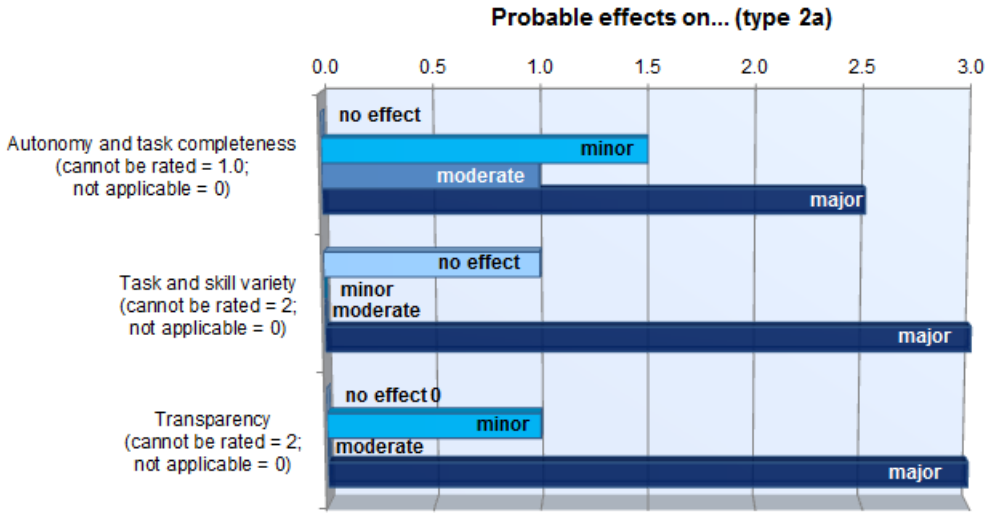


Source: Authors.

In addition to assessing effects on the three dimensions of intellectual capital, the interviewees estimated the effects of their programmes on learning-relevant aspects of the workplace. They rated the effects according to the three dimensions (not the individual items) of the FLMA, i.e. autonomy and task

completeness, task and skill variety, and transparency ([24]). With regard to the FLMA dimensions, interviewees report minor to major effects on autonomy and task completeness, no or major effects on task and skill variety, and minor or major effects on transparency.

Figure 15 **FLMA dimensions, type 2a programmes**



Source: Authors.

In summary, type 2a programmes are described as having a wide range of intended effects across all three dimensions of intellectual capital, with most actual values being lower than those for the original (highly) ambitious expectations, especially in the case of both human and structural capital. The special focus on structural capital is, to some extent, reflected in the higher values for some items related to structural capital, although this does not apply across the whole range of items; even type 3 programmes that focus on relational capital show higher values in some areas. The better match of type 2a programmes with items related to workplace organisation, organisational processes and process innovation reflects the particular focus of these programmes.

([24]) In the FLMA questionnaire, the 'autonomy and task completeness' dimension was covered by two questions because it involves two clearly discernible aspects. To calculate the data in Figure 15, values for both subaspects (autonomy and task completeness) were averaged. Therefore, values of 0.5 may appear if one person rated these two effects differently.

4.5.3. Programmes centred on structural capital in terms of organisational and business development (type 2b)

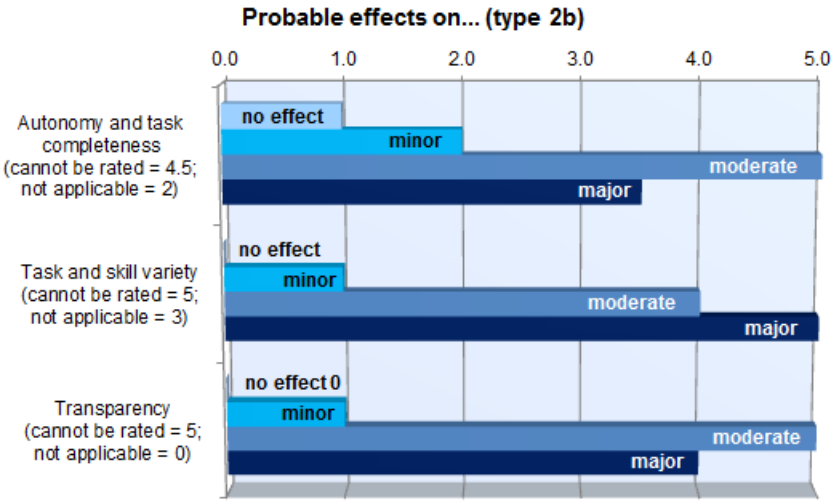
Type 2b programmes focus on structural capital development, with a particular emphasis on organisational and business development (see Section 4.2). Compared to 2a programmes, they are less concerned with individual workplaces than with the organisation as a whole. During data collection, 19 managers and owners of type 2b programmes from 12 different countries were interviewed (two interviews concerning programmes in country cluster 1, four in country cluster 2, 11 in country cluster 4 and two in country cluster 5).

In the area of human capital, the intended effects of type 2b programmes concern mostly informal skills development, with the exception of social skills. Actual effects generally match intended ones, with some being achieved to a greater extent than planned (with regard to personal skills). In general, actual effects correspond much more closely to intended effects than for the other programmes. The actual impact of this programme type on motivation and leadership skills is (perceived as being) comparatively strong, much more so than for all other programme types. The effects on the practical experience of employees are also rated as comparatively high, surpassed only by those of type 3 programmes.

In the case of structural capital, there is a strong emphasis on the categories of transfer and storage of knowledge as well as on infrastructure for product and process innovation; here, actual effects fall slightly short of intended effects. With regard to learning-intensive forms of work organisation, the actual effects are rated higher than the intended effects. As already mentioned, type 2b programmes are generally complementary to type 2a programmes. Accordingly, it may be concluded that the focus of the two programme types is well defined and suitable for achieving the intended results.

In the area of relational capital, the effects of type 2b programmes are moderate for all subdimensions. In general, actual values correspond to the scores for intended effects. In comparison with type 2a programmes, the scores for all (actual and intended) effects are higher; this suggests that there is a greater emphasis on relational capital. It is interesting to note that there are only some minor differences compared with type 3 programmes in the area of relational capital.

Figure 16 **FLMA dimensions, type 2b programmes**



Source: Authors.

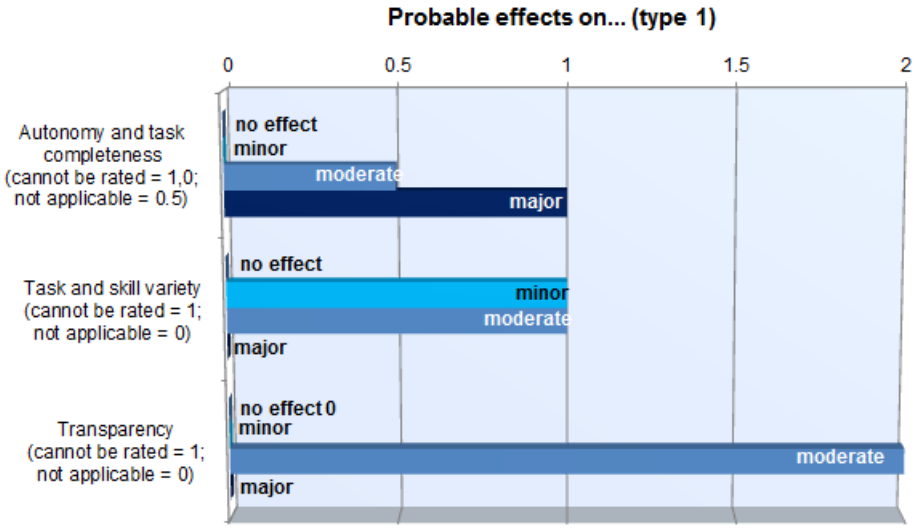
With regard to the FLMA dimensions, interviewees report no to major (predominantly moderate) effects on autonomy and task completeness, minor to major (predominantly major) effects on task and skill variety, and minor to major (predominantly moderate) effects on transparency.

4.5.4. Programmes centred on human capital (type 1)

Type 1 programmes focus on human capital development through the provision of training (see Section 4.2). Three type 1 programmes, from country clusters 3, 4 and 5, were analysed. As might be expected, the programmes show a broad spectrum of intended and actual effects in the human capital dimension. It is interesting to note that, in contrast to HE, very little or no attention is given to VET – both initial and continuing VET. The most prominent effects, apart from those in relation to continuing HE, are in the areas of domain-related KSC, personal skills, social skills and practical experience. The scores for actual effects are generally lower than for intended effects for domain-related KSC, social skills, motivation and continuing HE. Actual effects are rated as highly as intended ones with regard to practical experience, school and HE, and CVT.

The human capital-oriented programmes show few and minor effects on structural capital. These effects are generally not expected (in the cases of organisational structure and organisational processes) or expected only to a (very) small extent. With regard to relational capital, type 1 programmes focus on relations to educational institutions.

Figure 17 **FLMA dimensions, type 1 programmes**



Source: Authors.

With regard to learning-relevant aspects of workplaces, the interviewees report moderate to major effects on autonomy and task completeness, minor to moderate effects on task and skill variety, and moderate effects on transparency.

4.5.5. Programmes centred on relational capital (type 3)

Type 3 programmes emphasise relational capital development (see Section 4.2) and imply cluster development or cooperation between science and industry. For this study, 15 programmes were analysed: two from country cluster 1, four from each of country clusters 2 and 3, two from country cluster 4 and three from cluster 5.

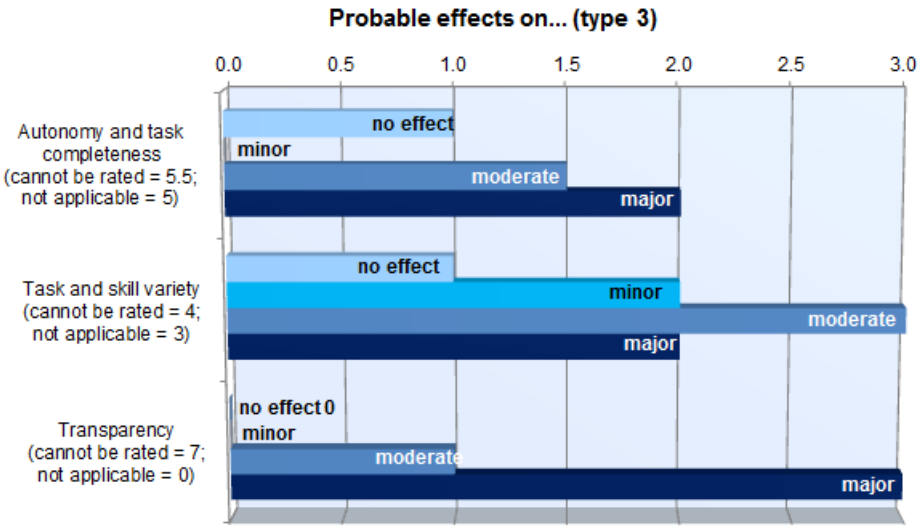
Like 2a and 2b programmes, type 3 programmes show intended human capital effects that are mostly related to informal skills development, with the exception of personal skills. Actual effects are rated slightly lower than intended ones in the case of 'soft skills' (e.g. social and leadership skills), practical experience and motivation. Actual effects are rated higher than intended effects in the subdimensions of domain-related KSC and more formal types of learning. If we compare effects with, in particular, type 1 programmes that focus on human capital, they are found to be at least similar, if not even greater.

Type 3 programmes score highly in many subdimensions of structural capital, except for ICT-related infrastructure and learning-intensive forms of work organisation. Actual effects tend to be rated marginally lower than intended effects. If we compare the pattern of effects in this regard with that of type 2b programmes, it shows a very similar picture – and often similar values. Type 4

programmes show somewhat higher scores for intended effects with regard to innovation and knowledge, despite showing lower scores for actual effects.

With regard to relational capital, type 3 programmes show moderate scores in several subdimensions and low scores for image/brand, CSR and relations to associations and the general public. Actual effects are generally rated marginally lower than intended effects and often (only) slightly lower than for type 4 programmes. However, the scoring pattern does not really show a special focus on the various items related to relational capital.

Figure 18 **FLMA dimensions, type 3 programmes**



Source: Authors.

With regard to the FLMA dimensions, interviewees report no to major (predominantly major) effects on autonomy and task completeness, no to major (predominantly moderate) effects on task and skill variety, and moderate or major (predominantly major) effects on transparency.

4.5.6. Programmes centred on cooperative R&D&I (type 4)

Type 4 programmes do not focus on any one dimension of intellectual capital but instead concern shared-budged cooperative R&D&I (see Section 4.2). Nine type 4 programmes were analysed: two of them from country cluster 1, one each from country clusters 2 and 3, two from cluster 4, and three from country cluster 5, covering programmes from eight different countries.

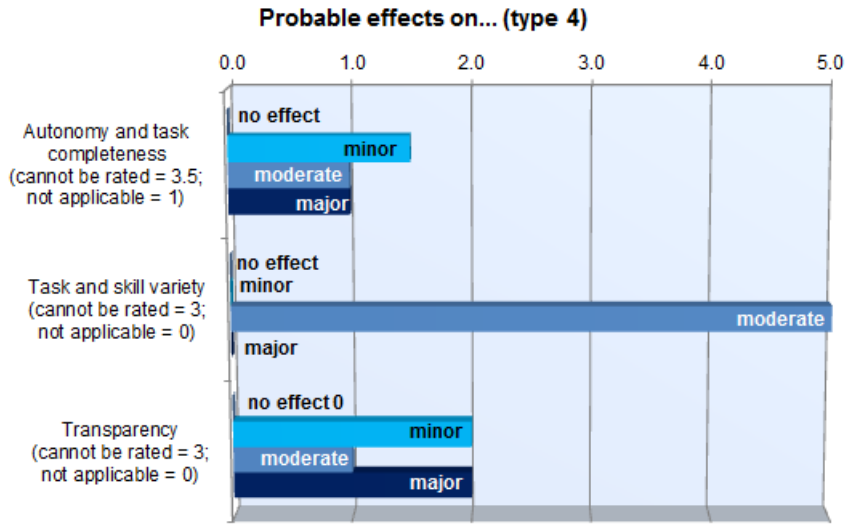
Type 4 programmes only marginally address human capital development, with the exception of domain-related KSC and practical experience of employees. It is interesting to note that the actual effects are, in almost all cases, rated

slightly higher than the intended ones, especially with regard to VET and continuing HE; exceptions are school and higher education and domain-related KSC, where intended and achieved effects are identical.

As might be expected, in the structural capital dimension, type 4 programmes mainly concern infrastructure for process and product development as well as the transfer and storage of knowledge. In these subdimensions, actual values are lower than (the very high) intended values, whereas actual and intended values approximately correspond in the other subdimensions. Actual values are higher with regard to equipment and the use of ICT and related technologies.

Type 4 programmes show moderate intended effects for almost all subdimensions of relational capital with the exception of CSR, where scores are low. Intended and actual values generally correlate. Differences in comparison with type 3 programmes are mostly very small.

Figure 19 **FLMA dimensions, type 4 programmes**



Source: Authors.

In terms of the FLMA dimensions, interviewees report effects on autonomy and task completeness that range from minor to major (predominantly minor), only moderate effects on task and skill variety, and effects on transparency that range from minor to major.

4.5.7. Analysis and interpretation of programmes that specifically address small and medium-sized enterprises ('SME-only')

A special analysis was performed of programmes with a focus on SMEs (only SMEs are entitled to apply for funding). The analysis covers programmes in nine

countries from all five innovation clusters and all programme types except type 1 (with 9 out of the 13 programmes belonging to type 2b). In the following, the effects of these programmes (referred to as 'SME-only'; n=13) on human, structural and relational capital are discussed in comparison with the other programmes (referred to as 'not SME-only'; n=39). It should be remembered that SMEs also participate in this latter group of programmes, but these programmes are not exclusively geared towards SMEs.

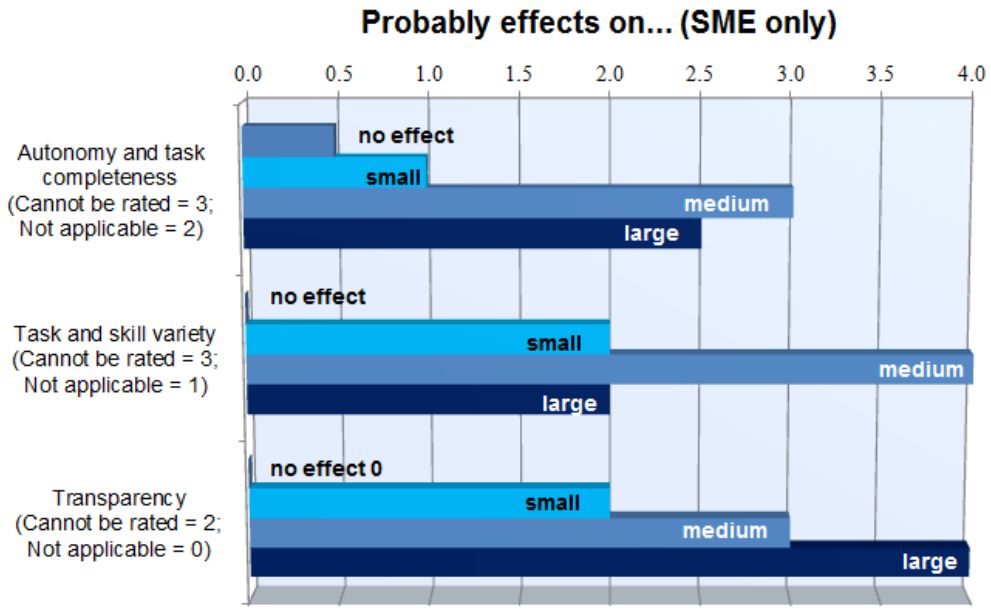
Both SME-focused and other programmes show moderate scores for a wide range of subdimensions in human capital. While scores are generally low to moderate, the SME-specific programmes tend to place an emphasis on formal or certified education (school, VET and HE, both initial and continuing), whereas the other programmes show higher scores in the area of more informally acquired or uncertified practical and social skills. In SME-focused programmes, actual values in the human capital dimension are generally quite close to expected values.

With regard to structural capital, all programmes – SME-specific and others – place an emphasis on infrastructure for product and process innovation, technological equipment, organisational structures and processes, as well as the transfer and storage of knowledge. These findings seem to reflect closely the typical objectives of SME-specific programmes. Scores for SME-specific programmes are, in general, consistently higher than those for other programmes.

In the area of relational capital, actual scores for SME-only programmes are higher for all but two subdimensions: relations to educational institutions (almost identical), and CSR (lower than those for other programmes). Especially high scores are found for knowledge generation within existing forms of cooperation, relations to customers and suppliers, and image/brand of the company. This pattern can also be regarded as typical for SME-centred programmes. They often focus on supplier-customer relations, and the image of SMEs as innovative companies is often boosted by R&D&I cooperation with HE and research institutions.

In general, expected and actual values are higher for SME-specific programmes than for other programmes. This holds good for all three dimensions of intellectual capital.

Figure 20 **FLMA dimensions, SME-only programmes**



Source: Authors.

With regard to the FLMA dimensions, interviewees report, in general, rather substantial effects. Whereas a minority of interviewees observe no effects with regard to autonomy and task completeness, most respondents perceive moderate or, to a lesser extent, major effects. For skill variety, most people report moderate effects, while fewer respondents observe minor or major effects. Finally, with respect to transparency, most interviewees report major effects, fewer respondents perceive moderate effects and fewer still observe minor effects.

4.5.8. Summary: core findings of the programme survey

In general, the expected and actual values reflect the purposes and objectives of the programmes, with the exception, to some extent, of type 3 programmes.

Human capital-centred type 1 programmes focus on human capital but show an unexpected gap as regards initial and, to a lesser extent, continuing VET. Unlike HE, these are hardly addressed. The programmes show little ambition and few results as regards structural capital, while relations to educational institutions exhibit the greatest impact in terms of relational capital. With regard to the FLMA dimensions, effects are moderate, and they are most pronounced in the area of transparency.

Workplace-centred type 2a programmes exhibit very high ambitions – and produce substantial results – in the areas of human and structural capital, and

show lower yet still moderate ambitions and impacts with regard to relational capital. Estimated effects on FLMA dimensions are substantial across all three dimensions, with highest values for skill variety and transparency.

Type 2b programmes address structural capital at the organisational level beyond the individual workplace; they focus on structural and, to a lesser extent, relational capital, while still showing certain expectations and impacts in the area of human capital, especially with regard to leadership skills and motivation. Effects on the latter are perceived to be greater than for all other programme types. In general, scores for actual effects match those for intended effects to an extent hardly seen for any other programme type. Estimated effects on FLMA dimensions are substantial across all three dimensions and, in particular, show higher values for skill variety and transparency.

Type 3 programmes, while being geared towards relational capital, focus mainly on structural capital. This is a little less surprising if we consider the specific subdimensions, i.e. the transfer and storage of knowledge, and product and process innovation. Ambitions with regard to human and relational capital and related impacts are comparable at moderate levels. As for type 2b programmes, estimated effects on FLMA dimensions are substantial across all three dimensions, also showing higher values for skill variety and transparency.

R&D&I-focused type 4 programmes show the highest scores for structural capital, particularly in the areas of the transfer and storage of knowledge and of process and product innovation. Ambitions and impacts for relational capital are moderate and balanced and remain higher than the scores obtained for human capital. FLMA effects are more moderate, but show somewhat higher scores for skill variety.

More specific analyses reveal interesting phenomena, with particular regard to differences between expected and actual effects. With the exception of type 1 programmes, substantially higher expected than actual effects are observed in the area of product and process innovation across all programmes, especially in the cases of type 2a, 2b and 4 programmes. This may reflect the risky nature of R&D&I; success is not guaranteed, and such risk might be one of the main reasons for public funding in the first place.

In addition, expected values are consistently higher than actual values with respect to organisational structures and processes. These structures and processes appear to be difficult to change. There might be a reluctance by companies to change organisational structures and processes that are essential for core business operations.

Far-reaching objectives in the way of learning-intensive forms of organisation seem to be difficult to achieve, even when they are a core ambition

of the programmes, as is the case with the type 2a programmes. Actual values, though still substantial, fall short of the very high expectations. It is interesting to note that, in all other programme types, the expectations regarding the human capital dimension are generally rather low. However, the rather low expected impacts on this dimension are often surpassed by the actual effects: in the case of 2b programmes, the (rather low) expectations are surpassed by the actual effects, especially for personal and social skills as well as for continuing VET. For type 3 programmes, which are oriented towards relational capital, actual scores surpass expected scores with particular regard to domain-related skills and knowledge, school and HE, and (initial) VET. Type 4 (R&D&I-oriented) programmes show higher actual than expected scores – at a generally low to moderate level – for almost all human capital subdimensions.

With regard to programmes specifically and exclusively geared towards SMEs, it was generally found that the scores for expected as well as actual impacts are higher than the comparable scores for other programmes that are not limited to SMEs.

Scores for estimated effects on FLMA dimensions are substantial across all three dimensions, with somewhat higher values for skill variety and transparency (programme types 2a, 2b and 3). This indicates that the programmes have an impact on the learning-intensity of workplaces.

4.6. Case studies

The previous chapters provided a review of policies and programmes which link innovation in enterprises to skills development. This review was complemented by 10 national examples of different types of publicly funded programmes that address human capital, structural capital (with a focus on workplace design as well as the organisation) or relational capital or promote R&D&I investment. Five case studies are included in Annex 6. The case studies represent a diverse array of programmes with regard to the level of intervention (national and regional) as well as the types of enterprises targeted. The rationale for the selection of the case studies and the methodology used are explained in Section 4.1. The following paragraphs serve to illustrate the case study approach, using parts of an anonymised example of an actual type 2a programme and its projects. The analysis was conducted at three different levels.

4.6.1. Level 1: programme manager versus average of type 2a programme managers

Programme managers were asked about the expected and actual effects on human, structural and relational capital in the respective programmes. The answers provided by the programme manager were contrasted with the average answers of all programme managers of the same programme type. This allowed us to draw some comparisons between the programmes and also gave an overview of each programme type. The results with respect to human capital are shown in Figure 21 (results on structural and relational capital were presented in a similar way).

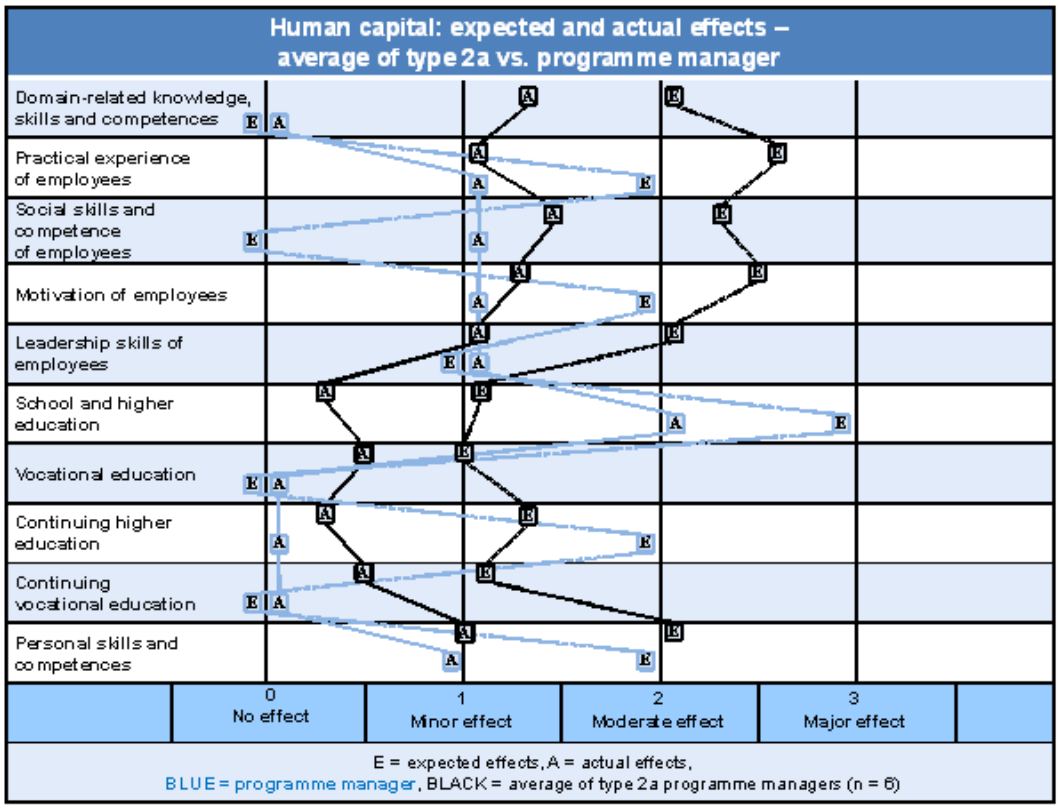
In the human capital domain, both the expectations and observations of effects by the programme manager were generally lower compared to the average of all type 2a programme managers, with the exception of the subdimension of school and higher education. The expected and actually observed effects reported by the programme manager match for 7 of the 10 dimensions, for which, in three cases, no effects were expected or observed (domain-related knowledge, skills and competences; vocational education; continuing vocational training) and, in one case, minor effects were expected and observed (leadership skills of employees). In the case of the social skills and competence of employees, the actual effect (minor) was rated higher than the expected effect (none). In all other cases, actual effects were assessed as lower than the expected ones. Moderate effects were expected in terms of the practical experience of employees, motivation of employees, continuing higher education and personal skills and competences. In all cases but one, the actual effects were minor; in the case of continuing higher education, there was no effect to be observed at all.

4.6.2. Level 2: programme manager versus average of project managers

The next level of analysis compares the view of the programme manager with the average view of all project managers of the same programme type on the expected and actual effects on human, structural and relational capital, and on the link between innovation and changes in the workplace/work organisation that lead to learning. Results on the human capital dimension are shown in Figure 22. In this case study, the responses of the project managers on the human capital domain were similar to those given by the programme manager, which suggests that the programme objectives for this domain had been well communicated and perceived. However, project managers reported higher expected and actual effects than the programme manager for almost all subdimensions. Expectations tend to exceed, at least slightly, actual effects. In three subdimensions

(motivation of employees, leadership skills of employees, and personal skills and competences), project managers reported major expected effects, but only moderate-to-major actual effects. Moderate effects were expected for continuing HE, but only minor-to-moderate actual effects were observed. The subdimension of continuing HE was expected to yield major results, but the projects seem to provide only moderate effects in this area. Contrary to the expectations and observations of the programme manager, there were no subdimensions in which no effect at all was expected or observed by the project managers.

Figure 21 **Results for expected and actual effects in the human capital dimension – programme manager versus average of type 2a programme managers**

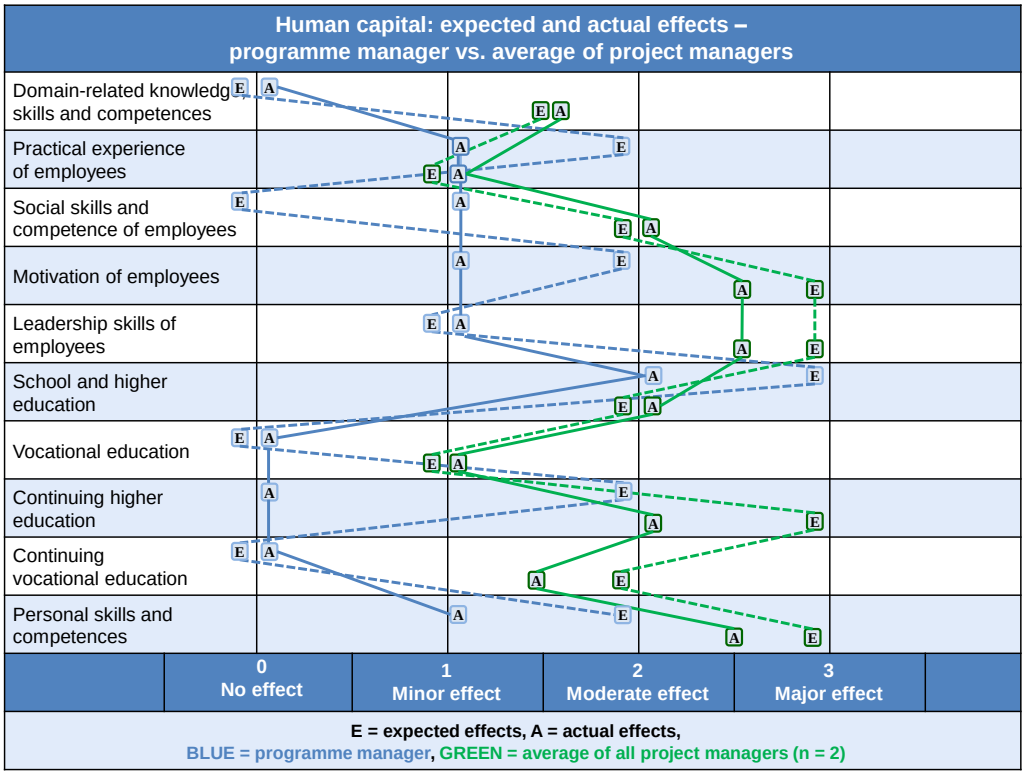


Source: Authors.

In addition to an assessment of the determinants of innovative ability, the link between innovation and the changes in workplace/work organisation that result in learning was examined. There are no large discrepancies between the judgments of the programme manager and the project managers (see Figure 23). Both parties (tend to) agree that the programme and projects have led to distinct and sustainable changes. Whereas the programme manager feels qualified to rate only part of the statements, all responses fall on the positive side of the

scale. Project managers agree most with the statement that more intensive learning at the workplace has contributed to innovation activities resulting in process innovation.

Figure 22 **Results for expected and actual effects in the human capital dimension – programme manager versus average of project managers**

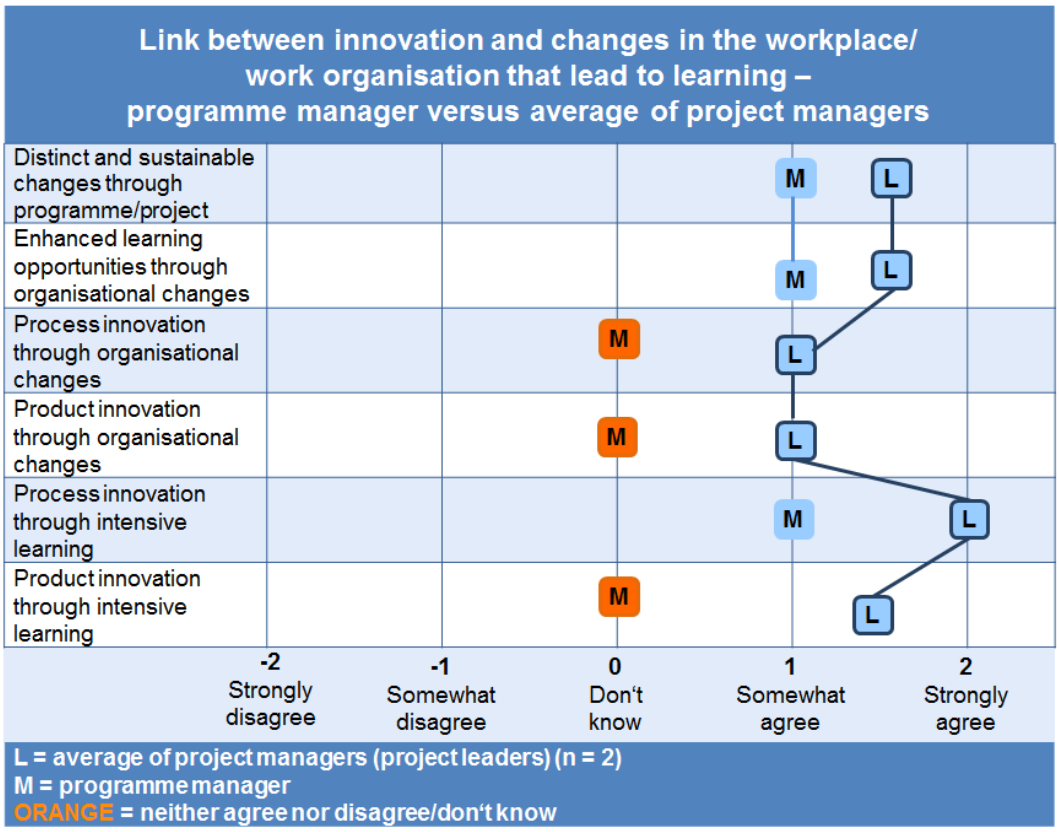


Source: Authors.

4.6.3. Level 3: project managers on the development of conditions for informal learning at the workplace

In the final part of the analysis, we move one level further in evaluating the outcomes of the programmes. Project managers and employees were asked about the impact of the programmes on the conditions for informal learning at the workplace. The three dimensions of autonomy, transparency, and task and skill variety were covered. It was not, in all cases, possible to obtain the employees' perspective (as was the case in the example presented here).

Figure 23 **Link between innovation and changes in the workplace/work organisation that lead to learning – programme manager versus average of project managers**

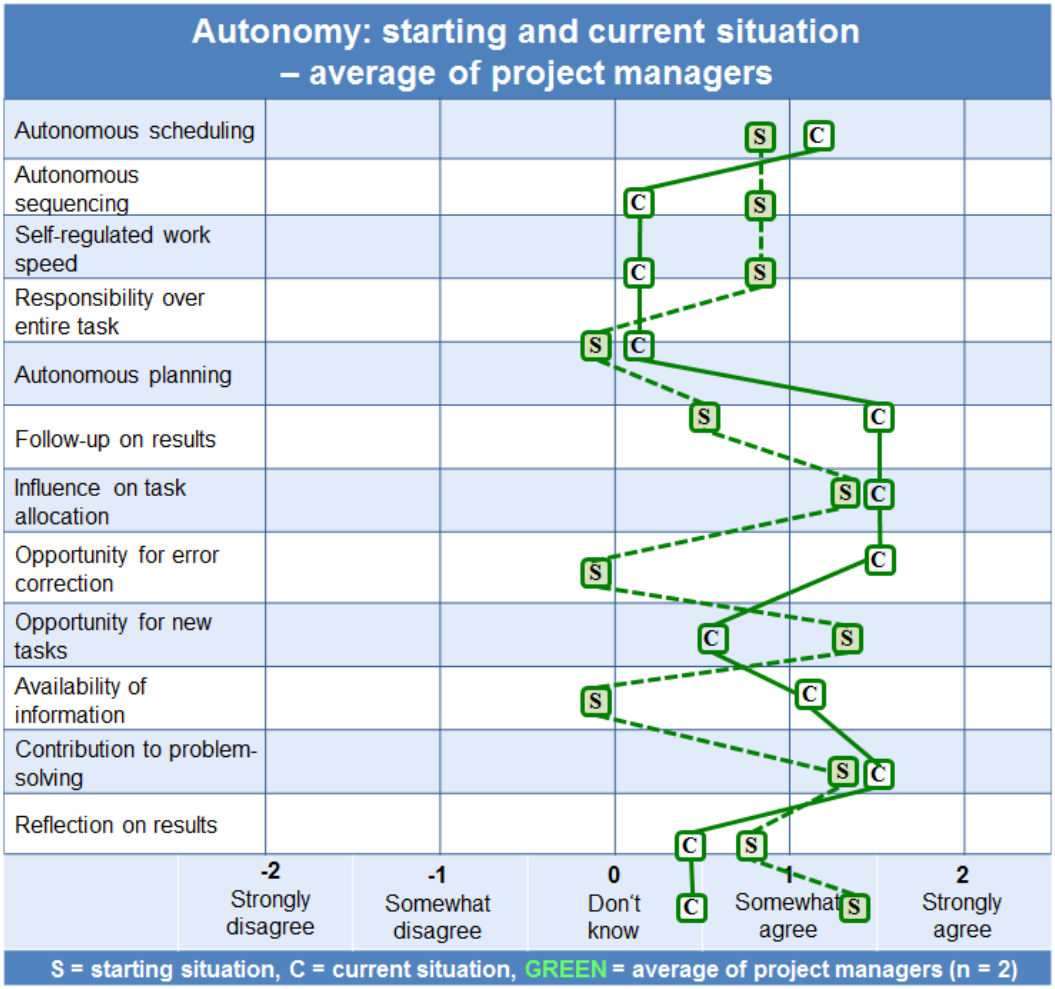


Source: Authors.

Figure 24 shows how the two project managers assess, from their perspective, the situation of employees in the specific participating enterprises with regard to autonomy (results on the other two dimensions are presented in a similar way). The results for the autonomy dimension show a mix of both positive and negative trends. From the perspective of the project managers, employees were and generally still are able to schedule their work autonomously, to follow-up on the results of their own work and to be suitably informed about important issues and proceedings. In contrast, the project managers judge the current situation of employees to have deteriorated with regard to sequencing their own tasks, regulating their own work speed, correcting their own mistakes, contributing to problem-solving and reflecting on the results of their work; nevertheless, on the whole, the current situation is not perceived as negative. Some aspects have also improved: compared to the initial project situation, employees are better able to plan their work autonomously, have a much

stronger direct influence on the tasks allocated to them and have more opportunities to look for and find new tasks.

Figure 24 **FLMA autonomy – average of project managers**



Source: Authors.

Examples of five case studies are provided in the country profiles presented in Annex 6. The countries function as case studies which describe the national innovation performance, innovation policy and programmes, the national innovation agencies and the background for the programme analysed. Accordingly, the broader country context is presented. Each fiche concludes with remarks concerning the results of the CATI/IndiGO interviews and the FLMA online questionnaires at programme manager and project manager level and, in some cases, at employee level. The results assess the determinants of innovative ability, and the three dimensions of transparency, variety and

autonomy capture the characteristics of workplaces relevant to learning in the workplace. They complement the findings of the survey.

The results of the 10 case studies show that project managers generally believe that distinct and sustainable changes were achieved by the projects, that these organisational changes created enhanced learning opportunities, that process and product innovations were promoted by these changes and that these innovations are also positively affected by the enhanced learning opportunities.

Questions with regard to the impact of the programmes and projects on working conditions which led to more learning-conducive workplaces yielded varied assessments by projects managers and employees, but there was no tendency for employees to rate the effects lower (or higher) than project managers.

Effects also vary considerably across projects and programmes, sometimes also within programmes. The results show three patterns at project level: no changes resulting from the project, balanced changes for the better or for the worse and a tendency towards more learning-intensive working conditions. Accordingly, there is some evidence for positive impacts, some for neutral and none for adverse impacts with regard to learning-conducive forms of work organisation.

CHAPTER 5.

Conclusions

This concluding chapter summarises the key findings and sets out some recommendations.

5.1. Findings

5.1.1. Impact of work organisation and learning on innovation performance

The findings of this study support the assumption that learning-intensive forms of work organisation and workplace learning – in addition to other, more formal modes of learning – correlate with the innovation performance of countries, based on the innovation performance of companies within these countries. These effects seem to take two routes:

(a) effects at organisational level. Organisational forms with higher employee autonomy and more complex tasks seem to lead to more intensive cooperation, a more learning- and innovation-oriented corporate culture, higher propensity to organisational learning and, last but not least, higher absorptive capacity and, therefore, greater innovative ability of the organisation;

(b) effects at individual level. Learning-intensive forms of work organisation seem to promote individual learning; this improves employees' capacity to initiate and take part in innovation processes and, ultimately, to contribute to the organisation's absorptive capacity and, therefore, its innovative ability.

The analysis of two main characteristics of learning-intensive forms of work organisation – task complexity and autonomy – suggests that task complexity is the most crucial factor for innovation performance. Its relationship to innovation appears to be similar to that of R&D expenditure in relation to GDP, and holds even if controlled for other factors, such as GDP per capita, share of tertiary-educated population, etc.

With regard to formal, non-formal and informal types of learning – as expressed in statistical data on training provision and employee participation in CVT, including non-formal and informal learning at the workplace – the analysis conducted in this study suggests that all these forms of learning correlate significantly with the innovation performance of the individual countries.

However, in direct comparison, the task-complexity aspects of work organisation seem to be the most powerful predictor of a country's innovation

performance. In addition to this, it is worth noting that most indicators for CVT seem to have a stronger association with the innovation performance of a country than higher education. This suggests that CVT might play a significant role with regard to innovation ability. On this basis, it seems that, in current research and innovation monitoring and reporting, the role of VET – in a broad sense – might be underestimated, as compared to higher education. Accordingly, a recommendation of this study is to include VET-related indicators in R&D&I reporting systems (see Section 5.2.2).

In general, the results seem to suggest that task-complexity aspects of work organisation and human capital formation are the driving factors of innovation performance. These relationships remain essentially stable when controlling for framework conditions, such as GDP per capita and the share of tertiary education.

5.1.2. Innovation types of countries and programme portfolios

On the basis of data from the EWCS, the CVTS and the IUS, five clusters of countries were found in this study with regard to specific combinations of work organisation, learning and innovation performance. They provide an overview of country characteristics and similar patterns between countries:

(a) the ‘high’ cluster scores highly in all three dimensions: very learning-intensive forms of work organisation with a high prevalence of learning and high innovation performance. The members of this cluster include Denmark, Germany and Sweden;
(b) the ‘solid’ cluster scores similarly, with only moderate values for learning and moderate to high values for innovation. The members of this cluster include Austria, Belgium, Finland, Luxembourg and the Netherlands;
(c) the ‘intermediate – moderate 1’ cluster: high learning, moderate innovation – combines high values for work organisation and medium values for learning with moderate innovation performance. The members of this cluster include Estonia, Malta and Norway;
(d) the ‘intermediate – ‘moderate 2’ cluster: low learning, moderate innovation’ – shows very similar innovation performance to moderate 1 but combined here with much lower values for work organisation and learning. Cyprus, the Czech Republic, France, Greece, Ireland, Italy, Portugal, Slovenia, Spain and the United Kingdom are all included in this cluster;
(e) the ‘low’ cluster, consisting of Bulgaria, Latvia, Lithuania, Hungary, Poland, Romania and Slovakia, scores low on all three variables.

Based on theoretical considerations, the study suggests that there are five principal ways of promoting innovative ability through publicly funded programmes:

(a) direct investment in human capital, e.g. through VET;
(b) investment in structural capital with a focus on the workplace, leading to more learning-intensive forms of work organisation and, therefore, workplace learning;
(c) investment in structural capital with a focus on the whole organisation, e.g. business development programmes;
(d) investment in relational capital, e.g. cluster building and networking; and
(e) direct investment in R&D&I.

On the basis of this classification, an analysis was conducted of 1 030 programmes aimed at fostering innovation in the EU-27 and Norway. The findings show that programmes that invest in R&D&I (31.0%) and programmes that invest in structural capital through work organisation (24.0%) are most frequent, followed by programmes that do not specifically address any of the five defined ways of promoting innovative ability ('other': 22.9%), programmes that invest in relational capital (11.6%) and programmes that invest directly in human capital (9.9%). Programmes that invest in structural capital through the workplace (0.7%) are extremely rare, accounting for only 7 of the 1 030 programmes. This is an important finding. Their complete absence from the programme portfolios of most countries indicates that the role of work organisation and workplace learning is generally underestimated and that such programmes are not on the political agenda in most countries. Considering the above-mentioned results from our study – positive relations between work organisation, workplace learning and innovation – this finding is even more striking. Therefore, an important recommendation of this study is that awareness should be raised of these positive relations and the number of programmes that invest in structural capital with a focus on the workplace increased (see Section 5.2.3).

Further investigations into the distribution of programmes in the country portfolios were conducted to reveal which ways of promoting innovative ability are being used by the countries involved and to see which countries show similar patterns. The analysis yielded the following results:

(a) the 'cooperative R&D&I' cluster: the countries in this cluster show the highest proportion of programmes that invest in R&D&I in their portfolios. Cluster members are not only countries in northern and western Europe – Austria, Denmark, Finland, Germany, Luxembourg, the Netherlands, Norway and Sweden – but also Hungary and Spain. This cluster also shows the

highest percentage of structural capital-related programmes with a focus on the workplace;

(b) the 'structural capital – business development' cluster: this cluster is characterised not only by a high percentage of programmes that invest in structural capital with a focus on work organisation but also by the lowest percentage of human capital-related programmes and the lowest percentage of 'other approaches'. Cluster members are countries from across Europe, apart from northern Europe: Belgium, the Czech Republic, France, Latvia, Malta, Portugal, Slovenia and Slovakia;

(c) the 'human capital – low cooperative R&D&I' cluster. This cluster is characterised by two features: a high proportion of human capital-related programmes and a very low proportion of programmes that invest in R&D&I. The five members – Cyprus, Greece, Lithuania, Poland and the United Kingdom – are from across Europe, apart from northern Europe;

(d) the 'relational capital' cluster: this cluster shows a high percentage of relational capital-related programmes and a low proportion of structural capital-related programmes with a focus either on work organisation or on the workplace. It consists of Ireland and Romania;

(e) the 'other approaches' cluster: this cluster has a high proportion of programmes which are not related to any of the approaches to fostering innovative ability discussed in this study. Its members are Bulgaria, Estonia and Italy.

All countries rely on more or less complex portfolios of programmes to pursue their objectives regarding innovation performance. Each type of programme seems to fulfil specific and useful functions within these portfolios. However, two kinds of programme have specific relevance. If we compare the portfolio clusters with the innovation clusters described above, it appears that the most advanced countries in terms of learning and innovation performance ('high' and 'solid' clusters) tend to belong to the 'cooperative R&D&I' portfolio cluster. Accordingly, 'successful' countries (countries with greater learning intensity and higher innovation performance) rely, to a substantial extent, on R&D&I programmes in their portfolios. Moreover, most of the few structural capital-related programmes with a focus on the workplace belong to countries in the 'high' cluster. This indicates that these programmes might play a quantitatively minor but qualitatively important role. The converse relationship is not as clear-cut, i.e. countries with lower learning and innovation intensities are dispersed across several clusters, some also having a significant proportion of R&D&I programmes in their portfolios. This might indicate that a substantial proportion of

R&D&I programmes in the portfolio is a necessary but not sufficient condition for promoting innovative ability and innovation performance.

5.1.3. Impact of programmes on innovative ability

The study analysed publicly funded R&D&I programmes in more depth using a survey conducted across the EU-27 and Norway, and 10 in-depth case studies. The findings indicate that publicly funded programmes seem to make varied and substantial contributions to all three dimensions of innovative ability: human, structural and relational capital. Although individual programmes are geared towards one of these dimensions, most programmes seek to and actually do achieve impacts in all three dimensions.

Human capital-centred programmes focus on human capital. However, gaps involving initial training and, to a lesser extent, CVT could be detected. Programmes tended to focus more on other dimensions of human capital formation, for example higher education. Given the above-mentioned findings and the role that VET might play in fostering innovation, this is somewhat unexpected. It suggests that human capital-centred programmes should focus more directly on VET and seek to raise awareness of the role of VET. As far as the relational capital dimension is concerned, relationships with educational institutions had the main impact; this is also in line with the programme focus on human capital.

Structural capital-related programmes with a focus on the workplace have very high ambitions – and achieve substantial results – in the areas of structural and human capital, and they have fewer, although still moderately high, ambitions and less of an impact with respect to relational capital. Interestingly, the ambitions regarding human capital enhancement were quite substantial and even higher than those of the programmes which focus on human capital development. This seems to indicate that, among the programme and project managers of structural capital-related programmes with a focus on the workplace, there is some degree of awareness regarding the link between learning-intensive forms of (work) organisation and the various forms of formal, non-formal and informal learning.

Programmes addressing structural capital beyond the individual workplace at the organisational level, structural capital – work organisation programmes, focus on structural and, to a lesser extent, relational capital. They also show some degree of expectations and impact regarding human capital, especially on leadership skills and motivation.

Programmes tuned towards relational capital somewhat surprisingly show a main emphasis on structural capital. This becomes less surprising when looking

at the specific subdimensions: transfer and storage of knowledge, and product and process innovation. Expectations and impact on human and relational capital are moderate.

R&D&I-focused programmes show their highest scores in structural capital. Interestingly, programmes focusing on relational capital, on the organisational level and on R&D&I directly show a very similar pattern, suggesting that the relevant dimension of structural capital can be addressed through a broad range of programmes. Expectations and impact of R&D&I programmes on relational capital are moderate, but still higher than with respect to human capital.

The analysis revealed that the programmes had substantial effects on the learning-conduciveness of the workplace. The greatest impact was seen at the level of skill variety and transparency. The two types of structural capital-related programmes with a focus on work organisation and the workplace, as well as the programmes that focus on relational capital, in particular showed substantial effects. A greater learning-conduciveness of the workplace seems to be a positive 'side effect' of all programmes.

In most programme types, expectations concerning the impacts on human capital development and changes that lead to a more learning-intensive workplace were only at a low to moderate level. The actual effects, however, often surpassed these expectations. This is in line with the other findings and indicates that, although the role of learning-intensive workplaces and workplace learning might be underestimated, it nevertheless has great potential.

The analysis also revealed that programmes exclusively geared towards SMEs generally seem to have higher expected and actual impacts than other, non-SME-specific programmes. This suggests that such programmes should be continued or even expanded.

5.2. Policy recommendations

On the basis of the results of this study, some recommendations can be made. They are mainly addressed to policy-makers at European and national levels.

5.2.1. Monitoring of programmes

Governments pursue complex sets of objectives and implement complex portfolios of programmes and measures to achieve them. Within this study, programmes that focus on a broad range of impacts were considered: from lifelong learning to business development and clustering, from general company-to-company and company-to-science cooperation to very specific sectoral or technological issues addressed in dedicated R&D&I programmes.

Although many of these programmes do not explicitly address innovative ability as their core objective, they nevertheless seem to have some impact on it. A better awareness and understanding of these impacts and the mechanisms behind them could help significantly in improving the programmes with regard to innovative ability, without diminishing their original focus. If these effects are not monitored, the impact of publicly funded programmes might be underestimated. Accordingly, programme evaluations should explicitly address innovative ability issues. Standardised instruments – such as the FLMA and the IndiGO ([25]) – could be used to allow for comparison across programmes. They should cover human, structural and relational capital and should address the following issues:

(a) human capital: are there any effects on formal, non-formal or informal learning in connection with CVT or continuing HE? Are there any effects on organisational policies, structures and processes regarding human resources management and, specifically, personnel development?
(b) structural capital: are there any effects on learning-intensive forms of work organisation? Are there any effects on organisational structures or processes pertaining to R&D&I?
(c) relational capital: are there any effects regarding the quantity and intensity of relationships with external partners (e.g. business, science, education/training, public authorities)? What are specific impacts on cooperation in the areas of R&D, innovation and education, training and learning?

In addition to monitoring the innovation ability impacts of programmes, the maintenance of European innovation programme databases, such as ERAWATCH, is important.

5.2.2. Integration of VET-related indicators in R&D&I reporting systems

Policy-makers should consider the integration of innovative ability issues in the R&D&I monitoring systems, such as (indicator-based, periodically published) national reports on R&D&I. Specifically, the following topics should be more systematically covered:

(a) human capital: as this study shows, CVT – including formal, non-formal and informal (workplace) learning – seems to be related to innovation

([25]) The FLMA is the questionnaire on the workplace characteristics relevant for learning [translation from German: Fragebogen zu lernrelevanten Merkmalen der Arbeitsaufgabe] (Richter and Wardanjan, 2000). The IndiGO stands for indicators of gains in organisational competence and may be used to measure aspects of human, structural and relational capital (Globisch et al., 2011).

performance. However, these CVT-related issues are usually ignored in R&D&I reporting. It is worth noting, in this connection, that HE indicators (e.g. number or proportion of science and engineering graduates) are widely recognised for their importance with regard to innovation, and are, therefore, integrated in R&D&I reporting systems. This is justified by established empirical relationships between these HE indicators and innovation performance. However, evidence discussed in this study indicates that CVT indicators – in the broad sense, as described above – might have an even stronger relationship to innovation performance than HE indicators. Therefore, the integration of CVT-related indicators in R&D&I reporting systems should also be considered. Some of the CVTS indicators and data might be used for this purpose;

(b) structural capital: forms of work organisation are usually ignored in R&D&I reporting. This may be due to a low level of awareness regarding the relevance of learning-intensive forms of work organisation on innovation performance. This study suggests that this relationship can be established empirically and that there are indicators available for national reporting and international comparison. For example, some of the EWCS data (especially those on cognitive factors and work organisation) could be used to design indicators for learning-intensive forms of work organisation;

(c) relational capital: some indicators of relational capital (e.g. proportion of companies cooperating in R&D with other companies or with HE institutions) are already present in national and European R&D&I monitoring and reporting. They should be complemented by data reflecting the full range of relationships that create relational capital, especially cooperation in the field of education and training (e.g. between companies and HE institutions and CVT providers). Where these indicators do not yet exist, action should be taken by policy-makers to establish them.

5.2.3. Development and use of workplace-centred programmes

Although research suggests that there are positive relations between work organisation, workplace learning and innovation, awareness and use of these relations seems to be low in many European countries; there are only very few workplace-centred programmes. Therefore, the role and function of programmes that focus on workplace organisation, work design and workplace learning should be strengthened.

As data from this study show gaps between (high) ambitions and (still considerable but lower than expected) achievements, design features of these

programmes with respect to innovative ability impacts need to be investigated in more detail:

(a) extent of and approaches to actual changes at the workplace in terms of tasks, responsibilities, work processes and technological environments;
(b) involvement and role of the social partners and other stakeholders. Attention should also be paid to organisations that provide standards and methods for work and workplace design, as actually employed in industry on a large scale (e.g. methods of time measurement in the automotive industry or the IT Infrastructure Library for IT services). It is assumed that considerable advances could be made regarding the effective and sustainable implementation of innovation-oriented work design by integrating aspects of learning intensity into these industry-standard methods (Hartmann and Garibaldo, 2011);
(c) function, design and impact of accompanying measures, for example conferences and seminars for researchers, policy-makers and experts from industry. Such accompanying measures might be essential to generate and maintain the awareness and use of the positive relations between work organisation, workplace learning and innovation;
(d) function and role of the respective programmes as 'focal points of awareness' regarding the importance of learning-intensive forms of work organisation and workplace learning for innovation. This also relates to the question as to whether these programmes should – as a further step – be used to build national 'centres of competence' (providing advice, collecting good practice examples, etc.).

5.2.4. Active involvement of social partners and other stakeholders

The social partners may play an important role in designing, implementing and transferring results from publicly funded programmes, especially those that address organisational development, work design and workplace learning. They may specifically help in raising awareness and obtaining commitment in industrial communities and individual companies.

In addition to the social partners, other organisations may also play a crucial role, including suppliers of design methods and standards, chambers of commerce and industry and industrial organisations not acting as social partners. Moreover, professional organisations in engineering, ergonomics, occupational health and other relevant areas of expertise may help to boost professional quality and credibility with respect to these programmes.

5.3. Further research

The following considers further research and some general methodological issues:

(a) the results of the study confirm the correlation between the learning intensity of work organisations, workplace learning in general and innovation. More specifically, the analyses suggest that workplace learning as well as CVT seem to play an important role. This relationship could be further investigated, e.g. by including additional framework conditions. It might also be useful to analyse the relationship to economic growth. The regression analyses could be extended with regard to analyses of microdata, e.g. along the lines of the work done by Lorenz and Valeyre (2005) and by the OECD (2010a). Further secondary data, e.g. Eurofound's European company survey (ECS), could be taken into account to include other perspectives;

(b) the correlation and causal effects in this study refer to different interlinked levels mirroring the complexity of the topic that needs to be taken into account when research is conducted: individual persons (workplace learning), individual workplaces (specific aspects of learning-intensive forms of work organisation at workplace level), organisations (specific aspects of learning-intensive forms of work organisation at organisational level; organisational culture; organisations' innovation performance) and countries (socio-economic indicators, including innovative ability and innovation performance);

(c) one finding of the study indicates a lack of awareness about some of the key relationships between organisation, learning and innovation. One reason for this is that different disciplines have different views on the respective phenomena, e.g. learning (educational sciences and psychology), organisational structures and processes (business economics, social and cultural sciences), or innovation (economics). Interdisciplinary research approaches could help us to arrive at a more coherent and comprehensive understanding.

List of abbreviations and country codes

Abbreviations	
AL	adult learning
CATI	computer-assisted telephone interview
CONF	continued training at conferences, workshops, lectures and seminars
CSR	corporate social responsibility
CVT	continuing vocational training
CVTS	continuing vocational training survey
DEACA	Danish enterprise and construction authority
EC	European Commission
ECS	European company survey
EI	Enterprise Ireland
EIS	European innovation scoreboard
EIT	European Institute of innovation and technology
EU	European Union
Eurofound	European foundation for the improvement of living and working conditions
EWCS	European working conditions survey
FLMA	questionnaire on the workplace characteristics relevant for learning
GDP	gross domestic product
HE	higher education
HR	human resources
ICT	information and communications technologies
IndiGO	indicators of gains in organisational competence
IPR	intellectual property rights
IUS	innovation union scoreboard
KSC	knowledge, skills and competences
LFS	labour force survey
OECD	Organisation for Economic Cooperation and Development
OLS	ordinary least squares
PARP	Polish agency for enterprise development
PCT	Patent cooperation treaty
R&D	research and development
R&D&I	research and development and innovation
SII	summary innovation index
SME	small and medium-sized enterprise
SPIR	strategic platforms for innovation and research
Tekes	Finnish funding agency for technology and innovation
VET	vocational education and training
VINNOVA	Swedish agency for innovation systems
WPL	workplace learning

Country codes	
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom

Annex 1.
Definitions

Formal, non-formal and informal learning

Formal learning: ‘learning that occurs in an organised and structured environment (e.g. in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). Formal learning is intentional from the learner’s point of view. It typically leads to validation and certification’ (Cedefop, 2008).

Informal learning: ‘learning resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is, in most cases, unintentional from the learner’s perspective. Informal learning outcomes do not usually lead to certification but may be validated and certified in the framework of recognition of prior learning schemes; informal learning is also referred to as experiential or incidental/random learning’ (Cedefop, 2008).

Non-formal learning: ‘learning which is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support). Non-formal learning is intentional from the learner’s point of view. (…) non-formal learning outcomes may be validated and lead to certification’ and is ‘sometimes described as semi-structured learning’ (Cedefop, 2008).

Knowledge, skills and competences

Knowledge: ‘outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of study or work’ (Cedefop, 2008). Knowledge can be divided into explicit and tacit knowledge. Individuals are usually aware of their explicit knowledge; it can be described formally, systematically and put easily into words (Nonaka and Takeuchi, 1997). Tacit knowledge is based on subjective experiences, insights and speculations (Schüppel, 1996) and influences cognitive processing, although learners are not always able to express it and are not necessarily aware of it (Cedefop, 2008). To apply knowledge in different situations, individuals have to use their skills and competences.

Skills: ‘ability to perform tasks and solve problems’ (Cedefop, 2008). Wélford defines skills ‘as a combination of factors resulting in “competent, expert, rapid

and accurate performance"' (Cedefop, 2005). Skills equip individuals with the ability to deal with their daily work tasks such as planning, execution or result monitoring.

Competence: 'ability to apply learning outcomes adequately in a defined context (education, work, personal or professional development). (…) competence is not limited to cognitive elements (involving the use of theory, concepts or tacit knowledge); it also encompasses functional aspects (involving technical skills) as well as interpersonal attributes (e.g. social or organisational skills) and ethical values' (Cedefop, 2008).

Annex 2.
Data and data analyses

Data

The variables used for the regression analysis are based on data from various surveys (e.g. CVTS or LFS) and are taken from the latest possible source. The factor and hierarchical cluster analysis used by the OECD to identify the different work organisation forms was not replicated, i.e. updated, in this study. Detailed information on the methods used by the OECD, data cleaning and chosen indicators would have been necessary for such an update. Moreover, the most recent data provided by Eurostat differs considerably in terms of the variables used.

Not all the survey data used for the purpose of this study refer to the same reference year, but this is not considered to be problematic. It would be problematic if the (relations of the) country variables changed over time. That being the case, a regression involving variables of different time frames would fail to demonstrate accurately the true relationship between these variables. Nevertheless, we assume that these differences in the point in time at which the variables were measured are not problematic, most importantly because innovation is an outcome of the effects of the variables we analyse. The variables analysed are likely to affect innovation performance with a time lag. For example, when firms begin to evaluate the working environment of their employees and invest in their training, and when working methods and tasks are altered, this does not mean that their innovation performance will increase in the same year. Employees need time to master new skills fully and to adapt to new and complex working methods and practices. Further, innovative products or processes resulting from R&D&I findings typically take years to be put into practice because of, among other things, the high level of investment required, the need for risk assessment and the planning periods involved. In addition, markets need time to respond to new products and services. These examples show that the true impact of these variables on innovation will (probably) be seen only several years after their measurement. Further, given that, for nearly all of our variables ([26]), the

([26]) The different work organisation form variables and cognitive factors represent exceptions to this statement. Regression results regarding these variables must, therefore, be interpreted with caution.

differences in measurement points are only a matter of two to three years, we assume that variable relationships remained fairly stable.

Six of the regression variables used in this study are indices ([27]) which summarise data on multiple underlying components:

(a) innovation index (2010): the innovation performance of countries is measured by the IUS. For 2010, this measure consists of 25 indicators, which are divided into three main categories: enablers, firm activities and outputs (see Section 3.2). The IUS includes input, throughput and output indicators of innovation. In connection with this study, innovation input (e.g. public or private R&D expenditure) is not relevant, since the focus is rather on actual innovation activities and results in companies. Therefore, only throughput and output parameters were summed and averaged to calculate the innovation index used in this study:
   (i) firm activities – linkages and entrepreneurship:
      - enterprises that innovate in-house,
      - innovative enterprises that collaborate with others,
      - public-private co-publications,
   (ii) firm activities – intellectual assets:
      - PCT (patent cooperation treaty) patent applications,
      - PCT patent applications in societal challenges,
      - community trademarks,
      - community designs,
   (iii) outputs – innovators:
      - enterprises that introduce product or process innovations,
      - enterprises that introduce marketing/organisational innovations,
   (iv) outputs – economic effects:
      - employment in knowledge-intensive activities,
      - medium and high-tech product exports,
      - knowledge-intensive services exports,
      - sales of new-to-market and new-to-firm innovations,

([27]) When reading the names of the indices (e.g. cognitive factors or work organisation index), it should be taken into account that the topics ('content') covered by the indices (e.g. work complexity by the cognitive factors index, autonomy by the work organisation index) do not always match their core content. For example, the indicator 'cognitive factors' would be better named 'task or work complexity', while the work organisation index refers to autonomy-related items. Nevertheless, we decided to rely on the official names to ensure better comparability and uniformity. When interpreting all regression results involving these indices, the different meanings should be taken into consideration.

- licence and patent revenues from abroad.

This choice of underlying indicators avoids the predominance of factors that are related to the innovation potential of a country but do not necessarily measure the innovative performance of enterprises.

(b) innovation output index (2010): the 2010 innovation output index was calculated in the same way as the (overall) innovation index but on the basis of only IUS output indicators. This measure allows us to compare the effects of variables on types of innovation (strictly output-related innovation versus overall innovation/innovation in outputs and firm activities);

(c) cognitive factors index: this index was calculated on the basis of data from five questions in the 2010 EWCS ([28]):
   (i) do you assess the quality of your own work? (q49b);
   (ii) does your work involve solving unforeseen problems on your own? (q49c);
   (iii) does your work involve monotonous tasks? (q49d);
   (iv) does your work involve complex tasks? (q49e);
   (v) does your work involve learning new things? (q49f);

These items clearly indicate that the index is particularly related to task-complexity aspects of work organisation (see Section 2.3). To derive the index, the percentages of employees who provided answers that demonstrated a higher learning orientation (yes to all questions except for iii, no for iii) were summed and averaged.

(d) work organisation index: this index was calculated on the basis of data from eight questions in the 2010 EWCS:
   (i) are you able to choose or change your order of tasks? (q50a);
   (ii) are you able to choose or change your methods of work? (q50b);
   (iii) are you able to choose or change your speed or rate of work? (q50c);
   (iv) are you involved in improving the work organisation or work processes of the department or organisation? (q51d);
   (v) do you have a say in the choice of your working partners? (q51e);
   (vi) can you take a break when you wish? (q51f);
   (vii) can you influence decisions that are important for your work? (q51o);
   (viii) do you work in a group or team that has common tasks and can plan its work? (q56);

([28]) In addition to the year 2010, the 2010 EWCS data file (European foundation for the improvement of living and working conditions, 2011) provides data on the years 1995, 2000 and 2005, which represent the basis for the calculation of the cognitive factors index (all years).

This index is related to the autonomy-related aspects of work organisation. Again, only answers that demonstrated a higher learning orientation were taken into account (yes to all questions).

(e) other forms of learning in enterprises index: data on the subcategories:
    (i) WS: continuing vocational training in work situation,
    (ii) JROT: job rotation, exchanges or secondments,
    (iii) LQUC: learning/quality circles,
    (iv) SLEAR: self-learning,

'Participants in other forms of CVT as a percentage of employees in all enterprises by SIZE and type of training [trng_cvts3_50]' from the CVTS 2005 questionnaire was summed and averaged to calculate this index. The fifth subcategory of this questionnaire, CONF (continued training at conferences, workshops, lectures and seminars), was excluded because it refers to learning activities that are not related to the workplace.

(f) human resource practices index: the HR index was derived using the 2009 European company survey (Eurofound, 2010) data. The following seven items that measure HR practices and work organisation in the management questionnaire were used in its calculation:
    (i) companies with autonomous team work (MM 559);
    (ii) companies that check training needs regularly (MM 561);
    (iii) companies that check training needs of permanent employees in skilled or high-skilled positions (MM 562_1);
    (iv) companies that check training needs of permanent employees in low-skilled or unskilled positions (MM 562_2);
    (v) companies that check training needs of employees with fixed-term contracts (MM 562_3);
    (vi) companies that check training needs of older employees (MM 562_4).

Data analyses

Participation in and provision of CVT, including other forms of learning in enterprises

It is assumed (assumption (d)(i)) (see Section 1.2) that participation in and provision of formal and non-formal learning – irrespective of whether it occurs within or outside enterprises – has a positive effect on innovative ability and performance. Further, it is assumed (assumption (d)(ii)) (see Section 1.2) that informal workplace learning as a specific type of learning also fosters innovation. Several different measures of participation in and provision of learning –

participation in adult learning (AL), the proportion of training enterprises, HR practices, employee participation in CVT courses, other forms of learning in enterprises and costs of CVT as a percentage of total labour costs – were analysed to investigate these assumptions. The relationship between private spending on CVT and innovation performance was not analysed because of lack of data.

Table 15 **Learning provision and participation, and innovation**

Bivariate estimation results		
Dependent	**Independent**	**Correlation coefficient**
Innovation index (2010)	Participation in AL (2009)	0.67***
Innovation index (2010)	Proportion of training enterprises as % of total (2005)	0.66***
Innovation index (2010)	HR index (2009)	0.58***
Innovation index (2010)	Employee participation in CVT courses (2005)	0.57***
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.51**
Innovation index (2010)	Costs of CVT as % of total labour cost (2005)	0.45*

*p < 0.05 (significant).
**p < 0.01 (highly significant).
***p < 0.001 (extremely significant).

Source: Authors.

Bivariate estimation results suggest that strong and significant linear relationships exist between all measures under investigation (in the EU-27 and Norway). Participation in AL and company provision of training and innovation show the highest correlations with innovation performance. Slightly lower correlations are shown by the relationships between HR index, employee participation in CVT courses and other forms of learning in enterprises.

If we compare the correlations of these further education (CVT) indicators with that of tertiary education in Figure 5 of the report, it is important that we note that both adult learning and company-provided training seem to have stronger correlations with innovation performance than tertiary education. This highlights that the focus on tertiary education in the IUS restricts the role of education and training with regard to innovation. Accordingly, the inclusion of CVT-indicators in the IUS should be considered.

In addition, Vosskamp et al. (2007) found that a relationship between age, tertiary education and innovation exists in the sense that the strength of the

association between tertiary education and innovation depends on the age of the tertiary educated employees. Accordingly, particularly strong links were found between the proportion of tertiary educated employees aged 45 to 54 – and mainly for ISCED 5B but not for ISCED 5A/6 – and innovation. This could suggest that tertiary education may have to be complemented with CVT, including workplace learning. The findings in this study as well as that of Vosskamp et al. indicate that tertiary education itself is not sufficient to make a significant contribution to innovation, an assumption that needs further investigation.

Table 16 **CVT provision and participation, and innovation (multivariate analyses)**

Multivariate estimation results			
Dependent	**Independent**	**Beta coefficient**	**R^2**
Innovation index (2010)	Cognitive factors (all years)	0.65***	0.72
	HR index (2009)	0.14	
	Participation in AL (2009)	0.14	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.19	0.59
	HR index (2009)	0.38*	
	GDP per capita (2010)	0.46**	

*p < 0.05 (significant).
**p < 0.01 (highly significant).
***p < 0.001 (extremely significant).

Source: Authors.

Table 16 shows that HR practices – although less of an innovation driver than GDP per capita – contribute more to innovation performance than the activities measured with the other forms of learning in enterprises index. The effect of these other forms of learning on overall innovation is comparatively low, both when regressed together with participation in AL and the HR index. This shows how correlations in bivariate analyses mainly capture the correlations between these other two measures and innovation performance. Other outcomes are also prone to omitted variable bias. Table 16 depicts how the positive effects of participation in AL and human resource practices on innovation performance observed earlier become insignificant when the extremely significant variable cognitive factors are included in the estimation. These observations exemplify how even seemingly robust multivariate analyses can still be biased with respect to endogeneity. The multivariate regressions indicate that other forms of learning in enterprises as measured here on the basis of CVTS3 are dominated by HR

policies and, in particular, GDP per capita. However, the results also suggest that other forms of learning, participation in AL and the HR index must be interpreted with caution, as these factors are interconnected and are, therefore, difficult to analyse separately in a reliable way ([29]). Important correlations between task-complexity aspects of work organisation and other variables seem to exist.

To sum up, a broad range of indicators of adult learning and CVT (in single variable form) correlate significantly with innovation performance indicators. In addition to the observations of Section 4.3, this lends further support to assumption (d)(i) (see Section 1.2). With regard to (d)(ii), the interpretation of the results is somewhat less straightforward. The data at hand are unable to detect correlations between the – rather narrowly defined – other forms of learning in enterprises index, derived from CVTS data, and innovation performance. Nevertheless, this relation is insignificant if task-complexity aspects of work organisation (cognitive factors) are also accounted for ([30]). If we accept these cognitive factors as a proxy of informal work-inherent learning ('learning while working') – assumption (d) (ii) (see Section 1.2) may also be regarded as principally supported by the findings.

Work organisation forms

This section aims to investigate whether the analyses of the OECD (2010a) and Lorenz and Valeyre (2005) still hold good if the different work organisation forms are related to the innovation index (UNU-MERIT, 2011).

([29]) It would appear worthwhile to investigate the relationship between these different variables in greater depth.

([30]) It must be taken into account that the other forms of learning in enterprises index used in this analysis covers only very specific, intermittent incidents of learning at or near the workplace, such as quality circles or self-organised learning. Many important aspects of workplace learning that are associated with factors of learning-intensity of workplaces are much better accounted for by the task-complexity aspects of work organisation.

Table 17 **Work organisation forms and innovation**

Bivariate estimation results			
Dependent	**Independent**	**Correlation coefficient**	
	Work organisation classes		
Innovation index (2010)	Discretionary learning (2005)	0.60***	
Innovation index (2010)	Taylorist (2005)	-0.55**	
Innovation index (2010)	Lean production (2005)	-0.28	
Innovation index (2010)	Traditional or simple (2005)	-0.28	
Multivariate estimation results			
Dependent	**Independent**	**Beta coefficient**	**R^2**
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.28	0.44
	Discretionary learning (2005)	0.49**	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.16	0.70
	Discretionary learning (2005)	0.14	
	R&D/GDP (2009)	0.65**	

*p < 0.05 (significant).
**p < 0.01 (highly significant).
***p < 0.001 (extremely significant).

Source: Authors.

The bivariate estimation results for the EU-27 countries and Norway highlight that discretionary learning proves to be the only work organisation form which has a high and positive correlation with innovation (r of 0.60). This work organisation form places special importance on intrinsic motivation, autonomy, learning, problem-solving and freedom of constraints in the skills development process. It is typically used in service sectors and is predominantly practiced in the Scandinavian countries and the Netherlands (OECD, 2010a). Multivariate analysis that includes only other forms of learning in enterprises as a control variable may lead to the conclusion that discretionary learning contributes significantly to innovation performance. Nevertheless, this relationship seems to

be biased with respect to endogeneity, as it becomes insignificant when R&D/GDP is included in the regression model.

Taylorism seems to have a highly significant negative effect on innovation. This particular work organisation form is characterised by low levels of discretion, learning and problem-solving. Besides being typical of the southern EU-15 countries as well as Bulgaria, Cyprus, the Czech Republic, Hungary and Romania, taylorism is commonly used by organisations in the textile and goods industry (ibid.). The correlations between lean production and traditional or simple work organisation and innovation in the EU-27 and Norway are weak (r of -0.28) and negligible. These work organisation forms do not appear to be associated with innovation performance.

In general, despite correlations between discretionary learning, taylorism and innovation performance, multivariate data analyses are unable to detect any relationships between different work organisation forms and innovation performance when important control variables (such as framework conditions) are accounted for. Accordingly, while correlations between discretionary learning and innovation are in line with the 2010a OECD study, the same cannot be considered to be the case for multivariate results (also in Annex 2). Given that the definition of these work organisation forms covers a wide range of concepts (related to types of learning, autonomy and task complexity), it is interesting to analyse these aspects separately to see whether relationships between them and innovation hold good.

Task-complexity aspects of work organisation (cognitive factors)

The following tables show the extent to which cognitive factors measured by the 2010 EWCS (aspects of work organisation that define or moderate the complexity of work tasks) influence innovation, labour productivity per hour and human resource practices.

The results suggest that task-complexity aspects of work organisation (cognitive factors) are actually the most important component related to the workplace in promoting innovation. The high importance of this factor is already suggested by its high and significant correlation with innovation performance (r of 0.82). Its contribution – greater than that of any other factor – to innovation performance is shown by the fact that this result proves to be robust against the inclusion of various control variables likely to be strongly linked to innovation, such as GDP per capita, R&D in relation to GDP and participation in adult learning (see Table 1: ‘Human, structural and relational capital as determinants of innovative ability’). Similar relationships with innovation were shown in bivariate

estimates, and several such relationships were even observed in multivariate analyses. In addition, all results have a high R^2 of approx. 0.70.

Table 18 **Estimations of cognitive factors**

Bivariate estimation results			
Dependent	**Independent**	**Correlation coefficient**	
Innovation index (2010)	Cognitive factors (all years)	0.82***	
Labour productivity per hour (2009)	Cognitive factors (all years)	0.60***	
HR index (2009)	Cognitive factors (all years)	0.56***	
Multivariate estimation results			
Dependent	**Independent**	**Beta coefficient**	**R^2**
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.21	0.74
	Cognitive factors (all years)	0.68	
	Share of tertiary education (2005)	0.16	

* p < 0.05 (significant).
** p < 0.01 (highly significant).
*** p < 0.001 (extremely significant).

Source: Authors.

Estimation results suggest that task-complexity aspects of work organisation and human resource practices (HR) are correlated in the EU-27 and Norway (r of 0.56) and that this relation is extremely significant. It may be assumed that, in countries with high numbers of workplaces that involve complex tasks, the enterprises' management regularly (need to) assess demands to improve working conditions and develop their staff's KSC. This helps to identify not only KSC gaps but also staff development potentials at the workplace. This observation suggests that one of the positive externalities of higher task complexity may be that employers are better placed to understand the specific needs of their employees and will therefore evaluate the environment in which they are working or may recognise that structured HR development policies are a precondition of task complexity. Another explanation could be that task complexity is high in working environments characterised by rapid change, e.g. environments in which employees work with the latest technologies. In such

working environments, employers may be required continuously to update the skills of their employees to enable them to work with the new technologies.

In conclusion, these results confirm assumption (c)(i) (see Section 1.2). This demonstrates that task-complexity aspects of work organisation have a positive effect on innovation. In combination with the observations of Section 4.3, this suggests that task complexity is (among) the most important driver(s) of innovation.

Autonomy-related aspects of work organisation

Previous sections discussed the analysis of the relations between different work organisation forms and specific work organisation-related aspects (task complexity) and innovation performance. Findings suggest that work organisation forms as such do not significantly contribute to innovation performance, while the opposite is true for task complexity aspects of work organisation (cognitive factors). As the level of autonomy in the workplace (autonomy-related aspects of work organisation) is used, *inter alia*, to define different work organisation forms, it is interesting to investigate its role and effects on innovation.

Bivariate regression results suggest that no significant association can be found between autonomy-related aspects of work organisation and innovation performance. Various calculations were carried out in an attempt to identify factors related to autonomy-related aspects of work organisation (such as GDP per capita and cognitive factors) so as to investigate whether the failure to account for these in bivariate analyses biased results or whether autonomy-related aspects of work organisations correlated only with output-related innovation. Nevertheless, all analyses found negligible effects of autonomy-related aspects of work organisation on innovation performance.

Regression tables

Table 19 **Estimation results of the EU-27 and Norway**

Dependent	Independent	C	Sig. C	B	Beta	Sig.	R^2
Innovation index (2010)	R&D/GDP (2009)	0.19	0.00	0.15	0.81	0.00	0.66
Innovation output index (2010)	R&D/GDP (2009)	0.21	0.00	0.03	0.52	0.01	0.27
Innovation index (2010)	GDP per capita (2010)	0.20	0.01	0.00	0.61	0.00	0.37
Innovation output index (2010)	GDP per capita (2010)	0.19	0.00	0.00	0.63	0.00	0.39
Innovation index (2010)	Cognitive factors (all years)	-0.40	0.00	1.35	0.82	0.00	0.67
Innovation output index (2010)	Cognitive factors (all years)	0.07	0.18	0.18	0.60	0.00	0.36
Innovation index (2010)	Labour productivity per hour (2009)	0.15	0.05	0.35	0.66	0.00	0.43
Innovation index (2010)	Participation in AL (LFS)	0.28	0.00	1.61	0.67	0.00	0.45
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.23	0.01	3.26	0.51	0.01	0.26
Innovation index (2010)	Workers in tertiary sector (2010)	0.17	0.16	0.88	0.40	0.03	0.16
Innovation index (2010)	Work organisation index (2010)	-0.09	0.79	0.95	0.32	0.10	0.10
Innovation output index (2010)	Work organisation index (2010)	0.22	0.04	0.07	0.07	0.73	0.00
Innovation index (2010)	Costs of CVT as % of total labour cost (2005)	0.18	0.10	0.17	0.45	0.02	0.21
Innovation index (2010)	Discretionary learning (2005)	0.09	0.34	0.91	0.60	0.00	0.36
Innovation index (2010)	Taylorist (2005)	0.68	0.00	-1.32	-0.55	0.00	0.31
Innovation index (2010)	Lean production (2005)	0.70	0.00	-0.98	-0.28	0.15	0.08
Innovation index (2010)	Traditional or simple (2005)	0.61	0.00	-1.00	-0.28	0.14	0.08
Innovation index (2010)	Share of training enterprises as % of total (2005)	0.08	0.38	0.61	0.66	0.00	0.43
Innovation index (2010)	Employee participation in CVT courses (2005)	0.17	0.04	0.83	0.57	0.00	0.32
Innovation index (2010)	Share of tertiary education (2005)	0.17	0.10	1.16	0.49	0.01	0.24
Innovation output index (2010)	HR index (2009)	0.05	0.46	0.35	0.50	0.01	0.25

Innovation index (2010)	HR index (2009)	-0.35	0.13	1.35	0.58	0.00	0.34
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.13	0.03	1.21	0.18	0.21	0.69
	R&D/GDP (2009)			0.14	0.73	0.00	
Innovation index (2010)	Work organisation index (2010)	0.63	0.04	-0.71	-0.23	0.24	0.48
	Participation in AL (2009)			1.99	0.82	0.00	
Innovation index (2010)	Cognitive factors (all years)	-0.38	0.01	1.20	0.70	0.00	0.68
	GDP per capita (2010)			0.00	0.18	0.23	
Innovation output index (2010)	Cognitive factors (all years)	0.13	0.02	0.12	0.25	0.23	0.43
	GDP per capita (2010)			0.06	0.48	0.03	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.11	0.19	2.19	0.34	0.06	0.47
	GDP per capita (2010)			0.00	0.49	0.01	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.41	0.00	1.60	0.25	0.05	0.82
	Cognitive factors (all years)			1.21	0.73	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.04	0.90	2.92	0.45	0.02	0.28
	Work organisation index (2010)			0.52	0.17	0.35	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.09	0.40	2.47	0.38	0.04	0.36
	Share of tertiary education (2005)			0.83	0.35	0.07	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.04	0.72	1.81	0.28	0.12	0.44
	Discretionary learning (2005)			0.75	0.49	0.01	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.05	0.56	0.89	0.14	0.50	0.45
	Share of training enterprises as a % of total (2005)			0.56	0.57	0.01	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.12	0.18	1.79	0.28	0.17	0.38
	Employee participation in CVT courses (2005)			0.64	0.42	0.04	

Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.22	0.00	1.11	0.17	0.35	0.49
	Participation in AL (2009)			1.45	0.58	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.46	0.03	2.96	0.46	0.02	0.30
	Lean production (2005)			-0.01	-0.22	0.23	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.38	0.01	1.26	0.20	0.15	0.71
	Cognitive factors (all years)			1.09	0.64	0.00	
	GDP per capita (2010)			0.00	0.15	0.33	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.08	0.02	1.22	0.19	0.17	0.73
	Participation in AL (2009)			0.38	0.15	0.37	
	Cognitive factors (all years)			1.08	0.65	0.00	
Innovation index (2010)	Workplace learning (2005)	-0.44	0.00	1.34	0.21	0.10	0.74
	Cognitive factors (all years)			1.14	0.68	0.00	
	Share of tertiary education (2005)			0.39	0.16	0.19	
Innovation output index (2010)	Work organisation index (2010)	0.15	0.08	-0.19	-0.21	0.22	0.40
	Cognitive factors (all years)			0.34	0.67	0.00	
Innovation index (2010)	Work organisation index (2010)	-0.46	0.03	0.14	0.05	0.70	0.67
	Cognitive factors (all years)			1.33	0.80	0.00	
Innovation index (2010)	Work organisation index (2010)	-0.08	0.76	-0.39	-0.13	0.39	0.71
	Participation in AL (2009)			0.01	0.35	0.07	
	Cognitive factors (all years)			1.06	0.64	0.00	
Innovation index (2010)	Work organisation new (2010)	-0.36	0.10	-0.04	-0.01	0.93	0.68
	Cognitive factors (all years)			1.21	0.71	0.00	
	GDP per capita (2010)			0.00	0.18	0.26	
Innovation index (2010)	Work organisation index (2010)	-0.39	0.07	-0.12	-0.04	0.76	0.71
	Cognitive factors (all years)			1.32	0.74	0.00	
	Share of tertiary education (2005)			0.53	0.23	0.09	

Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.37	0.10	1.24	0.19	0.26	0.59
	HR index (2009)			0.94	0.38	0.03	
	GDP per capita (2010)			0.00	0.46	0.01	
Innovation index (2010)	Cognitive factors (all years)	-0.47	0.02	1.11	0.65	0.00	0.72
	HR index (2009)			0.32	0.14	0.33	
	Participation in AL (2009)			0.36	0.14	0.40	
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	0.01	0.83	0.09	0.35	0.08	0.12
Other forms of learning in enterprises index (2005)	Participation in AL (2009)	0.04	0.00	0.22	0.57	0.00	0.32
Other forms of learning in enterprises index (2005)	Work organisation index (2010)	-0.01	0.78	0.14	0.30	0.14	0.09
Other forms of learning in enterprises index (2005)	Workers in tertiary sector (2010)	0.04	0.10	0.09	0.25	0.23	0.06
Other forms of learning in enterprises index (2005)	Costs of CVT as % of total labour cost (2005)	0.01	0.41	0.03	0.53	0.01	0.29
Other forms of learning in enterprises index (2005)	HR index (2009)	-0.04	0.38	0.17	0.44	0.03	0.20
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	0.00	0.98	0.08	0.31	0.22	0.19
	GDP per capita (2010)			0.00	0.16	0.52	
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	-0.04	0.50	0.07	0.28	0.17	0.16
	Work organisation index (2010)			0.10	0.21	0.32	
Work organisation index (2010)	Cognitive factors (all years)	0.44	0.00	0.18	0.33	0.08	0.11
Work organisation index (2010)	Costs of CVT as % of total labour cost (2005)	0.49	0.00	0.04	0.30	0.12	0.09
Work organisation index (2010)	Workers in tertiary sector (2010)	0.47	0.00	0.28	0.39	0.04	0.15
Work organisation index (2010)	Other forms of learning in enterprises index (2005)	0.51	0.00	0.65	0.30	0.14	0.09
Work organisation index (2010)	HR index (2009)	0.47	0.00	0.13	0.18	0.38	0.03

Work organisation index (2010)	Cognitive factors (all years)	0.40	0.00	0.29	0.52	0.04	0.18
	GDP per capita (2010)			0.00	-0.21	0.38	
Work organisation index (2010)	Cognitive factors (all years)	0.44	0.00	0.14	0.25	0.23	0.15
	Other forms of learning in enterprises index (2005)			0.45	0.21	0.32	
Cognitive factors (all years)	Innovation index (2010)	0.40	0.00	0.49	0.82	0.00	0.67
Cognitive factors (all years)	Innovation output index (2010)	0.31	0.00	1.18	0.60	0.00	0.36
Cognitive factors (all years)	Workplace learning (2005)	0.53	0.00	1.37	0.35	0.08	0.12
Cognitive factors (all years)	HR index (2009)	0.18	0.20	0.76	0.56	0.00	0.31
Cognitive factors (all years)	Work organisation index (2010)	0.15	0.33	0.61	0.33	0.04	0.48
	GDP per capita (2010)			0.00	0.58	0.00	
Participation in AL (2009)	Workplace learning (2005)	0.00	0.87	1.47	0.57	0.00	0.32
Participation in AL (2009)	Innovation index (2010)	-0.02	0.45	0.28	0.67	0.00	0.45
Participation in AL (2009)	HR index (2009)	-0.21	0.03	0.53	0.56	0.00	0.31
Labour productivity per hour (2009)	Cognitive factors (all years)	-0.31	0.32	1.85	0.60	0.00	0.36
Labour productivity per hour (2009)	Other forms of learning in enterprises index (2005)	0.48	0.32	5.43	0.45	0.02	0.20
Labour productivity per hour (2009)	Work organisation index (2010)	0.00	1.00	1.51	0.27	0.17	0.07
Labour productivity per hour (2009)	Other forms of learning in enterprises index (2005)	0.09	0.69	4.36	0.36	0.05	0.38
	Workers in tertiary sector (2010)			1.54	0.36	0.05	
Labour productivity per hour (2009)	Work organisation index (2010)	0.00	0.99	0.57	0.10	0.60	0.23
	Workers in tertiary sector (2010)			1.73	0.43	0.03	
HR index (2009)	Cognitive factors (all years)	0.33	0.00	0.41	0.56	0.00	0.31
Discretionary learning (2005)	HR index (2009)	0.09	0.59	0.48	0.33	0.10	0.11

Source: Authors.

Table 20 **Estimation results of the EU-27**

Dependent	Independent	C	Sig. C	B	Beta	Sig.	R^2
Innovation index (2010)	R&D/GDP (2009)	0.19	0.00	0.15	0.82	0.00	0.67
Innovation output index (2010)	R&D/GDP (2009)	0.21	0.00	0.03	0.54	0.00	0.29
Innovation index (2010)	GDP per capita (2010)	0.20	0.01	0.00	0.61	0.00	0.37
Innovation output index (2010)	GDP per capita (2010)	0.19	0.00	0.00	0.63	0.00	0.39
Innovation index (2010)	Cognitive factors (all years)	-0.45	0.00	1.42	0.83	0.00	0.69
Innovation output index (2010)	Cognitive factors (all years)	0.07	0.20	0.31	0.59	0.00	0.34
Innovation index (2010)	Labour productivity per hour (2009)	0.09	0.19	0.43	0.74	0.00	0.55
Innovation index (2010)	Participation in AL (LFS)	0.28	0.00	1.71	0.69	0.00	0.46
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.22	0.01	3.51	0.53	0.01	0.28
Innovation index (2010)	Workers in tertiary sector (2010)	0.17	0.18	0.90	0.41	0.03	0.17
Innovation index (2010)	Work organisation index (2010)	-0.16	0.62	1.10	0.35	0.07	0.12
Innovation output index (2010)	Work organisation index (2010)	0.22	0.04	0.07	0.07	0.73	0.00
Innovation index (2010)	Costs of CVT as % of total labour cost (2005)	0.18	0.11	0.17	0.45	0.02	0.20
Innovation index (2010)	Discretionary learning (2005)	0.06	0.54	1.02	0.65	0.00	0.42
Innovation index (2010)	Taylorist (2005)	0.73	0.00	-1.52	-0.61	0.00	0.37
Innovation index (2010)	Lean production (2005)	0.70	0.00	-0.97	-0.28	0.16	0.08
Innovation index (2010)	Traditional or simple (2005)	0.63	0.00	-1.12	-0.31	0.12	0.09
Innovation index (2010)	Share of training enterprises as % of total (2005)	0.05	0.57	0.67	0.70	0.00	0.49
Innovation index (2010)	Employee participation in CVT courses (2005)	0.17	0.05	0.83	0.57	0.00	0.32
Innovation index (2010)	Share of tertiary education (2005)	0.15	0.14	1.26	0.52	0.01	0.27
Innovation output index (2010)	HR index (2009)	0.05	0.46	0.35	0.50	0.01	0.25
Innovation index (2010)	HR index (2009)	-0.35	0.13	1.35	0.58	0.00	0.34

Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.13	0.04	1.44	0.21	0.15	0.70
	R&D/GDP (2009)			0.13	0.72	0.00	
Innovation index (2010)	Work organisation index (2010)	0.55	0.08	-0.56	-0.18	0.36	0.50
	Participation in AL (2009)			1.99	0.81	0.00	
Innovation index (2010)	Cognitive factors (all years)	-0.38	0.01	1.20	0.70	0.00	0.68
	GDP per capita (2010)			0.00	0.18	0.23	
Innovation output index (2010)	Cognitive factors (all years)	0.13	0.02	0.12	0.25	0.23	0.43
	GDP per capita (2010)			0.06	0.48	0.03	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.11	0.19	2.19	0.34	0.06	0.47
	GDP per capita (2010)			0.00	0.49	0.01	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.43	0.00	1.40	0.21	0.10	0.72
	Cognitive factors (all years)			1.26	0.74	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.14	0.64	3.14	0.48	0.02	0.33
	Work organisation index (2010)			0.70	0.22	0.23	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.05	0.61	2.73	0.41	0.03	0.42
	Share of tertiary education (2005)			0.95	0.38	0.04	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.01	0.94	2.03	0.31	0.07	0.52
	Discretionary learning (2005)			0.85	0.53	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.02	0.85	1.01	0.15	0.43	0.52
	Share of training enterprises as a % of total (2005)			0.63	0.62	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.12	0.19	2.03	0.31	0.14	0.39

	Employee participation in CVT courses (2005)			0.60	0.40	0.06	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.21	0.00	1.34	0.20	0.25	0.54
	Participation in AL (2009)			1.53	0.60	0.00	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	0.43	0.05	3.20	0.48	0.01	0.32
	Lean production (2005)			-0.72	-0.20	0.28	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.38	0.01	1.26	0.20	0.15	0.71
	Cognitive factors (all years)			1.09	0.64	0.00	
	GDP per capita (2010)			0.00	0.15	0.33	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.37	0.03	1.18	0.18	0.20	0.73
	Participation in AL (2009)			0.30	0.12	0.52	
	Cognitive factors (all years)			1.14	0.66	0.00	
Innovation index (2010)	Other forms of learning in enterprises (2005)	0.45	0.00	1.26	0.19	0.14	0.74
	Cognitive factors (all years)			1.17	0.68	0.00	
	Share of tertiary education (2005)			0.36	0.14	0.27	
Innovation output index (2010)	Work organisation index (2010)	0.16	0.07	-0.23	-0.24	0.20	0.39
	Cognitive factors (all years)			0.36	0.69	0.00	
Innovation index (2010)	Work organisation index (2010)	-0.37	0.10	-0.13	-0.04	0.76	0.67
	Cognitive factors (all years)			1.41	0.83	0.00	
Innovation index (2010)	Work organisation index (2010)	-0.11	0.70	-0.45	-0.14	0.34	0.72
	Participation in AL (2009)			0.71	0.29	0.14	
	Cognitive factors (all years)			1.17	0.68	0.00	
Innovation index (2010)	Work organisation index (2010)	-0.36	0.10	-0.04	-0.01	0.93	0.68
	Cognitive factors (all years)			1.21	0.71	0.00	

	GDP per capita (2010)			0.00	0.18	0.26	
Innovation index (2010)	Work organisation index (2010)	-0.36	0.09	-0.24	-0.08	0.55	0.72
	Cognitive factors (all years)			1.33	0.78	0.00	
	Share of tertiary education (2005)			0.46	0.19	0.16	
Innovation index (2010)	Other forms of learning in enterprises index (2005)	-0.37	0.10	1.24	0.19	0.26	0.59
	HR index (2009)			0.94	0.38	0.03	
	GDP per capita (2010)			0.00	0.46	0.01	
Innovation index (2010)	Cognitive factors (all years)	-0.47	0.02	1.11	0.65	0.00	0.72
	HR index (2009)			0.32	0.14	0.33	
	Participation in AL (2009)			0.36	0.14	0.40	
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	-0.01	0.79	0.11	0.43	0.03	0.19
Other forms of learning in enterprises index (2005)	Participation in AL (2009)	0.04	0.00	0.21	0.55	0.00	0.30
Other forms of learning in enterprises index (2005)	Work organisation index (2010)	0.00	0.95	0.12	0.25	0.23	0.06
Other forms of learning in enterprises index (2005)	Workers in tertiary sector (2010)	0.05	0.01	0.00	0.12	0.61	0.01
Other forms of learning in enterprises index (2005)	Costs of CVT as % of total labour cost (2005)	0.01	0.56	0.03	0.58	0.00	0.33
Other forms of learning in enterprises index (2005)	HR index (2009)	-0.04	0.38	0.17	0.44	0.03	0.20
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	0.00	0.98	0.08	0.31	0.22	0.19
	GDP per capita (2010)			0.00	0.16	0.52	
Other forms of learning in enterprises index (2005)	Cognitive factors (all years)	-0.02	0.67	0.10	0.40	0.07	0.19
	Work organisation index (2010)			0.03	0.07	0.74	
Work organisation index (2010)	Cognitive factors (all years)	0.40	0.00	0.24	0.44	0.02	0.20

Work organisation index (2010)	Costs of CVT as % of total labour cost (2005)	0.48	0.00	0.04	0.35	0.08	0.12
Work organisation index (2010)	Workers in tertiary sector (2010)	0.47	0.00	0.26	0.38	0.05	0.15
Work organisation index (2010)	Other forms of learning in enterprises index (2005)	0.51	0.00	0.52	0.25	0.23	0.06
Work organisation index (2010)	HR index (2009)	0.47	0.00	0.13	0.18	0.38	0.03
Work organisation index (2010)	Cognitive factors (all years)	0.40	0.00	0.29	0.52	0.04	0.18
	GDP per capita (2010)			0.00	-0.21	0.38	
Work organisation index (2010)	Cognitive factors (all years)	0.40	0.00	0.22	0.41	0.07	0.20
	Other forms of learning in enterprises index (2005)			0.15	0.07	0.74	
Cognitive factors (all years)	Innovation index (2010)	0.41	0.00	0.49	0.83	0.00	0.69
Cognitive factors (all years)	Innovation output index (2010)	0.33	0.00	0.01	0.59	0.00	0.34
Cognitive factors (all years)	Workplace learning (2005)	0.52	0.00	1.67	0.43	0.03	0.19
Cognitive factors (all years)	HR index (2009)	0.18	0.20	0.76	0.56	0.00	0.31
Cognitive factors (all years)	Work organisation index (2010)	0.15	0.33	0.61	0.33	0.04	0.48
	GDP per capita (2010)			0.00	0.57	0.00	
Participation in AL (2009)	Other forms of learning in enterprises (2005)	0.69	0.82	1.42	0.55	0.00	0.30
Participation in AL (2009)	Innovation index (2010)	-0.03	0.33	0.28	0.69	0.00	0.46
Participation in AL (2009)	HR index (2009)	-0.21	0.03	0.53	0.56	0.00	0.31
Labour productivity per hour (2009)	Cognitive factors (all years)	-0.64	0.01	2.31	0.79	0.00	0.62
Labour productivity per hour (2009)	Other forms of learning in enterprises index (2005)	0.51	0.00	4.53	0.40	0.05	0.16
Labour productivity per hour (2009)	Work organisation index (2010)	0.31	0.61	9.16	0.17	0.40	0.03
Labour	Other forms of	0.15	0.52	3.59	0.32	0.10	0.29

productivity per hour (2009)	learning in enterprises index (2005)						
	Workers in tertiary sector (2010)			1.45	0.37	0.06	
Labour productivity per hour (2009)	Work organisation index (2010)	31.08	0.57	-0.06	-0.01	0.95	0.29
	Workers in tertiary sector (2010)			1.77	0.48	0.02	
HR index (2009)	Cognitive factors (all years)	0.33	0.00	0.41	0.56	0.00	0.31
Discretionary learning (2005)	HR index (2009)	0.09	0.59	0.48	0.33	0.10	0.11

Source: Authors.

Table 21 **List of values of the EU-27 and Norway (additional variables)**

Lean production (2005)		Taylorist (2005)		Traditional or simple (2005)		GDP per capita (2010)		R&D/GDP (2010)		Workers in tertiary sector (2010)		Share of tertiary education (2005)	
MT	0.34	SK	0.34	ES	0.28	LU	271.00	FI	3.96	FI	0.42	FI	0.35
UK	0.33	PT	0.32	CY	0.26	NL	131.00	SE	3.62	IE	0.42	DK	0.34
EE	0.33	BG	0.30	EL	0.24	IE	127.00	DK	3.02	BE	0.41	EE	0.33
LV	0.33	RO	0.28	LT	0.23	AT	124.00	DE	2.82	LU	0.39	NO	0.33
RO	0.33	ES	0.26	CZ	0.22	DK	121.00	AT	2.75	CY	0.39	BE	0.31
PL	0.31	EL	0.25	BG	0.21	SE	119.00	FR	2.21	UK	0.38	NL	0.30
SI	0.31	HU	0.24	HU	0.20	BE	116.00	BE	1.96	EE	0.37	UK	0.30
FI	0.31	CZ	0.23	IE	0.20	DE	116.00	UK	1.87	LT	0.37	IE	0.30
LT	0.31	LT	0.22	UK	0.20	ES	113.00	SI	1.86	DK	0.36	SE	0.30
PT	0.30	CY	0.22	DE	0.19	UK	112.00	NL	1.84	SE	0.36	CY	0.29
LU	0.29	IT	0.21	SI	0.18	FI	108.00	NO	1.80	NL	0.35	ES	0.28
EL	0.29	PL	0.20	SK	0.18	IT	104.00	IE	1.77	ES	0.35	LU	0.27
DK	0.28					EL	103.00	LU	1.68	NO	0.34	LT	0.26
NO	0.28	Average	0.19	Average	0.17			PT	1.66	FR	0.33	FR	0.25
BG	0.28					Average	100.12					DE	0.25
		DE	0.18	BE	0.17			Average	1.63	Average	0.30		
Average	0.27	AT	0.18	IT	0.16	CY	98.00					Average	0.23
		FR	0.18	PL	0.15	FR	94.00	CZ	1.53	LV	0.30		
IE	0.27	LV	0.17	EE	0.15	SI	88.00	EE	1.42	DE	0.29	BG	0.22
BE	0.25	SI	0.17	LV	0.15	CZ	82.00	ES	1.38	EL	0.28	EL	0.21
CZ	0.25	BE	0.17	RO	0.15	MT	80.00	IT	1.27	SI	0.28	LV	0.21
ES	0.25	UK	0.17	LU	0.14	PT	80.00	HU	1.15	PL	0.28	SI	0.20
FR	0.25	LU	0.13	FI	0.13	SK	73.00	LT	0.84	BG	0.27	AT	0.18
CY	0.25	NL	0.12	PT	0.13	HU	65.00	PL	0.68	HU	0.23	HU	0.17
IT	0.24	EE	0.11	AT	0.13	EE	64.00	MT	0.54	AT	0.22	PL	0.17
NL	0.23	FI	0.11	NL	0.13	PL	61.00	BG	0.53	SK	0.19	SK	0.14
AT	0.21	IE	0.11	FR	0.11	LT	55.00	SK	0.48	MT	0.19	CZ	0.13
DE	0.20	MT	0.11	SE	0.11	LV	52.00	RO	0.47	CZ	0.18	PT	0.13
SK	0.19	DK	0.08	NO	0.10	RO	46.00	CY	0.46	IT	0.18	IT	0.12
HU	0.16	SE	0.07	DK	0.10	BG		LV	0.46	PT	0.17	MT	0.11
SE	0.15	NO	0.06	MT	0.08	NO		EL		RO	0.17	RO	0.11

Source: Authors.

Annex 3.
Contact points and CATIs overview

Contact points

Table 22 **Institutions contacted for interviews**

Country	Contact points
Austria	Federal Ministry of Transport, Innovation and Technology Austrian Research Promotion Agency Federal Ministry of Economy, Family and Youth
Belgium	Agency for Innovation by Science and Technology Department of Economics, Science and Innovation (Flemish Government) Department of Social Economy of the Flemish Government Flanders Synergy Flemish Council for Science and Innovation Social and Economic Council of Flanders Ministry of the Walloon Region, Directorate General operational for Economy, Employment and Research Ministry of the Brussels-Capital Region
Bulgaria	Bulgarian Small and Medium Enterprises Promotion Agency (BSMEPA) Bulgarian Chamber of Commerce and Industry ECORYS Holding BV Foundation for Entrepreneurship Development (FED) innovation relay centre
Cyprus	Cyprus Chamber of Commerce and Industry Human Resource Development Authority of Cyprus Research Promotion Foundation (RPF)
Czech Republic	Ministry of Industry and Trade (MPO) Ministry of Education, Youth and Sport Ministry of Labour and Social Affairs Technology Agency of the Czech Republic technology centre ASCR (TACR)
Denmark	Danish Agency for Science, Technology and Innovation Danish Enterprise and Construction Authority Danish Ministry of Science, Technology and Innovation
Estonia	Archimedes Foundation enterprise Estonia (EAS)

Finland	Finnish Funding Agency for Technology and Innovation (Tekes) Finnish work environment fund
France	agence nationale de la recherche (ANR) centre technique des industries mécaniques (CETIM) OSÉO innovation (OSEO) Pacte PME international
Germany	Deutsches Zentrum für Luft- und Raumfahrt eV Senatsverwaltung für Wirtschaft Technologie und Forschung Berlin VDI/VDE Innovation und Technik GmbH
Greece	Ministry of Education, Research and Technology Ministry of Industry Ministry of Regional Development and Competitiveness national documentation centre (EKT) National Hellenic Research Foundation (NHRF)
Hungary	business innovation centre National Innovation Office (NIH)
Ireland	Enterprise Ireland (EI) Irish Business and Employers' Confederation (IBEC) Irish Small and Medium Enterprises Association (ISME) National Centre for Partnership and Performance (NESC) SkillNETS Small Firm Association (SFA)
Italy	Agenzia Nazionale LLP ASTER (Regional Agency of Emilia-Romagna) AREA science park (Research institution/cluster in Trieste region) institute for the vocational training of workers (ISFOL) Italia Lavoro (ItalJob) Lombardy region Ministry of Labour and Social Policies Ministry of Economic Development National Agency for Innovation Tuscany region
Latvia	Latvijas Tehnoloģiskais Centrs (Latvian technological centre) Investment and Development Agency of Latvia (LIAA) Ministry of Finance Latvian Academy of Sciences Ministry of Education and Science Ministry of Welfare and Social Affairs
Lithuania	Lithuanian Innovation Centre Ministry of Economy of the Republic of Lithuania Public Policy and Management Institute European Social Fund Agency

Luxembourg	national research fund National Agency for Innovation and Research (Luxinnovation) Ministry of Economy and Foreign Commerce public research centre Henri Tudor fonds national de la recherche
Malta	Malta Council for Science and Technology (MCST) Employment and Training Corporation (ETC) Malta college of arts, science and technology (MCAST) Malta enterprise (ME)
Netherlands	Netherlands Centre for Social Innovation (NCSI) Netherlands Organisation for Applied Scientific Research (TNO) Ministry of Economic Affairs, Agriculture and Innovation Syntens innovation centre
Norway	The Research Council of Norway (Forskningsrådet) innovation Norway Norwegian Confederation of Trade Unions: Landsorganisasjonen i Norge Norwegian Agency for Lifelong Learning, agency of the Norwegian Ministry of Education and Research (Vox) Nordic-Baltic research and innovation programme on living labs (LILAN)
Poland	Narodowe Centrum Badań i Rozwoju, NCBiR (National Centre for Research and Development) Polish Agency for Enterprise Development
Portugal	Agência para a Sociedade do Conhecimento (Knowledge Society Agency – UMIC) Fundação para a Ciência e Tecnologia (FCT) Agencia de Inovação (ADI) North Regional Coordination and Development Commission (CCDR-N) Instituto de Apoio às Pequenas e Médias Empresas e à Inovação, IAPMEI Observatiorio Empresas Portugal
Romania	Autoritatea Nationala pentru Cercetare Stiintifica – ANCS (National Authority for Scientific Research – NASR) Centrul National de Management Programe – CNMP (National Centre for Programme Management – NCPM) Inno Consult AMCSIT (Management Agency for Scientific Research, Innovation and Technology Transfer)
Slovakia	Agentúra na podporu výskumu a vývoja Slovenská akadémia vied (Slovak Academy of Sciences)

	National Agency for Development of Small and Medium Enterprises (NADSME) Ministry of Economics/Ministry of Finance
Slovenia	Institute for Economic Research (and Faculty of economics) Slovenian Technology Agency (TIA) Ministry of Labour, Family and Social Affairs Republic of Slovenia – Ministry of the Economy Ministry of Higher Education, Science and Technology Slovene enterprise fund
Spain	Innobasque Centro para el Desarrollo Tecnológico Industrial (CDTI) IMPIVA-Generalitat Valenciana Ministry of Science and Innovation (MICINN) Fund for health research (FIS) Ministry of Industry, Tourism and Commerce government of the Valencia community Fundación Espanola para la Ciencia y la Tecnología (FECYT) Departamento de Desarrollo Rural, Industria, Empleo y Medio Ambiente ACC1Ó és l'Agència de Suport a la Competitivitat de l'Empresa Catalana Alianza por la Investigación e Innovación en la Salud Zabala Innovation Consulting Plan de Investigación e Innovación
Sweden	Swedish Agency for Innovation Systems (VINNOVA) Swedish Research Council
United Kingdom	Pera (PERA) Technology Strategy Board (TSB) business in the community (BITC) East Midlands Development Agency (EMDA) investors in people – improving business performance Scottish enterprise

Source: Authors.

CATIs overview

Table 23 **Interviews were conducted on the following programmes**

Country	Programme	Type	Innovation cluster
AT	Cooperation & innovation	3	2
AT	Industrial competence centres and networks	3	2
AT	*Forschungskompetenzen für die Wirtschaft*	2a	2
BE	'Competence pools' – Flanders synergy (FS)	3	2
BG	Innovation and technology transfer programme	3	5
BG	National innovation fund	4	5
CY	Research for enterprises; action I: new products and services, action II: collective research	3	4
CZ	Education for competitiveness	1	4
DE	Central innovation programme SME	4	1
DE	IKT 2020 *Schwerpunkt Mikrosystemtechnik*	4	1
DE	*Arbeiten – Lernen – Kompetenzen entwickeln Innovationsfähigkeit in einer modernen Arbeitswelt*	2a	1
DE	*ExzellenzTandem; Forschungsassistent*	2b	1
DK	Programme for user-driven innovation	3	1
DK	The business innovation fund	2b	1
EE	Cluster development programme	3	3
EL	Support of employment of research staff in	2b	4
EL	Support to companies for hiring highly qualified	2b	4
ES	Expande	2b	4
FI	Serve	4	2
FI	The Finnish workplace development programme	2a	2
FR	SME pact	3	4
HU	National technological programme	4	5

Country	Programme	Type	Innovation cluster
IE	Workplace innovation fund	2a	4
IE	Lean business offer	2b	4
IE	Graduates 4 international growth (G4IG) company information	2b	4
IE	Training networks programme (TNP)	2b	4
IT	Regional announcement: law 236/03, year 2000. D.G. Education, training and work.	2a	4
IT	Jobs placement in Palermo	2b	4
LT	Inogeb LT-1	3	5
LT	Process LT	2b	5
LU	Innovation management techniques training course	2b	2
LU	Technoport Schlassgoart – start-up incubator	2b	2
LV	Work youth practice	2b	5
MT	National research and innovation programme	4	3
NL	Innovation performance contracts	3	2
NL	Syntens	2b	2
NL	SBIR	2b	2
NO	The industrial PhD scheme	1	3
NO	Programme for regional R&D and innovation	3	3
NO	Norwegian centres of expertise	3	3
NO	User-driven research-based innovation (BIA), Brukerstyrt Innovasjonsarena	3	3
PL	Human capital operational programme; measure 2.1.1. Human capital development in enterprises	1	5
PT	Eurostars	4	4
RO	AAL JP	4	5
SE	Regional growth through dynamic innovation	3	1
SE	Management and work organisation renewal	2a	1

Country	Programme	Type	Innovation cluster
SI	Strategic R&D projects in enterprises	4	4
SI	Direct funding for joint development and investment projects (RIP)	2b	4
SK	Promoting cooperation between universities, the Slovak academy of sciences and the business	3	5
UK	Innovation, advice and guidance programme (IAG)	2b	4
UK	Coaching for high growth	2b	4
UK	Scottish Enterprise – innovation support service	2b	4

Annex 4.
Innovation clusters

To provide a comprehensive overview of European countries with regard to the three dimensions of key interest – learning-oriented work organisation, learning and innovation – a partition cluster analysis (k-means clustering) was used to cluster the 28 European countries into groups with comparable scores. The variables used for the cluster analysis are described in more detail in Section 3.4 (the actual figures are given in Table 24 below). A consistent and readily interpretable solution was found for five clusters, which are described in detail in Section 3.3.

Table 24 shows the final results of the cluster analysis. Table 25 shows, for each country, the distance to the centre of the cluster, thereby indicating, for each particular country, its fit to the average of its cluster.

Table 24 **Results of the k-means clustering**

Cluster centres of the final solution					
	Cluster				
	1	2	3	4	5
Work organisation (5th EWCS 2010)	0.659	0.700	0.580	0.680	0.585
Other forms of learning in enterprises (CVTS3 2005)	0.072	0.074	0.048	0.132	0.042
Innovation (IUS 2010)	0.591	0.413	0.187	0.729	0.461
	AT	EE	BG	DK	CY
	BE	MT	HU	DE	CZ
	FI	NO	LV	SE	FR
	LU		LT		EL
	NL		PL		IE
			RO		IT
			SK		PT
					SI
					ES
					UK

Source: Authors.

Table 25 **Affiliation of the individual cases to the clusters**

Cluster membership		
Country	**Cluster No**	**Distance to the centre of the cluster**
AT	1	0.022
BE	1	0.054
FI	1	0.064
LU	1	0.037
NL	1	0.090
EE	2	0.059
MT	2	0.027
NO	2	0.045
BG	3	0.069
HU	3	0.081
LV	3	0.090
LT	3	0.041
PL	3	0.035
RO	3	0.006
SK	3	0.068
DK	4	0.069
DE	4	0.083
SE	4	0.052
CY	5	0.090
CZ	5	0.070
FR	5	0.026
EL	5	0.053
IE	5	0.071
IT	5	0.017
PT	5	0.034
SI	5	0.070
ES	5	0.127
UK	5	0.087

Source: Authors.

Table 26 **Basic values for each country**

Country	Work organisation (5th EWCS 2010)	Other forms of learning in enterprises (CVTS3 2005)	Innovation (IUS 2010)
AT	0.64954	0.054	0.597894
BE	0.610483	0.088	0.607666
BG	0.519549	0.036	0.156222
CY	0.541032	0.034	0.539071
CZ	0.595337	0.104	0.429351
DK	0.732459	0.174	0.74127
EE	0.673117	0.062	0.463846
FI	0.700616	0.066	0.639459
FR	0.602926	0.026	0.471531
DE	0.60667	0.108	0.760789
EL	0.556193	0.018	0.42411
HU	0.594635	0.052	0.266663
IE	0.611601	–	0.511139
IT	0.578843	0.038	0.44593
LV	0.654571	0.03	0.140257
LT	0.563377	0.058	0.150814
LU	0.633097	0.098	0.595238
MT	0.692822	0.07	0.387361
NL	0.702698	0.054	0.514212
NO	0.733735	0.09	0.388044
PL	0.61418	0.046	0.185824
PT	0.552535	0.034	0.46038
RO	0.579866	0.046	0.181416
SK	0.531072	0.068	0.231096
SI	0.634186	0.092	0.460843
ES	0.555567	0.076	0.342311
SE	0.699956	0.114	0.683723
UK	0.624153	–	0.525875

Source: Eurofound, 2011; Eurostat, 2006; UNU-MERIT, 2011.

Annex 5.
Portfolio clusters

The programme portfolios of the EU-27 and Norway were analysed to take account of the various ways in which the programmes seek to promote innovative ability, as described in Section 4.4. For this analysis, a partitioning cluster analysis was performed, using the percentage of programmes in each of the categories 1 to 5 as descriptive variables. Five clusters were found; an interpretation of these clusters is provided in Section 4.4. The tables in this annex show the results of the cluster analysis, including the figures for each country and the distance to the centre of its respective cluster.

Table 27 **Affiliation of the individual cases to the clusters**

Cluster membership			
Case No	**Country**	**Cluster No**	**Distance to the centre of the cluster**
1	**AT**	2	0.112
2	**BE**	5	0.080
3	**BG**	3	0.151
4	**CY**	4	0.216
5	**CZ**	5	0.039
6	**DE**	2	0.184
7	**DK**	2	0.091
8	**EE**	3	0.104
9	**EL**	4	0.103
10	**ES**	2	0.187
11	**FI**	2	0.202
12	**FR**	5	0.145
13	**HU**	2	0.184
14	**IE**	1	0.153
15	**IT**	3	0.166
16	**LT**	4	0.158
17	**LU**	2	0.179

18	**LV**	5	0.067
19	**MT**	5	0.162
20	**NL**	2	0.091
21	**NO**	2	0.117
22	**PL**	4	0.076
23	**PT**	5	0.136
24	**RO**	1	0.153
25	**SE**	2	0.146
26	**SI**	5	0.175
27	**SK**	5	0.233
28	**UK**	4	0.081

Source: Authors.

Table 28 **Number of cases in each cluster**

Number of cases in each cluster		
Cluster No	1	2
	2	10
	3	3
	4	5
	5	8
Valid		**28**
Missing		**0**

Source: Authors.

Table 29 **Results of the k-means clustering**

Cluster centres of the final solution					
	Cluster				
	1	2	3	4	5
Type 1	0.088	0.105	0.076	0.121	0.061
Type 2a	0.000	0.009	0.000	0.007	0.000
Type 2b	0.100	0.178	0.114	0.307	0.430
Type 3	0.311	0.094	0.115	0.097	0.124
Type 4	0.130	0.382	0.194	0.072	0.230
Type 5	0.370	0.232	0.500	0.396	0.155

Source: Authors.

Table 30 **Distance between clusters for results of the k-means clustering**

Distance between cluster centres of the final solution					
Cluster	1	2	3	4	5
1		0.369	0.244	0.306	0.448
2	0.369		0.336	0.374	0.309
3	0.244	0.336		0.255	0.470
4	0.306	0.374	0.255		0.320
5	0.448	0.309	0.470	0.320	
6		0.369	0.244	0.306	0.448

Source: Authors.

Table 31 **Basic values for each country**

Country	Type 1	Type 2a	Type 2b	Type 3	Type 4	Type 5
AT	0.0526	0.0263	0.1579	0.0789	0.4737	0.2105
BE	0.0964	–	0.4096	0.1084	0.2771	0.1084
BG	0.1176	–	–	0.1176	0.1765	0.5882
CY	–	–	0.3333	0.1111	–	0.5556
CZ	0.0385	–	0.4615	0.1154	0.2308	0.1538
DE	0.129	0.0323	0.2581	0.1613	0.3226	0.0968
DK	0.0769	–	0.1154	0.1154	0.4231	0.2692
EE	0.1111	–	0.1667	0.1111	0.1111	0.5
EL	0.1875	–	0.25	0.0625	0.0625	0.4375
ES	0.2549	–	0.1176	0.0784	0.2941	0.2549
FI	0.0513	–	0.2308	0.0256	0.5385	0.1538
FR	0.1463	–	0.3171	0.1463	0.2195	0.1707
HU	0.1212	–	0.303	0.0303	0.2727	0.2727
IE	0.1765	–	0.1176	0.2059	0.1765	0.3235
IT	–	–	0.1765	0.1176	0.2941	0.4118
LT	0.2	0.0333	0.3	0.1333	0.0667	0.2667
LU	0.1	–	0.2	0.1	0.25	0.35
LV	0.0625	–	0.375	0.125	0.25	0.1875
MT	0.0833	–	0.5417	0.125	0.2083	0.0417
NL	0.0667	–	0.2333	0.1	0.3333	0.2667
NO	0.1111	–	0.0833	0.1111	0.4444	0.25
PL	0.129	–	0.3548	0.0645	0.0968	0.3548
PT	–	–	0.4074	0.0741	0.2593	0.2593
RO	–	–	0.0833	0.4167	0.0833	0.4167
SE	0.0833	0.0278	0.0833	0.1389	0.4722	0.1944
SI	0.0588	–	0.5294	–	0.2941	0.1176
SK	–	–	0.4	0.3	0.1	0.2
UK	0.0909	–	0.2955	0.1136	0.1364	0.3636

Source: Authors.

Annex 6.
Case studies

Programme centred on human capital (type 1), Poland

Poland is considered a 'moderate innovator' (IUS 2010); it is below the EU average in 20 out of the 24 subindicators, and, in most categories, Poland's scores are fairly low. Exceptions to this are its fairly well-educated human resources, high non-R&D innovation expenditure and above average exports of medium and high-tech manufacturing goods. The picture looks better from the perspective of annual average growth per indicator (UNO-MERIT, 2011). The impact of the global economic crisis on innovation performance has been lower in Poland than in other countries. The latest TrendChart Report (INNO Policy TrendChart, 2011a) welcomes the recent formulation of a strategy for innovation and effectiveness in the economy. However, the evaluation of recent measures so far is mixed, with positive short-term outcomes, but few structural changes. The bulk of EUR 1.1 billion in public innovation expenditure during 2010 targeted research and technology (40%), and creation and growth of enterprises (33%). Investment in human resources is estimated at 15%. The funding is channelled primarily through either the Polish agency for enterprise development (PARP), or the Ministry of Science and Higher Education via its two executive agencies, the National R&D centre (responsible for the management and implementation of strategic scientific research and development programmes), and the National science centre (responsible for basic research projects).

Programme agency: PARP is a government agency answerable to the Minister for the Economy. The main objectives of PARP comprise enterprise development, application of new techniques, export development, job creation, human resources and regional development. PARP has substantial involvement in implementing three programme lines of the operational programme 2007-13, namely innovative economy (EUR 3.9 billion), human capital (EUR 672 million) and eastern Poland development (EUR 2.6 billion).

Programme background: the programme analysed in this case study comes within the scope of the 'human capital development in enterprises' measure of the Human capital operational programme 2007-13. The development of human resources and adaptation potential of enterprises, together with improvements in employees' health, constitute priority II of the operational programme. This priority is divided into three measures. The submeasure analysed in this case

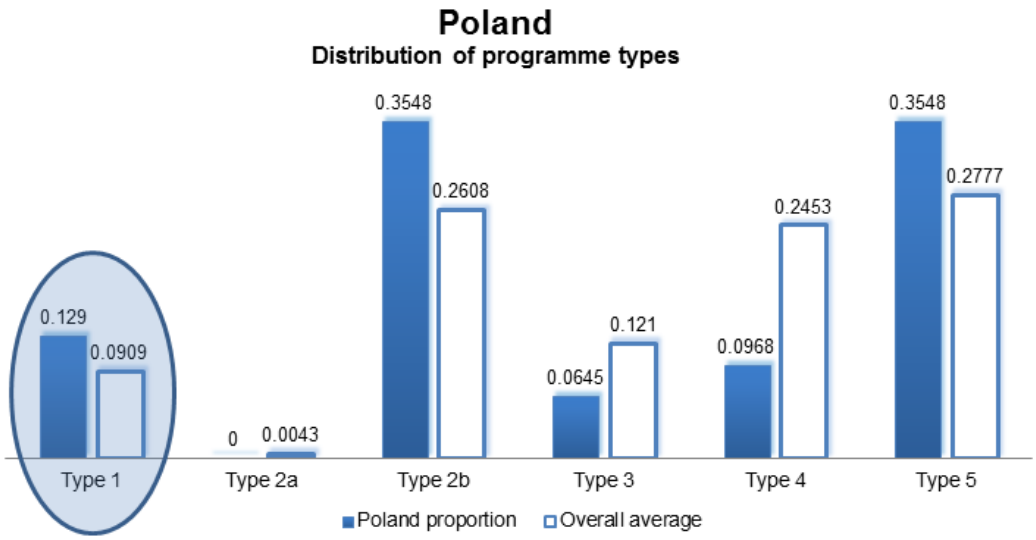
study is 'Development of human resources for a modern economy'. According to the Ministry of Regional Development Poland (2009), projects can entail:

(a) supra-regional, closed training projects (both general and specialist) and counselling for entrepreneurs and employees, based on individual company development;
(b) national, open training projects (both general and specialist) and counselling for entrepreneurs and employees;
(c) postgraduate studies for employees and entrepreneurs.

The target groups directly benefiting from the funds are entrepreneurs and employees. Overall, 665 projects have been funded so far, with a maximum duration of three years for each project. In 2012, a call for proposals was launched for SMEs only, with the goal of promoting the skills (particularly soft skills) of people in HR and managerial positions.

Programme type: the Human capital development in enterprises programme can be categorised as a 'type 1' programme, as its investment in innovative ability primarily aims to enhance human capital. This type of programme covers mainly formal basic or continuing education and training. The programme also aims to promote informal and non-formal learning. The development of capacity for innovation is addressed explicitly as an integral part of a more complex set of issues in each project.

Figure 25 **Distribution of programme types in Poland compared to overall average**



Source: Authors.

Poland currently has 28 programmes under way. Over 70% of these are ‘type 2b’ and ‘type 5’ programmes. Compared to the European average, Poland has a comparatively high proportion of ‘type 1’, human capital-related programmes, and a low proportion of ‘type 4’, cooperative R&D&I programmes. Poland is therefore part of the cluster referred to as ‘human capital – low cooperative R&D&I’. Accordingly, the overall focus on the Human capital development in enterprises programme is characteristic of Poland’s programme portfolio.

Findings: the programme was analysed at the programme and project levels. The programme manager expected the programme to have effects not in the structural and relational capital dimension, but in the human capital dimension. This is generally in line with the programme focus. Effects in 6 out of the 10 subdimensions of human capital were expected, but expectations were fairly low. This is somewhat surprising, considering that the programme focus is human capital. Despite these rather low expectations, the actual effects in the human capital dimension were, in fact, fairly high.

The project managers appear to have had higher expectations and ambitions for their projects than the programme manager. Two exemplary projects were analysed. Both project managers had a very similar and generally more favourable view of the expected and actual effects in the human capital dimension than the programme manager. On structural and relational capital, effects were expected and observed in practice in almost all of the subdimensions. It would seem that the project was aimed strictly at human capital development, while individual projects (successfully) sought to achieve objectives beyond the human capital dimension. The average of project managers’ assessments confirms that relational capital is the dimension least addressed by the Human capital development in enterprises programme.

Generally, no consideration was given by either the programme or project managers to the link between innovation and changes in the workplace and work organisation that lead to learning; however, the findings show that the programme appears at least implicitly to address one aspect of that link without explicitly considering any potential link to other, related aspects. Human capital development would appear to be considered important, but not to fostering innovation in enterprises.

One embedded case gave us an insight into a single project as viewed by the project manager as well as an employee involved in the project. The employee’s assessment of developments is very similar to that of the project manager. The overall picture of the development of conditions for informal learning is (fairly) positive. Both project manager and employee report either an

unchanged situation or improvements in the dimensions of autonomy, transparency and variety. While autonomy-related aspects are rated more favourably by the employee, issues of transparency are viewed more positively by the project manager. Task and skill variety is altogether assessed slightly more negatively than the other two dimensions. Yet even in this dimension, improvements are attributed to the project.

Programme centred on structural capital in terms of workplace organisation and design (type 2a), Sweden

Sweden is the top innovation performer within the EU-27 (UNU-MERIT, 2011). Sweden's strengths lie in human resources, the openness and attractiveness of the research system, finance and support; however, innovation output is noted as an area of relative weakness (ibid.). Sweden's economy is heavily dependent on exports and on the performance of a limited number of about 20 larger companies. At the same time, more than 40% of business R&D is undertaken by companies whose headquarters are outside Sweden. Swedish enterprises, in comparison, tend increasingly to marginalise their domestic market in terms of R&D investments (INNO Policy TrendChart, 2009a).

The current (2009-12) Swedish innovation policy is outlined in the framework of the 2008 Research and innovation bill. It provides for a substantial increase in the research budget (Ministry of Education and Research Sweden, 2008a, 2008b). The bill introduces a 'strategic instrument' which focuses on a few strategic areas, including medicine, technology, climate and environment as well as technology, interdisciplinary science and humanities.

Programme agency: VINNOVA ([31]), the Swedish governmental agency for innovation systems under the Ministry of Enterprise, Energy and Communications, is Sweden's central innovation agency and was established in 2001. Its objective is to promote sustainable growth by funding needs-driven research and the development of effective innovation systems. The total budget for investment in projects amounts to EUR 220 million each year. VINNOVA generally requires co-financing of all projects, which doubles the total annual investment to around EUR 440 million. An important part of VINNOVA's activities

([31]) Detailed information about the Swedish governmental agency for innovation systems VINNOVA and how the agency develops Sweden's innovation capacity for sustainable growth can be found by consulting: http://www.vinnova.se/en/About-VINNOVA/.

focuses on promoting cooperation among companies, universities, research institutes and other organisations in the Swedish innovation field. For this purpose, there are several funding and accompanying instruments, including e.g. long-term investment in strong research and innovation milieus and forums such as conferences and seminars.

VINNOVA's working life initiatives aim to strengthen innovative capacity in industry and the public sector. They are designed to contribute to sustainable growth by improving organisational conditions for competitiveness and growth. The emphasis is on organisation and management systems. Central are processes of innovation and change in and around companies, including various aspects of work organisation and operational management as well as industrial and organisational change (Döös and Wilhelmson, 2009).

Programme background: since the late 1960s, Sweden has had a rich history of programmes dealing with workplace and organisational design that focus on topics such as job redesign, group work, factory layouts and workplace democracy. In the 1990s, R&D aimed at working life in Sweden underwent several reorganisations. The commitment on the part of employer associations to centralised tripartite cooperation has weakened somewhat, whereas the involvement of the academic community and private businesses has been growing. Increased diversification and regionalisation of activities has become a more prominent feature of R&D in working life and work organisation in Sweden.

'The Management and work organisation renewal programme focuses on the importance of strategic management and work organisation for well-functioning workplaces, and thereby the efficiency and long-term development of operations. The goal is new or improved working methods and organisational solutions which safeguard and develop ideas generated within the organisation or by other actors. In the long run, it is anticipated that these will result in new or improved work processes, products or service offerings' (Larsson, 2010).

The programme involves five calls for proposals and initiatives (Larsson, 2010):

(a) 'the competent workplace (2007-11)' aims to support organisations in reaching their goals by improving the conditions for strategically relevant competence. They intend to inspire a renewal of the thinking behind work organisation, including aspects such as division of knowledge, collective competence, relationships and networks;
(b) 'managerial task: conditions, ways of working and results (2008-12)' seeks to elucidate and further develop the leadership that is practised in Swedish workplaces;

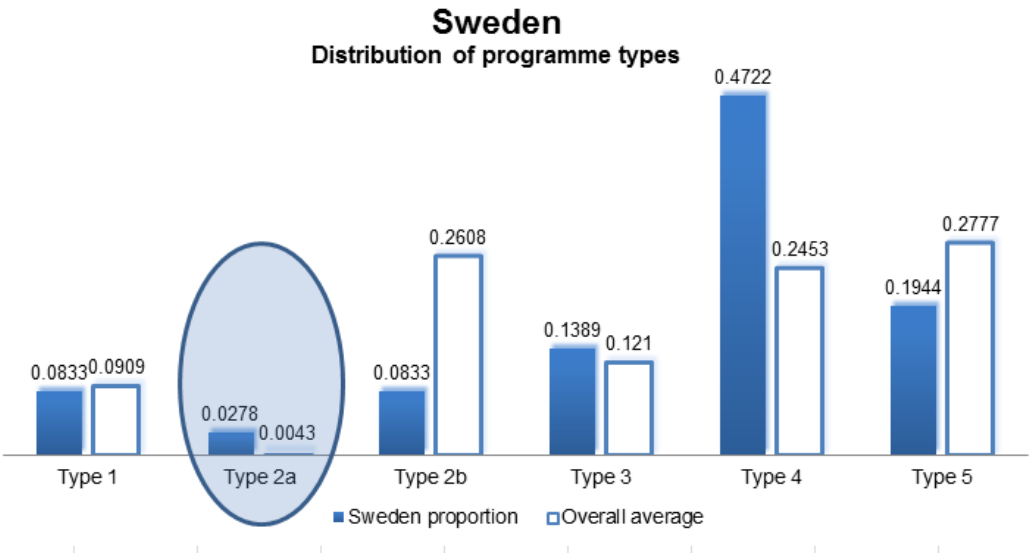
(c) ‘winning services (2009-13)’ addresses R&D&I projects related to the organisation and management of service activities. Its goal is to develop work organisations and strategic management so that the experience, expertise and development ideas of staff are fostered and utilised within the organisation;

(d) ‘Swedish management’ targets the advantages of Swedish leadership traditions and seeks to adapt them to working globally;

(e) ‘innovative work organisation (2009-12)’ aims to raise awareness of the importance of research into workplace-related innovation. The pilot project concentrates on innovative aspects of work organisations which create sound prospects for increased productivity, competitiveness and good working conditions.

Programme type: in VINNOVA’s management and work organisation renewal programme, the investment in innovative ability primarily aims to develop structural capital with a focus on the workplace. It can therefore be classified as a type 2a programme, addressing the organisation at the workplace level and (indirectly) human capital patterns such as domain-related knowledge and skills, practical experiences, motivation and social skills. Sweden’s programme portfolio predominantly represents policy initiatives seeking to stimulate investment in R&D&I (type 4). Sweden therefore belongs to the ‘cooperative R&D&I cluster’.

Figure 26 **Distribution of programme types in Sweden compared to overall average**



Source: Authors.

Findings: the general impression made by the findings of determinants of innovative ability in the 'management and work organisation renewal programme' is comparable to other programmes of this type: a number of effects across all three domains of intellectual capital were expected, but actual achievements seem to tend to fall short of expectations. In view of the longstanding tradition for this kind of programme in Sweden and the traditionally high expectations in this field, this might be because expectations were overly high. Another explanation may be the focus of the recent calls within the programme. As was the case with similar developments in the German *Arbeiten – Lernen – Kompetenzen entwickeln* (working – learning – developing competences) programme, there is a strong focus on management-related issues, in contrast to direct interventions at the workplace level. This might limit impacts in terms of concrete and substantial changes in work and work organisation. Consistent with this line of reasoning are the findings that no effects were expected (or found) in the domain of organisational structure, and that the effects in the domains of organisational processes and learning-intensive forms of organisation fail to fulfil the (limited) expectations.

At the project level too, there is a tendency for effects to be smaller than anticipated, but the overall assessment for all three dimensions is more favourable; this applies in particular to the subdimensions of organisational structure, organisational processes and learning-intensive forms of organisation.

A more detailed examination of the effects of the programme was made through in-depth analysis of two projects, taking into account the project managers' perspective on the employees' situation in terms of informal learning opportunities in the workplace. Generally, the assessment is positive in almost all subdimensions of the transparency dimension. For the other two dimensions (task and skill variety and autonomy and task completeness), the development from the initial to the current situation varies, ranging from unchanged (positive) conditions for informal learning to negative trends (but remaining positive).

Programme centred on structural capital in terms of organisational and business development (type 2b), Ireland

According to the most recent TrendChart report for Ireland (INNO Policy TrendChart, 2009b), the Irish national innovation system is different from most other European countries. Very few public and private research institutions exist, and the two existing technological universities were established only in the 1960s and 1970s. At the same time, a number of what are now called Institutes of

Technology were founded that increasingly perform research. The universities and institutes account for around 90% of all basic research performed in Ireland, whereas no company – neither domestic nor foreign-owned – is engaged in such activities (ibid.).

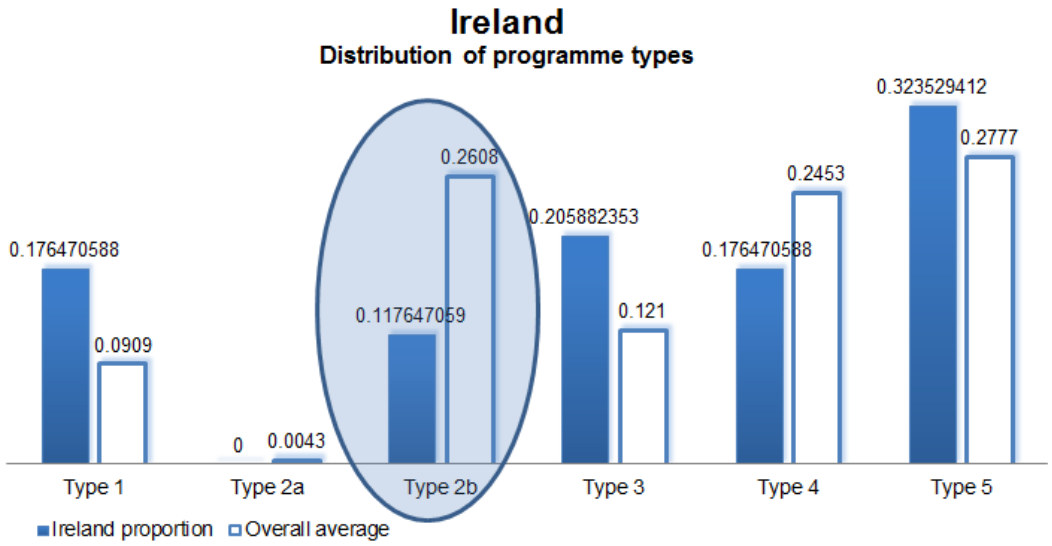
Ireland's vision is to become internationally renowned for the excellence of its research by 2013. The path to a 'knowledge economy' is substantiated by the government's commitment as expressed in the national development plan for 2007 to 2013 (ibid.). This plan sets ambitious quantitative targets, e.g. for the increase of gross and business expenditure on R&D, as well as government expenditure. Compared to the EU-27, Ireland places an emphasis on raising awareness of innovation among firms and the promotion of entrepreneurship and start-ups, and is very visible in technology diffusion in enterprises, prototype creation, applied industrial and pre-competitive research as well as cooperation and clustering (ibid.).

The most recent IUS (UNU-MERIT, 2011) ranks Ireland ninth out of all 27 EU Member States. Its innovation performance exhibits strengths in the categories of 'human resources', 'research systems' and 'intellectual assets'. Weaknesses relate to SMEs introducing innovations.

Programme agency: Enterprise Ireland (EI) is a corporate body established in 1998 and operating under the aegis of the Minister for Enterprise, Trade and Innovation. Its main responsibility is the development and achievement of export sales growth from Irish-owned companies in the manufacturing and internationally traded services sector. EI grants support for a broad range of activities addressing strategy and planning, sales and marketing, research and innovation, productivity and efficiency, management development, and expansion.

The programme landscape is completed by a 'high potential start-up funding' programme, aimed at businesses with a potential to create 10 jobs and realise EUR 1 million in export sales within three to four years after foundation. Less ambitious start-up subsidies are available from the County and City Enterprise Boards. In 2010, EI approved financial support amounting to EUR 356.9 million for Irish companies (Enterprise Ireland, 2010).

Figure 27 **Distribution of programme types in Ireland compared to the overall average**



Source: Authors.

In Ireland, a total of 28 programmes were running at the time of this study. Only 12% of them are 'type 2b' programmes. Most of the programmes fall into the 'type 5' category, which describes general investment. Compared to the overall average, Ireland has a higher proportion of 'type 1' and 'type 3' programmes, the former focusing on human capital development (e.g. formal training programmes), and the latter addressing relational capital (e.g. cluster initiatives). Since general investment, e.g. in R&D infrastructure, is needed while catching up with other European countries, this programme distribution seems in line with Ireland's ambitious goal of becoming a 'knowledge economy'.

Programme analysed: EI's lean business offer (Enterprise Ireland, 2011) aims to improve business processes with methodologies such as lean ([32]) and/or other best practice methods specific to particular business sectors. In 2010, EI approved funding for 72 companies in this scheme (Enterprise Ireland, 2010). Three different programme modules are in place at EI for its eligible clients, which are enterprises that have been trading for at least five years and are engaged in manufacturing or eligible internationally traded services.

([32]) 'Lean' refers to a production practice that aims to optimise work flows and processes to produce goods efficiently. Any expenditure of resources that does not create value for the end customer are considered wasteful, and should therefore be eliminated.

The ‘LeanStart’ programme represents the introduction to lean concepts. The support is intended to be used to hire a consultant who introduces the lean process. The outcome is two-fold: besides immediate cost reductions, connectivity to future lean projects is sought. The grant consists of a maximum subsidy of EUR 5 000 that must be co-funded by the company.

The continuation of the programme scheme is represented by the ‘LeanPlus’ programme that stands for an assignment of medium-term duration, i.e. up to six months. Funding aims to enable businesses to make sustained use of lean techniques. The maximum cost for an individual project is set at EUR 75 000, of which the company has to bear 50%. This funding is used for hiring an external consultant.

In terms of duration, scope and coverage, the ‘LeanTransform’ programme marks the highest expectations. Projects last at least one year, target the whole company and require an internationally renowned team of experts. The transformation of business culture and productivity performance must lead to sustainable improvements. The programme primarily addresses larger companies. The maximum project costs are not fixed by a threshold amount, but are typically over EUR 100 000. The beneficiary company bears a minimum of 50%.

Programme type: the Enterprise Ireland’s lean business offer aims to develop structural capital with a focus on the organisational level. It is therefore a ‘type 2b’ programme. Distinctive programme patterns are an enhancement of organisational and technological structures and processes. It addresses organisational innovation and business development.

Findings: the lean business offer programme is a typical type 2b programme. Compared to other programmes of this type, there is less emphasis on product innovation, whereas process innovation is central. Overall, all three dimensions of innovative ability show a good correlation between the expected effects reported by the programme manager and the project managers. Another overall finding is that actual effects lag slightly behind the expectations. Expectations relating to the improvement of determinants of innovative ability were not fully met. This is a finding of the whole study as well.

Regarding the human capital dimension, there is very good correlation between expectations and actual effects. The largest difference between the programme manager’s and project managers’ perception relates to the subdimensions of social skills and competences of employees. The programme manager did not report any expected or actual effects, whereas the project managers expected and saw minor-to-moderate effects.

Similar evidence was found with regard to the structural capital dimension, the key aspect of this type of programme. There is one remarkable deviation. The programme manager did not expect to report any actual effects for the dimension learning-intensive forms of organisation. According to the project managers, moderate effects were expected and realised.

Looking at the results for the expected and actual effects in the relational capital dimension, two deviations are worth pointing out: whereas a large effect for relationships with educational institutions was intended when designing the programme, this only plays a minor role in the projects conducted by the companies. Second, the image of the participating companies has improved by taking part in the programme. Impacts of the projects go beyond the enhancement of work organisation into the wider environment of the participating companies. This is a positive effect of the programme, which was not anticipated.

A closer look was taken at the effects of the programme by in-depth analysis of two projects conducted, taking the programme manager's, the project managers' and the employees' perspective into account. For both embedded cases, the overall results show good correlation between the programme manager's and project managers' assessments, while the employees' views differ to some degree (they assess developments overall more negatively).

Programme centred on relational capital (type 3), Denmark

According to the IUS (UNU-MERIT, 2011), Denmark is in the group of innovation leaders, but is, however, a slow grower in terms of annual growth in innovation performance. The Danish Government launched a new national reform programme in 2011, which includes initiatives to strengthen capacity for innovation in Danish firms and to streamline the policy support system. Among other factors, funding has been increased, and the visibility of new measures and their accessibility have been improved. Five key weak points regarding innovation policies have been highlighted (INNO Policy TrendChart 2011b): slow growth in productivity; weak international competitiveness; lags in renewal and innovation; low efficiency in the public sector; and small number of new growth companies.

To tackle the challenges outlined above, changes have been introduced since 2009 to the institutional design of the Danish innovation policy. The Ministry of Science, Technology and Innovation continues to be the public body with chief responsibility for research and innovation. Additionally, the Ministry of Economic

and Business Affairs established the Business Innovation Fund in 2009 (Business Innovation Fund, 2010).

By 2010, the Council for strategic research and the Council for technology and innovation were working together to develop a new type of policy measure, referred to as the strategic platforms for innovation and research (SPIR). These platforms are intended to help to establish a Danish model for strengthening the links between research and innovation. In addition, a partnering model is to be created with the aim of involving more private sector enterprises in the planning and performance of research and innovation (ibid.). The programme analysed within this study, the programme for user-driven innovation, combines cooperation between public institutions, business and end-users.

Programme type: the programme for user-driven innovation corresponds to the type 3 programmes investigated in this study. This type is characterised by helping to build relations to all relevant groups outside the organisation or enterprise, such as stakeholders, customers, suppliers, associations and educational institutions. At around 15.5%, the share of type 3 programmes in Denmark is comparable to the distribution of programmes of this type within Europe. The shares of type 1 (human capital programmes) and type 5 (other programmes) programmes in Denmark correspond to the European distribution. While type 2b programmes (structural capital – work organisation) are underrepresented, type 4 programmes (stimulation of R&D&I investment in shared budget) are overrepresented.

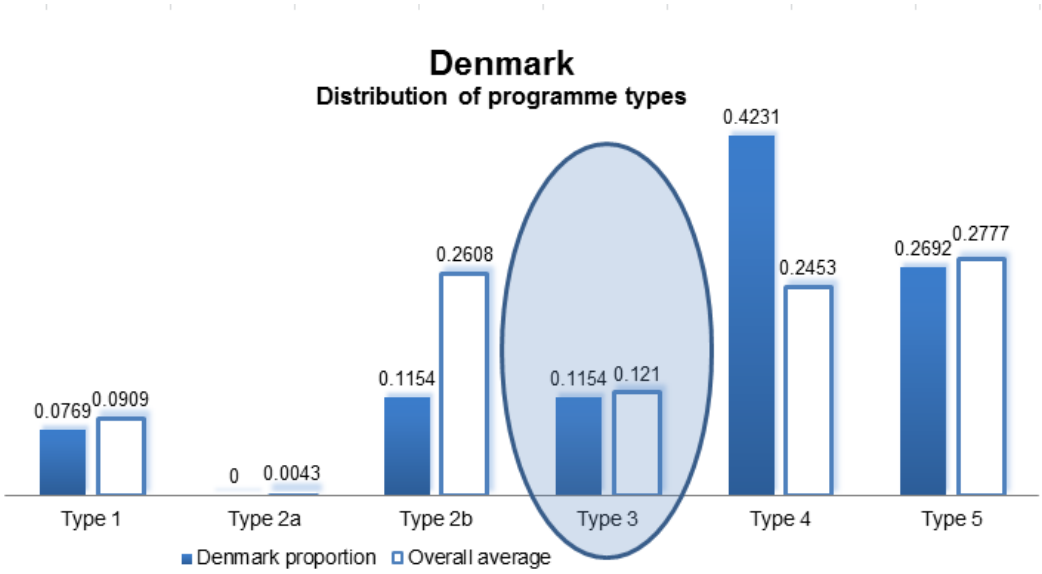
Programme researched: the Ministry of Economic and Business Affairs launched the Programme for user-driven innovation in January 2007, and it ran until the end of 2010. It is:

(a) ‘a systematic approach to the development of new products, services, processes, or forms of organisation;
(b) based on the exploration or involvement of users’ lives, identity, practice or needs;
(c) including unrecognised needs which are expected later to materialise as demand from major user segments;
(d) users are customers, consumers, enterprises, employees, suppliers, cooperating partners or citizens in a broad sense’ (Danish Ministry of Economic and Business Affairs, 2007).

The programme aims to strengthen the diffusion of methods for user-driven innovation. Based on a better understanding of the users’ and costumers’ needs, new products, services, as well as concepts and processes in enterprises and public institutions are to be developed, if possible, by involving the users. The programme intends to generate more growth in the participating companies and

in user satisfaction. The institutions that could benefit from the programme were mainly healthcare and welfare centres (e.g. hospitals).

Figure 28 **Distribution of programme types in Denmark compared to overall average**



Source: Authors.

The programme had a total budget of about EUR 40.2 million and funded 83 projects in the private and public sectors. The budget available for individual projects amounted to between EUR 33 000 and EUR 430 000. The projects examined and addressed user needs in an innovative manner, which included the development and testing of new tools and methods (Danish enterprise and construction authority, 2007). The Danish enterprise and construction authority (DEACA), which is a part of the Ministry of Economic and Business Affairs, administered the programme.

Findings: the focus of the programme is innovation in products, services and organisational structure by involving customers/users of products in development. These aspects are part of the structural and relational capital of organisations.

Although the programme focus was not explicitly on human capital, the manager of the Programme for user-driven innovation had expectations with regard to the development of employees' domain-related KSC, practical experience, motivation of employees, leadership and the development of social skills and competences, but not regarding participation in educational programmes outside the organisation. Employees were expected to learn while

working, but in a more informal way through the interaction with the users of products and services. The average of responses from 22 project managers shows that human capital aspects appear, in practice, to have had moderate to major effects (e.g. perceived improvements related to KSC as well as personal skills, practical experience and motivation). The actual effects of the projects on the subdimensions of human capital were rated moderate to major.

The responses concerning the impact on the improvement of structural capital vary widely. The programme manager expected and observed major improvements with regard to the introduction of new products and processes, and moderate to major effects on the organisational structure and processes within the organisations. The actual effects observed by the 22 project managers were fairly minor to moderate. The greatest effects were perceived in the transfer of knowledge, cooperation and communication within the organisation and the development of learning-intensive forms of organisation.

The responses of the programme and project managers showed that the programme fostered certain aspects of relational capital; this is consistent with the objectives of the programme. They observed major actual effects on the relationship to customers and the relation to stakeholders as well as lesser effects on relations to suppliers. The project managers seem to have had on average more positive expectations and experiences with the projects at their organisations. Most of the expectations and actual effects ranged from moderate to high.

With regard to the link between innovation and changes in workplace/work organisation that lead to learning, the programme manager tended to disagree with the statements on this item, while the 22 project managers on average agreed with all statements.

Programme centred on cooperative R&D&I (type 4), Finland

According to the IUS (UNU-MERIT, 2011), Finland ranks among the ‘innovation leaders’. Compared to the EU-27 average, the country performs strongly in human resources, finance and support as well as in linkages and entrepreneurship, while it shows relative weakness in terms of intellectual assets, innovators and output. Finland has distinctively high growth rates for a couple of innovation indicators such as venture capital and exports of knowledge-intensive services (ibid.). One of its main shortcomings relates to the structure of company population. The remarkably high growth and productivity rates mentioned above, alongside the progress in R&D investment and exports, are predominantly

sustained by a few industrial clusters and a small number of individual large domestic multinational enterprises (e.g. NOKIA). These circumstances pinpoint the fact that the country faces a lack of innovative growth-oriented SMEs and start-ups (INNO Policy TrendChart, 2009c).

The country has established a mostly centralised system of planning and decision-making on research policy, which it operates on four levels (ERAWATCH, 2011):

(a) first level: the Finnish Parliament and Government – concerned with the determination of future guidelines and decisions on the national innovation strategy – and the Research and Innovation Council, functioning as an advisory body;
(b) second level: the Ministry of Education and Culture and the Ministry of Employment and Economy – concerned with the designation of programmes in innovation policy principally related to research and technology policy;
(c) third level: the Academy of Finland, and the Finnish funding agency for technology and innovation – concerned with the allocation of R&D&I funding;
(d) fourth level: universities, public research institutes, private research organisations and business enterprises – concerned with conducting final research projects.

Finland's expenditure on research and development was 4% of GDP in 2009, and for the period 2011-15, the Finnish Government plans to maintain this (ibid.). Under the Proposal for Finland's national innovation strategy (Ministry of Employment and the Economy Finland, 2008), the country aims to diversify its innovation efforts and to reinforce a more demand and supply-based innovation policy. Further, it has ambitions to promote innovative individuals and communities and to become a pioneer in innovation research, particularly in the field of systemic development. Finnish innovation policy puts a strong emphasis on cooperation between research organisations and companies.

Programme agency: Finland's principal public player in the field of financing research, development and innovation is Tekes. The organisation provides funding to Finnish companies and public research units for innovative projects that aim to create new knowledge and develop novel products, processes and services. Its main aim is to encourage renewal in industries to underpin sustainable growth. Tekes seeks to achieve this with a two-fold approach. On the one hand, it focuses its efforts on Finnish SMEs. On the other hand, it promotes network structures and programmes between companies and research organisations by setting up cooperation platforms and engages in ways to stimulate Finland's participation in international networks.

In 2010, some 61% of Tekes R&D&I funds was granted to SMEs. The agency also encourages and supports the development of new business concepts and encourages investment in start-ups. Additionally, Tekes reinforced its focus on the service sector, and on funding public research projects (Tekes, 2011).

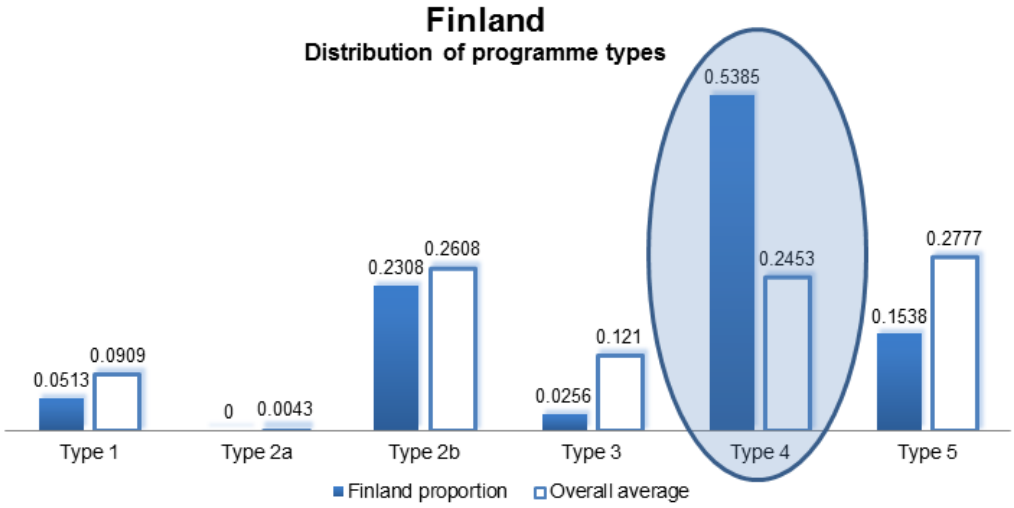
Programme background: from 2005 to 2006, a predecessor programme ran under the name 'Serve' – innovation services technology programme. Like today's programme, it was concerned with the development of novel and internationally competitive service concepts and business models (Tekes, 2007). For the following period (subsequently extended until 2013), Tekes allocated EUR 224 million to the programme Serve – Pioneers of Service Business. It aims to support Finnish companies to become pioneers and international leaders in the customer-centred, knowledge-based service business. A key element of the programme is to help create new service concepts (including brand concepts and scalable business models) that lead to the establishment of closer ties and create added value for the customer. By targeting the multiple facets that affect the complex relationship between customers and service providers (e.g. developing the ability and means to see beyond current needs, increasing agility and flexibility), the programme encompasses more than just service innovation at the business and research level. The innovation chain is completed by simultaneously promoting network-building and international R&D&I cooperation as well as encouraging joint research projects and knowledge transfer from academia to business. Serve targets companies which aim to foster service innovation in the following areas of industry: knowledge-intensive business services; industrial services; financial and insurance services; trade; real estate services and logistical services. With regard to research organisations, Serve provides funding to academic units that concentrate on service innovation.

Programme type: as the Finnish programme Serve concentrates on the generation of new knowledge in the area of service innovation and the development of service concepts in companies, it is classified as a type 4 programme. According to the typology set out in this study (see Section 4.2), programmes belonging to this cluster are characterised by their focus on the stimulation of R&D&I investments.

The Finnish programme portfolio is dominated by type 4 programmes, which account for more than 53% of the country's programme portfolio. This dominance is consistent with previous observations, which showed that this type of programme is well represented in countries that belong to one of the two leading clusters. Their established industrial base makes them concentrate on programmes that aim to support R&D&I activities in industry. While the figures

indicate that the focus is more evenly spread across Europe for type 2b, 4 and 5 programmes, Finland shows little interest in investing in structural capital (with an emphasis on work organisation, 2b type) and general investment in R&D&I structure (type 5). Moreover, it neglects investment in human (type 1) and relational capital (type 3). Among the programmes currently running there is not a single type 2a programme. Again, this is consistent with the features attributed to the 'solid' cluster (see Table 5).

Figure 29 **Distribution of programme types in Finland compared to overall average**



Source: Authors.

Findings: with regard to the human capital dimension, the assessment by the Serve programme manager shows that the actual effects exceed the expected effects (except for social skills, competences of employees and continuing HE). While the average ratings of all type 4 programme managers indicate only minor to moderate effects on the human capital dimension, the Serve programme manager is almost constantly above this average. This observation also holds true for the structural and relational capital dimension.

Like the programme manager, the project managers' assessment also reflects a high correlation between actual and expected effects in the human capital dimension (except for domain-related KSC: no effect expected, but major effects observed). The same holds true for the structural and relational capital dimension. Most features are rated to have moderate to major effects.

Beyond the assessment of the expected and actual effects of Serve on capacity for innovation, an analysis was conducted of the causal relationship between innovation and changes at the workplace and in work organisation that

result in learning. While the programme manager gives a moderately positive assessment of all aspects, the project managers express even greater positive agreement, albeit with the exception of two aspects: product innovation through (a) organisational changes and (b) intensive learning. The average of project managers' assessments indicates that product innovation was not within scope of these projects, while Serve scores highly in process innovation through intensive learning for these projects. In the light of the aims of the programme, which is primarily focused on process innovation, the project managers' evaluation is understandable and consistent. In general, it is worth noting that Serve would appear to generate a workplace climate which promotes sustainable changes and improves learning opportunities.

To gain a more complete picture of Serve's impact on workplace conditions for informal learning, the project managers were also asked to assess and compare the three pertinent workplace characteristics – namely transparency, task and skill variety, and autonomy, in the light of the initial and current situations. Project managers consistently see the current situation in companies as being the same or more positive, with regard to transparency. Similarly, for the dimension of task and skill variety – with the exception of task rotation and risk assumption – a more positive assessment of the current situation is also consistently assessed more positively. The project managers express (high) agreement with all autonomy-related aspects in the current situation. The only exceptions to this are the project managers' view that there has been a slight fall in the opportunity for employees to self-regulate their work speed, plan autonomously, receive appropriate information and contribute to finding solutions to existing problems.

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The potential of vocational education and training (VET), including workplace learning, to foster innovation has not yet been fully exploited. There is a need for improvements in synergies between policies for innovation, business development and learning in enterprises.
What are the links between work organisation, workplace learning, training and innovation? How can workplaces be developed that are conducive to learning and innovation? In Europe, are there any examples of policy initiatives and publicly funded programmes that combine innovation and skills development being applied in enterprises? If so, how do they differ and how do they operate? Which types of programmes are used to foster the innovative ability of enterprises?
This report looks at innovation and learning in enterprises and examines the role that VET and learning-conducive working environments play in fostering enterprises' innovative capacity. It covers the EU-27 plus Norway and analyses the impacts of learning-intensive forms of work organisation and learning on innovation in enterprises. Furthermore, it provides an overview of programme portfolios in the various European countries and analyses the impacts of publicly funded innovation programmes on the innovative ability of organisations.

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