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**Learning Organisations:
the importance of work organisation for innovation**

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While innovation is widely recognised by OECD countries as an important engine of growth, the underlying processes of innovation has been changing, shifting away from models largely focused on R&D in knowledge based globalised economies. Understanding in a comprehensive way how organisations build up resources for innovation has become a crucial challenge to find new ways of supporting innovation in all areas of economic activity. The aim of this paper is to provide analytical tools and empirical results to open the black box of what is a learning organisation.

The literature on learning organisations is highly disparate and there is nothing like a unified definition of the “learning organisation” that has been developed by different authors in a cumulative manner. A key feature of the literature is that much of it is normative and concerned with the promotion of management tools that are designed to improve the learning capabilities of an organisation and its members. This management consultancy literature is only weakly linked to an empirical research program designed to observe and measure the extent to which existing firms display the characteristics of learning organisations. In particular, there has been little effort to develop indicators of the learning organisation that could be measured with survey data. A **first objective** in this paper is to identify some common definitional ground in the case study and management literature. Particular attention will be given to the way the literature treats the role of organisational culture in promoting employee learning and its relation to the use of specific human resource management policies.

A **second aim** of the paper will be to present evidence on the spread of learning organisations at a national and EU-wide level, to examine the role of learning cultures in the development of learning organisations, and to examine the relation of learning organisation to institutional characteristics at the national level including the innovation system, the education and further training system and the structure of labour markets. Using the 2000 edition of European Working Conditions Survey (EWCS), Lorenz and Valeyre (2005) are able to identify for the EU-15 forms of work organisation characterised by high levels of learning, problem-solving and autonomy in work. The frequency of these ‘discretionary learning’ forms of work organisation varies considerably across EU-member nations, being highest in the Nordic nations and the Netherlands, at intermediate levels in the Continental nations, and lowest in the UK, Ireland and southern nations. In Arundel et al. (2007) evidence is presented to show that in nations where the frequency of the learning forms of work organisation is the highest firms display superior performance in terms of new-to-the-market product or process innovations. In Holm et al (2009), using multi-level analysis on the results of the 2005 edition of the European Working Conditions Survey (EWCS), it is shown for the EU-27 and Norway that the learning forms of work organisation are more frequent in nations with systems of flexicurity characterised by high levels of labour market mobility, and expenditure unemployment protection including active labour market policies. These results point to systematic relations between the way work and employee learning are organised on the one the one hand, and national institutional context and innovative performance on the other.

Another important aspect is longitudinal. How are the characteristics of work and learning evolving over time? Greenan, Kalugina and Walkowiak (2007), using the common questions in three waves of the EWCS (1995, 2000 and 2005) in a multi-level analysis find a decreasing pattern in the EU 15 average evolution of work characteristics that are conducive to high learning opportunities (complex tasks, autonomy, problem solving, learning). They label it the “complexity paradox”: the increasing level of education, the

growing experience of an ageing workforce, the shifts in sector and occupation shares and the diffusion of computers should drive the expansion of jobs with complex tasks, high discretion and learning, but this is not what is observed in the data. A **third objective** of this paper is to uncover this complexity paradox, searching in the literature for the reasons that may explain the negative trend in work complexity: growing standardisation, job polarisation, organisational change and skill mismatch are possible culprits.

In globalised advanced economies, growth and innovation do necessarily translate into increased work complexity, which is an important component of learning organisations. Thus, the connection between the learning activities of employees in their tasks, the dynamic capabilities of the organisations and the propensity to innovate needs to be investigated thoroughly. This will be a **fourth objective** of the paper. We will try to address it by focusing first on the trade-offs that employers face when they decide to make new strategic decisions implying some changes in work methods, organisational structure, products or processes. We will then consider what happens on the employee side when employers innovate. We will carefully scrutinise empirical results based on innovation surveys and on linked employer/employee datasets. Is it possible to identify management practices that lead to higher innovation performance levels? What kind of work organisations fosters a culture of innovative behaviour and creativity? Do incentives to innovate matter? Empirical studies from the economic, the industrial relations and the psycho-sociology fields will be reviewed.

Finally, this paper will identify metrics and survey methods that are most promising to capture differences in the capacities of organisations to adapt and compete through learning across countries.

Section 1: Defining learning organisations and learning cultures¹

In the literature on learning organisations, as we noted above, there is nothing like a unified definition of the “learning organisation” that has been developed by different authors in a cumulative manner. A key feature of the management literature is that much of it is normative and concerned with the development of diagnostic tools that can be used by managers to assess and improve the learning capabilities of their organisations. This management literature is only weakly linked to an empirical research program designed to observe and measure the extent to which existing firms display the characteristics of learning organisations. In particular, there has been little effort to develop indicators of the learning organisation that could be measured with survey data.

The notion of the learning organisation is closely linked to that of organisational learning and before considering some of the principal ways in which learning organisations have been defined and analysed it is useful to briefly consider the historical background of research on organisational learning. A seminal contribution was that of March and Simon (1958) and it is perhaps not an exaggeration to say that their conception dominated organisational theory literature until the 1990s along with few other contributions such as of Argyris and Schön (1978) March and Olson (1975), and Levitt and March (1988). March and Simon (1958) analysed organisational learning in terms of processes of search and the modification of routines which were identified as the basic building block of organisations. They identify a spectrum of behaviours going from those that are spontaneously invoked in response to repeated stimulus with little or no search activity, to those that depend on considerable search and the mediation of existing routines in response to more or less novel stimulus.

Argyris and Schön (1978) defined organisation learning as ‘the detection and correction of error’ where learning can take place in three forms – single loop, double loop and deuterio learning. Single loop learning takes place when errors are detected and firms carry on with their ongoing policies and goals. As observed by Dodgson (1993), single loop learning has also been referred to as lower level learning (Fiol and Lyles, 1985), adaptive learning or coping (Senge, 1990) and non strategic learning (Mason, 1993). In double loop learning, in addition to detection and correction of errors, the organisation is involved in the questioning and modifications of existing norms, procedure, policies and objectives. As discussed by Dodgson (1993), double loop learning involves changing the organisational knowledge base. Deuterio learning occurs when the firm learns how to carry out single and double loop learning, for example, by indentifying the processes and structures that facilitate learning. Dodgson describes organisational learning as the way firms organise knowledge around their activities and within their cultures and develop organisational efficiency by improving the use of the broad skills of their workforces whereas Senge (1990) defines it as generative learning or learning to expand organisations capabilities. Generative learning emphasises continuous, double-loop experimentation and feedback. Double-loop learning enhances the continual search for solutions while instilling behaviours and a culture where learning is embraced. Unlike adaptive learning, generative learning requires a new mindset and the capacity to create new visions for future realities. Fiol and Lyles (1985) defined higher level of learning as the process of improving actions through better knowledge and understanding and Mason (1993) gave the name strategic learning in which organisations make sense of their environment in the ways that broaden the range of objectives that can be pursued or the range of resources and actions available

for processing these objectives. So organisational learning is more than the sum parts of individual learning (Dodgeson, 1993, Fiol and Lyles, 1985).

From the late 80s and early 90s the notion of the 'learning organisation' started gaining in popularity in the management literature. The term learning organisation was proposed by Pedler, Boydell and Bugoyne in 1989 and became more widely used following Senge's best seller, *The Fifth Discipline*, in 1990. Both the notions of organisational learning and the learning organisation have at their core the translation of information into business success through individual, team, organisational and wider learning processes. On the other hand, the learning organisation literature can be distinguished by its action orientation and the way it has been geared toward developing specific diagnostic and evaluative methodological tools which can help to identify, promote and evaluate the quality of learning processes inside organisations (Easterby-Smith, Araujo and Burgoyne, 1999; Tsang, 1997).

Senge's (1990) provides a good example of the normative practitioner's orientation of much of the literature. Senge defines learning organisations as, "organisations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continuously learning to see the whole together" (p. 3). He defines five disciplines for the development of learning organisations: systems thinking, personal mastery, mental models, shared vision, and team learning (Senge, 1990). Senge proposes that people put aside their old ways of thinking (mental models), learn to be open with others (personal mastery), understand how their company really works (systems thinking), form a plan everyone can agree on (shared vision), and then work together to achieve that vision (team learning). Much of his 1993 book develops and illustrates with case study examples of these five disciplines or component technologies of learning organisations.

The number of books and articles that have been written in the spirit of providing management aids and diagnostic tools for developing or improving a company's learning capabilities is vast. Often cited contributions include Crossan et al. (1999); Deane, Clark et al. 1997; Garvin, 1993; Gephart et al. (1996); Goh ,1998; Levine, 2001; Marquardt and Reynolds, (1994); Mohanty and Deshmukh, 1999; Pace, 2002; Pedler, Burgoyne and Boydell, 1991; Redding, 1997; Rothwell, 2002; and Watkins and Marsick, 1996 and 2003.

Pedler et al. (1989) define the learning company as, "an organisation that facilitates the learning of all its members and continuously transforms itself in order to meet its strategic goals". They continue to identify eleven policy areas through which this occurs including internal exchange, reward flexibility, enabling structures, learning climate and self-learning for everyone. Garvin (1993, p. 80) defines a learning organisation as, "an organisation skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights." He draws on case study evidence of the practices used by a number of companies to illustrate the use of strategic building block for constructing learning organisations. For example, he cites the training methods developed at Xerox as exemplary for promoting employee problem-solving capabilities. Redding (1997) in an article that bills itself as, "a step to step guide to conducting an assessment to determine whether your company has the characteristics of a learning organisation" defines the learning organisation in terms of the degree to which the company, "has purposely built its capacity to learn as a whole system and woven that capacity into all its aspects: vision and strategy, leadership and management, culture, structure, systems and processes".

Deane, Clark et al. (1997) make an explicit link between learning organisations and performance in terms of whether project outcomes meet customer needs, explaining that a variety of gaps can exist between the two. The article presents a model that is designed to help managers assess and narrow these gaps and foster a continuous improvement cycle "typical of learning organisations". A similar focus on providing management aides can be found in Goh's (1998) discussion of "strategic building blocks for learning in relation to overall company design and performance.

A few of these studies propose survey instruments that can be used for quantitative assessments of a company's characteristics and the extent to which they correspond to a learning organisation. One of the most frequently cited is the Organisational Learning Profile (OLP) assessment tool described in Pace (2002). The instrument, which draws inspiration from the work of Huber (1991) and Levitt and March (1988), consists of 34 items assessing the degree to which organisational learning is taking place. In the original Pace et al. (1997) study factor analysis is used to identify four latent factors or dimensions of the learning organisation: a) information-sharing patterns, b) inquiry climate, c) learning practices, and d) achievement mindset. Information-sharing patterns include the ways and the extent to which organisational members share information. Inquiry climate includes the ways and extent to which organisation members inquire, challenge, and experiment to improve organisational functioning. The learning practices factor focuses on the kinds of activities in which organisational members engage to learn. Finally, the achievement mindset factor has to do with the perspective that organisational members have regarding their desire to achieve in the organisation.

Another often cited assessment instrument is the Dimensions of the Learning Organisation Questionnaire (DLOQ) developed by Watkins and Marsick (1996, 2003).² The survey consists of 55 subjective questions concerning the kinds of beliefs and behaviours of organisational members related to seven dimensions of a learning organisation: a) creates continuous learning opportunities, b) promotes dialogue and inquiry, c) promotes collaboration and team learning, d) empowers people to evolve in a collective vision, e) establishes systems to capture and share learning, f) connects the organisation to its environment, and g) provides strategic leadership for learning. Drawing on the results of interviews conducted in a sample of 836 organisations, confirmatory factor analysis is used to assess construct validity, and structural equation modelling (SEM) is used to examine the hypothesised relations between the different dimensions and measures of company performance. The authors conclude that the learning organisation is a multi-dimensional construct involving a complex set of interrelations between individuals, teams and the organisation as a whole.

Despite the disparate nature of this literature and its largely normative focus, it is possible to identify some common definitional ground beyond, of course, the obvious point that learning organisations are those with a capacity to adapt and compete through learning. First, most of the research sees the learning organisation as a multi-level concept and define the learning organisation in terms of the interrelations between individual behaviours, team organisation and organisational practices, and structure. The multi-level nature of the concept, for example, is explicit in the DLOQ assessment tool where the items are divided between the individual, team or group and company levels. It is also explicit in Redding's (1997) step-by-step assessment guide where the interrelations between individual, team and organisation learning are emphasized. In a more general

sense, the multi-level nature of learning organisation can be seen in the emphasis placed by both Crossan et al. (1999) and Rothwell (2002) in the relation of leadership style in to individual employee learning dynamics.

Secondly, there is an emphasis in this literature on the importance of the beliefs, values and norms of employees for sustained learning. Although this aspect is discussed in a variety of ways and with differences in language, the emphasis on beliefs, values and attitudes raises the issue of the role of organisational culture in promoting and sustaining employee learning. The idea of organisational culture, of course, has been extensively developed in the field of organisational studies. While the term has been defined in a wide variety of ways (see Ott, 1998, for an overview) many authors identify company culture with subjective beliefs, norms and values that are shared by organisational members and contribute to coordinating their activities. For example, Schein (1985) defines organisational culture as, "A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems". In a similar vein Hill and Jones (2001) define organisational culture as, "the specific collection of values and norms that are shared by people and groups in an organisation and that control the way they interact with each other and with stakeholders outside the organisation."

Understood in this way, organisational culture enters into most discussions of the learning organisation. It can be seen in the emphasis many authors place on the importance of developing shared beliefs and values that support employee learning. For example, Senge's (1990) emphasis on the need to put aside established ways of thinks or mental models and to develop a shared vision can be seen as call for organisational culture change. Similarly, Watkins and Marsick (2003) describe their DLOQ assessment tool as designed to, "measure important shifts in an organisation's climate, culture, systems, and structures that influence whether individuals learn." Examination of different items in their questionnaire reveals that many are designed to assess the extent to which employees hold the sorts of attitudes and values that are favourable to knowledge acquisition, exchange, and learning. The same emphasis on values and norms supportive of leaning can be seen in the discussion of Crossan et al. (1999) of the role of the organisational "environment" in supporting continuous learning by employees, in Rothwell's (2002) emphasis on the importance of a "learning atmosphere" for sustaining employee learning, or in the way Gephart et al. (1996) define a learning culture in terms of values and norms that, "promote enquiry, risk-taking and experimentation" as well as allowing "mistakes to be shared and viewed as opportunities for learning."

A learning culture, defined as set of shared beliefs, values and norms favourable to learning can be seen as an essential part of the organisational context within which specific organisational design principles and types work organisation are successfully implemented. The connections between organisational culture and organisational design have been addressed explicitly in a recent article by Dimovski et al. (2007), who define an organisational learning culture as, "a set of norms, values and underlying assumptions about the functioning of an organisation that support more systematic, in depth approaches aimed to achieve deuterio, strategic or generative learning...". They argue that a learning culture may be a crucial link between a business process orientation (BPO) and achieving high-level company performance. The key organisational design principles they identify are: cross-functional management and work organisation; decentralised decision-making

including autonomous team organisation, and tight links with customers and suppliers. The basic thesis is that in the absence of a supportive learning culture repeated changes in organisational design may amount to empty restructuring, as after the initial shock and adjustment behaviour will tend to drift back into its original form, or possibly towards new and unintended perverse forms.

The idea of culture as a key factor impacting on the ability of firms to achieve higher rates of learning in turn raises the issue of personnel policies serving to foster and promote learning cultures. Johnston and Hawke (2002) take up this issue explicitly and they identify five types of human resource management (HRM) policies for fostering what they see as the core of a learning culture, employee commitment. The five policy areas are; further vocational training and performance assessment, payment for skill, transparent career paths, supportive management, and increased opportunities for informal learning. A similar emphasis on supportive HRM policies can be found in other studies of the learning organisation, even if the causal links we are drawing here between specific human resources policies and the development of learning cultures are not made so explicitly. For example, Garvin (2003) in his discussion of Xerox, GM Saturn and Boeing points to importance of supportive and open management, reward for risk-taking and making ample opportunities for informal learning and communication. Redding (1997) explicitly discusses the relation of culture to enterprise structure and advocates the use of performance management tools including those linking pay to learning performance measures. Gephart et al. (1996) argue that “cultures of learning” exist where “learning and creativity are rewarded, supported, and promoted through various performance systems from the top to bottom”.

The multi-level nature of the concept of a learning organisation, as well as the importance of learning cultures understood as systems of beliefs and values supporting learning, poses a particular challenge for measurement and quantitative analysis, especially from an internationally comparative perspective. An ideal approach would be to use linked employer-employee data allowing for a rich characterisation and transnational comparison of enterprise structure and management practices in relation to individual learning dynamics. In the absence of such data, Sections 2 and 3 below draw on harmonised employee level data for the EU-15 and EU-27 in order to explore the characteristics of learning organisations from both cross sectional and time-series perspectives.

Section 2: Mapping learning organisations and their characteristics for the EU

In this section we draw on a series of papers by Lorenz and his co-authors that address the spread of learning organisations and their characteristics for EU member nations. The papers use a common methodology developed in Lorenz and Valeyre (2005) and they show how different styles of employee learning are linked to different ways of organising work. An attempt is made to connect the differences in forms of work organisation and learning to differences in organisational culture and HRM policies. Arundel et al. (2007) link national differences in work organisation and employee learning to innovation style and performance for the EU-15. Holms et al. (2008) explore the relation between national differences in employee learning dynamics and the national institutional context for the EU-27 and Norway. The focus is on the structure of the labour markets and national labour market policies.

The papers draw on the 2000 and 2005 waves of the European Working Conditions Survey (EWCS) carried out at the individual level by the European Foundation for the Improvement of Living and Working Conditions for the EU-15 and EU-27 respectively³. The papers focus on employees working in establishments with at least 10 persons in both industry and services, but excluding agriculture and fishing; public administration and social security; education; health and social work; and private domestic employees. It is important to emphasise that the use of employee-level data captures the frequencies of different forms of work organisation and employee learning within private sector establishments, but cannot be used to identify the frequency of adoption of different types of enterprise or company structures. The data thus can only provide an indirect measure of the diffusion of learning organisations. However, the absence of a harmonised employer-level EU survey on organisational dynamics precludes developing direct measures based on employer-level data. The ideal approach would be a linked employer-employee data set in order to more explicitly examine the relations between employee learning and organisational structure and design.

Mapping learning organisations for the EU

The basic methodology used to map the importance of different forms of work organisation and employee learning across EU member nations is set out in Lorenz and Valeyre (2005). A combination of factor analysis and hierarchical classification on the basis of 15 binary variables has been derived from the EWCS data in order to assign employees to distinct categories or groups. The choice of variables is based on organisational taxonomy developed by Lam (2005) which extends the classic work of Mintzberg (1979). Lam contrasts two ideal organisational forms that support different styles of learning and innovation: the ‘operating adhocracy’ and ‘J-form’ or the Japanese forms of organisation.⁴ She observes that the operating adhocracy relies on the expertise of individual professionals and uses project structures to temporarily fuse the knowledge of these experts into creative project teams that carry out innovative projects typically on behalf of its clients. High levels of discretion in work provide scope for exploring new knowledge and adhocracies tend to show a superior capacity for radical innovation. Compared to the operating adhocracy, the J-form is a relatively bureaucratic form that relies on formal team structures and rules of job rotation to embed knowledge within collective organisation. Stable job careers within internal labour markets provide

incentives for members to commit themselves to the goals of continuous product and process improvement and the J-form tends to excel at incremental learning and innovation.

Table 2.1 here

Table 2.1 presents four basic systems of work organisation resulting from the analysis of the 2000 wave of the EWCS in terms of the percentage of employees characterised by each of the 15 binary organisational variables. For example, 93.9 % of all employees with a job subject to 'discretionary learning' report learning new things in work. The first cluster, which account for 39 percent of the employees,⁵ is distinctive for the way high levels of autonomy in work are combined with high levels of learning, problem-solving and task complexity. The variables measuring constraints on work pace, monotony and repetitiveness are under-represented. The use of team work is about at the average level for the population as a whole, while less than half of the employees in this cluster participate in job rotation which points to the importance of horizontal job specialisation. The forms of work organisation in this cluster correspond rather closely to those found in adhocracies and due to the combined importance of work discretion and learning we refer to this cluster as the 'discretionary learning' form.

The second cluster accounts for 28 percent of the employees. Compared to the first cluster, work organisation in the second cluster is characterised by low levels of employee discretion in setting work pace and methods. The use of job rotation and team work, on the other hand, are much higher than in the first cluster, and work effort is more constrained by quantitative production norms and by the collective nature of work organisation. The use of quality norms is the highest of the four clusters and the use of employee responsibility for quality control is considerably above the average level for the population as a whole. Compared to operating adhocracies, these features point to a more structured or bureaucratic style of organisational learning that corresponds rather closely to the characteristics of the Japanese-inspired 'lean production' model associated with the work of MacDuffie and Krafcik (1992) and Womack et al. (1990).

The third class, which groups 14 percent of the employees, corresponds in most respects to a classic characterisation of taylorism. The work situation is in most respects the opposite of that found in the first cluster, with low discretion and low level of learning and problem-solving.

The fourth cluster groups 19 percent of the employees. All the variables are underrepresented with the exception of monotony in work, which is close to the average. The frequency of the two variables measuring learning and task complexity is the lowest among the four types of work organisation, while at the same time there are few constraints on the work rate. This class presumably groups traditional forms of work organisation where methods are for the most part informal and non-codified.

Table 2.2 shows that there are wide differences in the employee learning dynamics across European nations. The 'discretionary learning' forms of work organisation are most widely diffused in the Netherlands, the Nordic countries and to a lesser extent Germany and Austria, while they are little diffused in Ireland and the southern European nations. The more bureaucratic lean model is most in evidence in the UK, Ireland, and Spain and to a lesser extent in France, while it is little developed in the Nordic countries or in Germany, Austria and the Netherlands. The low learning taylorist forms of work organisation show

almost the reverse pattern compared to the ‘discretionary learning’ forms, being most frequent in the southern European nations and in Ireland and Italy. Finally, the traditional forms of work organisation are most in evidence in Greece and Italy and to a lesser extent in Germany, Sweden, Belgium, Spain and Portugal.

Table 2.2 here

A number of important conclusions come out of the cluster analysis. The results show considerable diversity in how people work and learning across the member nations of the European Union. Not only are the traditional taylorist forms of work organisation holding their own in certain nations, but there is no convergence to a single model of high employee learning. The evidence points to the existence of two models with strong learning dynamics: a relatively decentralised model associated with substantial employee autonomy in setting work methods and work pace (referred to as the ‘discretionary learning’ model), and a more hierarchical model which places emphasis on regulating individual or group work pace by setting tight quantitative production norms and precise quality standards (referred to as the ‘lean’ model).

The relation between organisational learning and innovation

In Arundel et al. (2007) these results are extended in order to explore the relation between work organisation and employee learning and problem-solving on the one hand, and innovation style and performance on the other. Economists and business scholars frequently measure innovation by R&D expenditures or by the number of patents applied for or granted. The weaknesses of these measures are well known. R&D doesn’t necessarily result in the development of new products or processes and many innovative firms do not perform R&D. A large fraction of innovations are not patented and the importance of patenting varies according to sector. Furthermore, R&D and patents entirely fail to capture innovation that occurs through diffusion processes, such as when a firm purchases innovative production equipment or product components from other firms.

The Community Innovation Surveys (CIS) were in part designed to respond to these limitations by providing survey-based estimates of the percentage of manufacturing firms and selected service sector firms that have developed or introduced a new product or process over a three-year time period. However, the CIS estimates of the percentage of innovative firms are based on a very broad definition of innovation ranging from intensive in-house R&D that results in new-to-market products or processes to minimal effort to introduce manufacturing equipment purchased from a supplier. Consequently, a broad all-encompassing definition where a distinction is made between ‘innovative firms’ and ‘non-innovative firms’ is both misleading in international comparisons and fails to provide a clear picture of the structure of innovation capabilities within individual countries.

In order to overcome these limitations, Arundel and Hollanders (2005), in collaboration with Paul Crowley of Eurostat, developed a taxonomy classifying all innovative CIS respondent firms into three mutually exclusive innovation modes that capture different methods of innovating, plus a fourth group for non-innovators.⁶ The classification method uses two main criteria: the level of novelty of the firm’s innovations, and the creative effort that the firm expends on in-house innovative activities. The three innovation modes are as follows:

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.

Technology modifiers: These firms primarily innovate through modifying technology developed by other firms or institutions. None of them perform 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.

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.

Table 2.3 here

Table 2.3 presents the distribution of firms according to innovation mode for 14 EU nations for which the necessary data are available and also includes the percentage of firms that did not innovate. The results are weighted to reflect the distribution of all firms within the industry and service sectors covered by CIS-3. The results show that Finland, Germany, Sweden and Luxembourg have the highest percentage of firms in the lead category of innovators, while Germany, Luxembourg and Austria have the highest percentages of firms that are technology modifiers. In Spain, Greece, and the UK over 80% of firms are either adopters or non-innovators.

The relation between organisational learning and innovation is explored at the aggregate level by means of correlations between the frequencies of different forms of work organisation and modes of innovation. Figure 2.1 presents the results of this exercise for the 'discretionary learning' (DL) form of work organisation. The main result is that there is a positive correlation between 'discretionary learning' and the frequency of the two innovation modes for which the levels of novelty and creative in-house effort are the highest, the lead innovators and modifiers, while there is a negative correlation between 'discretionary learning' and the frequency of non-innovators. Furthermore, the strongest positive correlation is between lead innovators and 'discretionary learning', with an R^2 of 0.39.⁷

Figure 2.1 here

Figure 2.2 presents the same analysis using the frequency of the lean form of work organisation. The results tend to go in the opposite direction of those for 'discretionary learning'. Thus they show a negative correlation between the frequency of the lean form and the frequency of the two innovation modes which depend on in-house creative effort for innovation, and a positive correlation with the frequency of adopters and non-innovators.⁸

Figure 2.2 here

A first major result is that in nations where work is organised to support high levels of discretion in solving complex problems, firms tend to be more active in terms of innovations developed through their own in-house creative efforts. In countries where

learning and problem-solving on the job are constrained, and little discretion is left to the employee, firms tend to engage in a supplier-dominated innovation strategy. Their technological renewal depends more on the absorption of innovations developed elsewhere. The negative correlation between 'lean production' and 'modifier innovation' raises important questions about how successful European firms have been in making use of Japanese-inspired business practices to support incremental innovation. Our analysis gives rise to new hypotheses on how management techniques such as job rotation and teamwork are related to innovation. They point to a need to develop analytical concepts that can link workplace organisation and the dynamics of innovation at the level of the firm.

Second, the results indicate that learning and interaction within organisations and at workplaces are at least as important for innovation performance as learning through interactions with external agents. Therefore, in order to understand national systems of innovation it is necessary to bring the organisation of work and employee learning into the analysis. Early conceptions of national innovation systems were built upon an analysis of interactive learning between producers and users. Now the analysis needs to be founded also on an understanding of learning organisations and the way people interact and learn at the workplace in different national economies.

A third implication is that indicators for innovation need to do more than capture material inputs such as R&D expenditures and human capital inputs such as the quality of the available pool of skills based on the number of years of education. Indicators also need to capture how these material and human resources are used and whether or not the work environment promotes the further development of the knowledge and skills of employees. One step toward more adequately addressing the relation between organisation and innovation is to gather and analyse complementary firm-level data on both innovation modes and organisational forms. One option is to develop better indicators of organisational innovation and practices in future CIS surveys, as proposed by the third revision of the Oslo Manual in 2005. Another option is to develop new linked employer-employer survey instruments providing the basis for a rich multi-level characterisation of the innovative behaviours and practices of both organisations and their employees. As we discuss in section 4 below, an advantage of this approach is that it allows an assessment of the impact of different organisational arrangements and designs on employee outcomes and thus a better appreciation of the conditions favouring a sustained interest on the part of employees for learning and change.⁹

The role of learning cultures

Drawing on the results of the 2005 wave of the EWCS, Holmes et al. (2009) extend the methodology developed by Lorenz and Valeyre (2005) to characterise the frequency of different forms of work organisation and employee learning dynamics for the 27 members of the EU and Norway. The 2005 wave of the EWCS includes a number of new questions pertaining to intrinsically motivating aspects of work organisation and certain of these can be used to capture features of a learning culture. In what follows we draw on these measures as well as indicators of human resource management (HRM) policies to explore in a preliminary manner the links between learning culture and employee learning dynamics for the 28 European nations.

Johnston and Hawke (2002), as we noted above, identify learning cultures with employee commitment and they identify specific types of HRM policies that contribute to building

such high commitment cultures. They, at least implicitly, draw inspiration from the literature on HRM complementarities. A basic idea in this literature is that the forms of work organisation requiring considerable discretion and problem-solving activity on the part of employees are more likely to be effective if they are supported by particular policies around pay, training and manpower planning that serve to promote a culture of employee commitment. For example, as we stress in this report, work in learning organisations is characterised by a high degree of task complexity. Learning is continuous as employees are expected to take initiative and to exercise autonomy in resolving the production and service related problems they confront. In the lean production model, while work requires problem-solving skills and involves learning, these dynamics are embedded in a more formal structure based on codified protocols (e.g. team work and job rotation practices) often associated with tight quantitative production norms. Autonomy is relatively low compared to the 'discretionary learning' model.

Nonetheless, since learning and problem-solving capabilities are central to both of these models, it can be expected, as Johnston and Hawke (2002) argue, that learning organisations will have an interest in investing more in the training of their employees than more traditional taylorist organisations, characterised by low task complexity and high task repetition.

For similar incentives reasons, it can be argued that firms relying on high levels of employee learning and problem solving will have an interest in adopting pay and promotion policies linking compensation and careers to individual, group or company performance. The quite plausible hypothesis is that employees will be more likely to commit themselves to the goal of improving the firm's capacity for learning and problem-solving if they are promised a share of the quasi-rents which derive from their enhanced commitment and effort (Ichniowski et al., 1997; Freeman and Lazear, 1995; Levine and Tyson, 1990; Lorenz, et al. 2004, Osterman, 1994). Further, it has been argued that such complementary pay policies are more likely to be effective if they are embedded in some system of employee representation that assures employees that their interests will be represented in the design and operation of the pay and promotion system (Eaton and Voos, 1992; Freeman and Lazear, 1995; Levine and Tyson, 1990; Lorenz, et al. 2004).

Variable pay systems, however, may have different effects depending on whether they are collective or individual. Collective incentive schemes, such as profit sharing and gain sharing schemes that link pay to enterprise performance, are likely to outperform individual schemes such a piece rate systems or individual bonus payments where a premium is placed on knowledge sharing amongst members and across different services. Individual incentive schemes are more prone to generating competitive behaviours and they may motivate employees to hoard knowledge and ideas in the interests of achieving a superior performance relative to their colleagues.

Other personnel polices identified as supportive to learning cultures, such as encouragement from management and creating ample opportunities for discussion and knowledge exchange, are discussed extensively in the knowledge management (KM) literature or in the literature dealing with creativity in work. For example, the KM literature dealing with 'communities of practices' emphasizes the importance of providing ample opportunities for interaction and exchange amongst employees in order to foster the processes of learning and problem-solving coming out these largely informal and spontaneous group structures (Brown and Duguid, 1991; Wenger, 1998). The literature on

creativity at work emphasises the importance support and encouragement at the levels of management and the work group as well as fostering communication and knowledge exchange in order to promote diversity of ideas (Albrecht and Hall, 1991; Amabile, et al. 1996; Kimberly and Evanisko, 1981; Roffe, 1999).

There is no unified way of treating culture in relation to HRM and personnel policies in the literature on learning organisations. Some authors (eg. Gephart et al. 1996) see HRM policies such as pay for knowledge as part of what defines a culture of learning. Others (e.g. Johnston and Hawke, 2002) see HRM policies as fostering the values and norms characteristic of learning cultures and, at least implicitly, treat culture as a variable mediating the relation between HRM policies and employee learning. In order to explore the links between learning cultures, HRM policies and employee learning we adopt a two-stage strategy. In the first stage we use logit regression to examine the relation between specific HRM policies the likelihood of different forms of work organisation and employee learning. In the second stage we introduce into the regressions our learning culture measures in order to determine to what extent the effects of HRM policies on employee learning are mediated by indicators of a learning culture.

Table 2.4 presents the frequency of the four forms of work organisation for the EU-27 and Norway. As in the cluster analysis based on the 2000 wave of the EWCS, the Nordic nations and the Netherlands stand out for their high use of the ‘discretionary learning’ forms of work organisation and their low level of use of Taylorism. The lean forms are most present in the UK and Portugal amongst the EU-15 and amongst Latvia, Lithuania, Poland and Romania amongst the new member nations. The Taylorist forms are relatively developed in all of the southern nations amongst the EU-15 and in a number of the new member nations including the Czech Republic, Cyprus, Hungary, Bulgaria and Romania. The simple forms are relatively frequent in Spain, Greece and Ireland amongst the EU-15 and in Hungary, Lithuania, Cyprus and the Czech Republic amongst the new member nations.

Table 2.4 here

The EWCS, of course, was not designed to measure the values and norms characteristic of a learning culture. Nonetheless, the 2005 wave of the survey included a number of new questions designed to capture intrinsically motivating aspects of work. Certain of these can be used to measure the extent to which employees hold the kinds of beliefs and attitudes that would be characteristic in organisations with strong learning cultures. These include a question asking how often the employee applies his or her own ideas in work, a question asking how often the employee finds his or her job intellectually demanding, and a question asking how strongly the employee agrees that he or she has opportunities to learn and grow at work. Table 2.5 presents the frequency with which these beliefs or attitudes are held by employees according to the form of work organisation. The frequencies for the three beliefs or attitudes are consistently higher for the ‘discretionary learning’ than for the lean forms. Further, both the ‘discretionary learning’ and lean forms stand out for the higher frequency of the three measures compared to the Taylorist or simple forms.

Table 2.5 here

The EWCS survey includes a limited number of measures of the kinds of HRM policies that employees are subject to. We draw on these questions in order to identify the use of

HRM policies in four of the areas that are identified in the learning organisation literature as supportive of, or an element of, a learning culture. The four policy areas are: further vocational training; pay for performance; consultation and assessment; and assistance to employees. The training measure is a binary indicator of whether or not the employee received training provided by the employer over the last 12 months. The pay system measures distinguish between piece rate or individual bonus payments, pay based on group performance, and pay based on the performance of the enterprise. Assessment is captured by a question asking whether or not the employee has had a frank discussion with his or her boss about work performance, and by a question asking whether or not the employee has been subject to regular formal assessment of his or her work performance. Consultation is measured by a question asking whether or not the employee has been consulted or not over changes in work organisation or working conditions. Assistance is measured by two questions, one asking whether the employee can almost always or often get assistance from his or her boss or superior when it is asked for, and a second asking whether the employee can almost always or often get external assistance when it is asked for.

Table 2.6 presents the results of the logit regression analysis. The first 4 columns show the relation between the likelihood of the different forms of work organisation and the various HRM policies. Considering first the predictors of the ‘discretionary learning’ forms, the results for the most part conform to our expectations. There are positive and significant coefficients on the indicators for further training, the two indicators of assistance, the indicators of pay linked to enterprise performance and the indicators of consultation and discussion with one’s employer over work performance. The negative coefficient on individual piece rate or productivity bonus may be explained by the fact that work activity in the ‘discretionary learning’ forms is largely non-repetitive and unsupervised which reduces the scope for linking pay to well-defined measures of individual output. The negative coefficients on group-based pay and on regular formal assessment are somewhat surprising. For the former indicator, the explanation may be the same as that for individual performance pay. If teamwork is non-repetitive and complex in nature, then the scope for linking pay to well-defined measures of group performance may be reduced. Pay linked to measures of enterprise performance does not face the same technical difficulty.

A related possible reason pertains to the relation between intrinsic and extrinsic motivation as discussed by Amabile et al. (1996) in their research on creativity at work. As they observe, in much of the literature on intrinsic motivation it is assumed that extrinsic motivators in the form of compensation for performance will undermine the positive effect of such intrinsic motivators as curiosity and a sense of personal accomplishment and fulfilment. On their account, however, pay and rewards can combine synergistically with intrinsic motivation in so far as they are perceived by the employee as giving recognition for accomplishment and not as a management tool for controlling one’s effort. If group-based pay combined with regular formal assessment is perceived by the members of a team as tools designed to control their collective effort then they may prove incompatible with relying on intrinsic motivators for promoting knowledge exploration and learning in the ‘discretionary learning’ forms.

When we compare the relatively regulated and pace constrained lean forms with the ‘discretionary learning’ forms, it is interesting to note that the coefficients on pay linked to individual and group performance and on being subject to regular formal assessment take the opposite sign and are positive and significant. These differences may be understood in terms of the different nature of learning in the lean forms. Since work and learning activity

is less autonomous in the lean forms, with above average levels of repetitiveness and with work pace being sharply constrained by hierarchical and norm-based constraints, there is greater scope for linking pay directly to well-defined measures of individual or group output. Such measures of individual or group output in turn provide a basis for subjecting employees to regular formal performance assessment. While this emphasis on extrinsic motivators may act to undermine the effects of intrinsic motivators, this may be less problematic for management in the lean forms, given the scope for regulating work pace through norm-based and hierarchical constraints.

Table 2.6 here

Columns 5 through 8 present the regression estimates including the learning culture measures. Examining these variables first, the coefficients are all positive and significant for the 'discretionary learning' and learn forms, while they are negative and significant for the taylorist and simple forms. The main differences between the 'discretionary learning' forms and the lean forms concerns the much larger positive coefficient on the indicator for applying one's own ideas in work in the case of the 'discretionary learning' forms, whereas the positive coefficient on finding the job intellectually demanding is somewhat smaller than it is for the lean forms. These differences are consistent with the fact that whereas the learning and complexity are equally high in the two models, the level of autonomy and hence scope for creative use of one's own ideas is much higher in the 'discretionary learning' forms.

Examining next the effects of introducing the learning culture variables on the coefficients for the HRM variable, we find support for the idea that culture mediates the impact of HRM practices on the likelihood of employee learning. The size of the positive coefficients on the HRM variables for the model estimating the likelihood of the 'discretionary learning' forms is reduced in all cases and in the case of the two variables measuring assistance to employees the coefficients are no longer statistically significant or are of borderline statistical significance. This shows that by introducing the learning culture variables we have fully or in part "explained" the positive relation between specific HRM policies and the likelihood of the 'discretionary learning' forms. In the case of the lean forms, we can see the same tendency, with decreases in the size of most of the positive coefficients on the HRM variables. The downward shifts in the size of the positive coefficients are relatively small, however, this tends to reinforce the view that learning cultures play a less important role in promoting employee learning in the relative regulated and work pace constrained lean forms of work organisation.

Linking learning organisations to institutional context

In Recent work on national systems of innovation (Amable 2003; Hall and Soskice 2001; Lorenz and Lundvall 2006; Whitley 2006) has argued that there are systematic relations between the structure of labour markets and systems of unemployment protection on the one hand, and the dynamics of knowledge accumulation and learning at the work place on the other. National systems combining high levels of labour market mobility with relatively high levels of unemployment protection and expenditure on 'active' labour market policies may have an advantage in terms of the adoption of the forms of work organisation and knowledge exploration at the firm level that can promote innovation. This is related to the fact that organisations which compete on the basis of strategies of continuous knowledge exploration tend to have relatively porous organisational boundaries

so as to permit the insertion of new knowledge and ideas from the outside. Job tenures tend to be short as careers are often structured around a series of discrete projects rather than advancing within an intra-firm hierarchy (Lam and Lundvall 2006).

Well developed systems of unemployment protection in association with active labour market policies may contribute to the development of such fluid labour markets for two complementary reasons. Firstly, in terms of incentives, the security such systems provide in terms of income maintenance can encourage individuals to commit themselves to what would otherwise be perceived as unacceptably risky forms of employment and career paths. Second, active labour market policies, including expenditures on further vocational training education and other forms of life-long-learning, contribute to the flexibility of labour markets by supporting the continuous reconfiguration of the workforce's skills and competences.

Holms et al. (2009) address these issues in a paper focusing on the the EU-27 and Norway. Using data on labour market mobility and on expenditure on labour market policies available from Eurostat's electronic data set, the authors use multi-level logistic analysis to analyze the relation between the likelihood of the different forms of work organisation and differences in institutional context. A principal components analysis for the 28 nations is conducted on the aggregate data identifying three factors or components. The first, FLXSCR, which accounts for 24 percent of the total variance, can be interpreted as a measure of flexicurity or alternatively as a measure of precarious rigidity. Countries scoring high on this factor combine high levels of labour market flexibility with high level expenditures on both active and passive labour market policies. They have a particular emphasis on training designed to promote the movement of the unemployed into employment. These are classic characteristics of policies for flexible security and correspond closely to the notion of a "golden triangle of flexicurity" based on the combination of flexible labour markets, high levels of unemployment protection and labour market policies designed to move the unemployed into employment through up-grading skills. The second, PASVSCR, accounts for 23 percent of the variance. This factor measures the balance in a nation between an emphasis on passive security in the form of income support for the unemployed or the part-time employed versus an emphasis on active measures in the form of subsidies for start-ups and self-employment and direct job creation of community or social benefit. The third, EMPPTC, accounting for 18 percent of the variance, measures the importance of subsidies for maintaining existing job or moving the unemployed into jobs of social or community value, versus expenditures services for job search.

Figure 2.3 plots the position of the 28 European nations on the FLXSCR and PASVSCR scales. The figure shows that the Nordic countries (DK, NO, SE and FI) all score high on the flexible security scale, that the continental European nations score near to or above average, and that the eastern European nations, with the exception of Bulgaria, score low. The southern nations are at average levels, with the exception of Greece that scores low, and the Baltic nations are at average or above average levels. The UK scores low on the flexible security scale while Ireland scores relatively high. Figure 2.3 also shows that the Continental nations with the exception of Belgium stand out for their emphasis on passive security in the form of income transfers, while the UK, the Slovakia, Lithuania and Bulgaria stand out for giving a relative priority to start-up incentives or job creation measures.

Figure 2.3 here

The aggregate measures are used for a multi-level logistic analysis built-up from a rather simple single-level model explaining the likelihood of the different forms of work organisation as a function of level of formal education, years of working experience, occupation, sector and gender.

Equation (1) below illustrates the two-level structure (I employees in J countries) of the model:

Level1 :

$$\begin{aligned} \text{Logit}_{ij} = & \beta_{0j} + \beta_{1j}\text{Medu}_{ij} + \beta_{2j}\text{Hedu}_{ij} + \beta_{3j}\text{Mexp}_{ij} + \beta_{4j}\text{Hexp}_{ij} \\ & \beta_{5j}\text{Occu1}_{ij} + \beta_{6j}\text{Occu2}_{ij} + \beta_{7j}\text{Occu3}_{ij} + \beta_{8j}\text{Female}_{ij} \\ & \beta_{9j}\text{Sect2}_{ij} + \beta_{10j}\text{Sect3}_{ij} + \beta_{11j}\text{Sect4}_{ij} + \beta_{12j}\text{Sect5}_{ij} \end{aligned}$$

Level2 :

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\text{ActFlex} + \gamma_{02}\text{UempPtc} + \gamma_{03}\text{JobPtc} + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + u_{4j}$$

$$\beta_{5j} = \gamma_{50}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80}$$

$$\beta_{9j} = \gamma_{90}$$

$$\beta_{10j} = \gamma_{100}$$

$$\beta_{11j} = \gamma_{110}$$

$$\beta_{12j} = \gamma_{120}$$

(1)

There are two dummies for education. *Medu* indicates that the employee has upper secondary education or post secondary but not tertiary education. *Hedu* indicates that the employee has education of the tertiary level. The reference category is thus lower secondary or less education (*Ledu*). There are also two dummies for experience. *Mexp* indicates that the employee has more than 5 but no more than 15 years of work experience. *Hexp* indicates that the employee has more than 15 years of work experience. The reference category is thus employees with at most 5 years of work experience (*Lexp*).

We distinguish between four occupational categories. *Occu1* is managers, professional and technicians. *Occu2* is clerks and sales. *Occu3* is skilled workers. The reference category is unskilled workers (*occu4*). For gender our reference category is male and the variable *female* is coded 1 if the employee is a woman. We distinguish between 5 industrial sectors: *Sect2* is construction and utilities (NACE groups E and F). *Sect3* is Retail, wholesale, hotels & restaurants and other services (NACE groups G, H and I). *Sect4* is business and financial services (NACE groups J and K). *Sect5* is community, personal and social

services (NACE group O). The reference category is mining and manufacturing (*Sect1*, NACE groups C and D).

The level 1 model of equation (1) is similar to any other binary logistic model. The dependent variable is the logit-transformation of the conditional probability of success for the i^{th} worker in the j^{th} country:

$$E(y_{ij} = 1 | \beta_j) = \pi_{ij}$$

$$\ln\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \text{Logit}_{ij} \quad (2)$$

The important difference between equation (2) and the traditional logistic model is the subscript j on the vector of estimators, β , signalling that the model will provide country specific intercept and slope estimates.

The basic results in a model with random intercepts and random coefficients for education and experience are given in Table 2.7.

Table 2.7 here

Focusing on the results for the ‘discretionary learning’ model, the first level fixed effects results show a positive relation with level of formal education and years of working experience. There is moderate trans-national variance on the coefficients for the indicators for secondary and tertiary education. The first-level results for the taylorist forms show the opposite results with a negative effect for the level of formal education and for years of working experience.

Considering the second level fixed effects a significant result is that there is a positive and significant impact of the aggregate measure of active flexibility on the likelihood of the ‘discretionary learning’ forms of work organisation. This supports the initial hypothesis that the combination of a mobile workforce and labour market policies emphasizing expenditures on further training are associated with greater use of forms of work organisation that involve high levels of learning and discretion. The results also identify for the taylorist forms of work organisation model a negative coefficient on the flexicurity scale. This may be explained by the fact that of the four forms of work organisation the levels of learning, problem-solving and complexity are the lowest in the taylorist forms, and active labour market policies would not be likely to play a major role in moving the unemployed into active employment in simple or traditional work settings.

Arundel, et al. (2007) provided evidence showing that in nations where work is organised to support high levels of discretion in solving complex problems firms tend to be more active in terms of innovations developed through their own in-house creative efforts. In countries where learning and problem-solving on the job are constrained, and little discretion is left to the employee, firms tend to engage in a supplier-dominated innovation strategies. Their technological renewal depends more on the absorption of innovations developed elsewhere. Holms et al (2009) extends on these results by exploring the relation between individual level outcomes and national systems of labour market flexibility and

regulation. These still preliminary results provide support for the view that the way work is organised is nation-specific and that it varies in a systemic way with the degree of labour market mobility and with the way labour markets are regulated. The implications of these results are that the institutional set-up determining the dynamic performance of national systems is much broader than normally assumed when applying the innovation system concept. Policies affecting employment security including income maintenance policies for the unemployed are of fundamental importance for how firms learn and innovate. There are alternative ways to systems of innovation and competency-building and different systems tend to organise work and distribute security and protection differently among citizens.

Section 3: Measuring trends: the complexity paradox

The previous section mapped the spread of learning organisations across Europe using the European Working Conditions Survey (EWCS). Relying on the different waves on the same data source, this section is dedicated to assessing the trends of work characteristics associated with learning organisations over 1995, 2000 and 2005 for EU 15 countries. It will give a detailed account of results found in Greenan, Kalugina and Walkowiak (2007).

Data and Measurement frame

The European Foundation for the Improvement of Living and Working Conditions has carried out four surveys on the working conditions in Europe (in 1990/1, 1995/6, 2000 and 2005), and also surveyed the acceding and candidate countries in 2001/2¹⁰. Greenan, Kalugina and Walkowiak (2007) have analysed trends for EU 15 over 1995-2005 and for EU 21 over 2000-2005. They did not use the first waves of the survey because the formulation of the core set of questions for describing work organisation has strongly evolved between the first and second waves of the survey. They report on trends in three different dimensions of work experience in Europe: quality of working conditions, work intensity and work complexity. In this section, we focus on the results found about trends in work complexity in EU15 over a ten years period, between 1995 and 2005. Data coverage is different to the one retained in section 2 as the sample used is representative of persons in employment, defined in the Labour Force Surveys as including *“those who did any work for pay or profit during the reference week (the reference week varied from country to country) or those who were temporarily absent from their jobs”*. Thus, in addition to the sample used in the work presented in section 2 (8081 salaried employees in 2000 and 9986 salaried employees in 2005), we include the self employed, salaried employees in establishments with less than 10 employees and salaried employees in agriculture and fishing, public administration and social security, education, health and social work and private domestic employees. As the sample is restricted to EU 15, we exclude new member states (Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovakia, Bulgaria and Romania) and Norway. The total sample used includes 15 986 persons in 1995, 21 703 persons in 2000 and 14 952 persons in 2005.

In order to characterise work organisation in Europe, the authors select a set of twelve primary variables capturing the experience of persons in employment about how their work is organised and coordinated. These questions are formulated in a simple and objective way, using a yes/no scale. This contributes to the international comparability of answers by lowering country differences in the way questions are understood and answered. However this does not wear away heterogeneity in legal and cultural norms across country that could still generate country patterns or effect.

Work organisation is a latent multidimensional variable which is not directly observable. Each of the twelve primary variables that are selected contributes to the construction of an overall picture of work organisation but none of them alone is sufficient to describe it effectively. To measure the various dimensions of work organisation Greenan, Kalugina and Walkowiak (2007) build synthetic indicators which are multi-item scales resulting from a multiple correspondence analysing (MCA) where the twelve selected variables play an active role. The survey weights are used in the analysis in order to draw an overall picture of work organisation in Europe, taking into account the differences in sampling frames across countries. The MCA method amounts to a non-linear principal components

analysis that assigns numerical scores to respondents and response categories of dummy-coded categorical variables. It results in a graphical map of the interdependencies among the variables which reveals the association structures in the data (Hwang, Dillon and Takane, 2006). An interesting result from this MCA, which we will discuss further below, is that the first key dimension arising from the analysis summarises how individual and organisational knowledge is involved in the work process. This is why it is interpreted as a work complexity indicator.

The longitudinal dimension of the data is limited, consisting of three cross sections in 1995, 2000 and 2005. Greenan, Kalugina and Walkowiak (2007) measure trends in the synthetic indicator of work complexity applying the method proposed by Greenan and Mairesse (2006). They run an MCA for the starting year of the time period, 1995. This is the benchmark analysis relative to which trends over time in the work complexity indicator are computed. The underlying work organisation metric of the base year (1995) from the MCA is then applied to the following years. The weights issued from 1995's MCA procedure are applied to the distribution of individual characteristics measured in 2000 and 2005 to build up comparable multi-item scales across time. A core assumption in this method is that it is meaningful to apply the structural relationships observed in 1995 to 2000 and 2005.

A decreasing trend in work complexity

The twelve primary variables of the work organisation analysis provides some detailed information on the characteristics of tasks (are they monotonous? Are they complex?), on how they are performed (with precise quality standards? with self assessment of quality? with discretion for changing the order of tasks? with discretion for changing the methods of work?), on how they are coordinated (with task rotation involving colleagues? with assistance from colleagues? with freedom to take breaks? with freedom to take days off or holidays?) and on the associated learning process (learning new things at work? solving unforeseen problems on your own?).

In table 3.1, column 1 gives the exact formulation of the corresponding question in the EWCS. The first factor of the work organisation MCA for 1995, accounting for 22% of total inertia is a multi-item scale which weights are given table 3.1, column 2. The bold weights indicate that the item response has a high contribution to the inertia of the factor. The factor shows an opposition between complex jobs involving opportunities of learning and routine jobs: on one side jobs involving complex tasks also entail discretion on how the work is carried out and learning new things, while on the opposite workers declare that their work is not complex, that they are not able to change or choose their methods of work and order of task, that they do not solve unforeseen problems or assess themselves the quality of their work, that they are not free to take breaks or days off when they wish to and that they do not feel that they learn new things. As mentioned in the previous section, the fact that complexity, discretion and learning goes hand in hand with one another supports the idea of the existence of a learning model of organisation. This interaction has already been identified in work based on an employee level survey at a national level and connected with economic performance issues at the employer level (Greenan and Guellec, 1998). However, in this analysis, complexity, discretion and learning make up a dimension of their own, weakly connected with other features of work organisation like quality standards, task monotony, job rotation, or support from colleagues. This result echoes findings of Lorenz and Valeyre (2005), based on the previous wave of the EWCS and presented in section 2, where the discretionary learning model is only weakly connected to

the use of teams, job rotation and quality norms We label this multi-item scale indicator, work complexity, knowing that a high work complexity is conducive to high learning opportunities.

Table 3.1 here

Table 3.2, columns 1, 2 and 3 gives the rank of each EU15 country in term of the average level of work complexity in 1995, 2000 and 2005. Generally speaking, it is in Scandinavian countries (Denmark, Sweden and Finland) that workers frequently perform complex tasks, but other countries also offer high learning opportunities and complex tasks. Indeed, Netherlands is ranked in the third position in 1995 and 2005. Routine jobs are more frequent in Mediterranean countries, but they are also frequent in the British Isles (ranking 10th for UK and 9th for Ireland) and in Germany (ranking 13th in 2005). These results are in line with the distribution of the ‘discretionary learning’ form of work organisation presented in section 2.

In table 3.1, columns 3, 4 and 5 give the weighted distributions of the twelve primary variables in 1995, 2000 and 2005 for EU-15. These descriptive statistics are somewhat surprising: most of the variables under scrutiny show a slight downward trend over the ten years time period. For example, the percentage of EU15 persons in employment declaring that their jobs involved learning new things decreased from 76% in 1995 to 70% in 2005, for task rotation, the percentage decreased from 55% to 43% and for discretion in the choice of methods of work the percentage decreased from 72% to 68%. There are only two exceptions to this general picture: a small increase in quality standards (71% in 1995, 74% in 2005) and a large increase in freedom to take holidays or days off (57% in 1995, 67% in 2005). How do these trends translate in the work complexity indicator?

In table 3.2, trends in the work complexity indicator are computed in two different ways. Columns V1 (variation 1) give the sign of the variation of the EU15 or country average work complexity indicator over 1995-2000 (column 4), 2000-2005 (column 6) and 1995-2005 (column 8). In EU15, average work complexity has first decreased significantly over 1995-2000, and then it has increased over 2000-2005 without compensating the initial decrease so that a significant overall decreased is measured over the ten years period. However, work complexity has significantly decreased over 1995-2005 in three countries only, Great Britain, Spain and Germany which have a strong weight in EU15 average trend. On the opposite, it has significantly increased over the ten years in Denmark, Ireland, Austria, Belgium, Luxembourg and Greece. Columns V2 (variation 2) give the sign of the variation once they have been purged of the structural effect of sectors and occupations. More precisely, the authors run regression at the individual level where work complexity is explained by occupation, sector and year dummies. Then, they retrieve the residuals which provide the value of each indicator when the occupation and the sector are controlled for and they test the significance of its average variation over 1995-2000 (column 5), 2000-2005 (column 7) and 1995-2005 (column 9). V1 results appear robust to the inclusion of occupation and sector structures. Belgium and Italy are the only countries for which a change in the significance of the variation is observed. In Belgium the increase in work complexity is no longer significant, which indicates that the proportion of sectors or/and occupations implying more complex jobs increased but that the degree of work complexity within jobs did not change. In Italy, shifts in occupations and sector structures were hiding a general decreasing trend in job complexity.

Table 3.2 here

To understand how organisations adopt new ideas and behavioural patterns, and how workers absorb and exploit knowledge to innovate, the evolutionary literature (Cohen and Levinthal, 1990; Winter and Zollo, 2002) analyses the micro-dynamics of routines, capabilities and learning. It is now largely admitted that the way coordination takes place at workplaces has some important consequences in terms of learning processes. We also know that patterns of work coordination differ substantially across employers, sectors and countries. A widespread idea is that to adapt the fordist and the taylorist models of production, where coordination rests on standardisation of products and processes, to more rapid changes in the environment of firms there is a movement towards a model where coordination rests on mutual adjustments, allowing for a learning process that is more prevalent, less concentrated on a small fraction of the work force. If this is true, the negative average work complexity trend in EU15 is puzzling. It is unexpected as the knowledge base of the core of the European economy is most of the time described as expanding. How can an increased dependency of the economy on the generation of new knowledge fit with an average decreasing trend of work complexity experienced by EU15 workers? It is also at odds with the groupings of countries from the literature on the variety of capitalism or welfare regimes. Strong decreasing trends in work complexity are observed in countries from different institutional and cultural backgrounds: UK, Germany, Spain and Italy. If Scandinavian countries appear to be preserved over 1995-2005, it is because the initial and significant decreasing trends they registered over the 1995-2000 period was counterbalanced by a subsequent significant growth in 2000-2005. Greenan, Kalugina and Walkowiak (2007) try to uncover this complexity paradox by exploring micro and macro drivers of changes in work complexity using multilevel analysis.

Micro and macro drivers of changes in work in Europe

Several papers in the economic literature show that work organisation depends on macro-drivers. They could be related to an increased market volatility due to globalisation (Thesmar and Thoening, 2000), to the supply of skills on the labour market (Caroli, Greenan and Guellec, 2001), to demographic trends (Belletini and Ottaviano, 2005) or to the availability and price of the technologies which complements given work organisation practices (Milgrom and Roberts, 1992). Institutional settings such as the legal environment of each country or regulation of labour markets could also contribute to shaping work organisation (Amable, 2003). What is the influence of these macro drivers on the trend in work complexity?

Greenan, Kalugina and Walkowiak (2007) use multilevel analysis to assess individual effects (level 1) as well as country effects (level 2) in the decreasing trend of work complexity. The multilevel analysis is a relevant econometric approach if the answers of workers of a same country are correlated. In that case, the variance in answers can be decomposed into a within-country variance and a between-country variance. This decomposition requires estimating a basic two-level regression model called the intercept-only model, which contains no explanatory variables. This decomposition of variance will serve as a benchmark with which other, more complicated models are compared. If there are no explanatory variables at level 1, the model equation could be formulated as following:

$$Y_{ij} = \beta_{0j} + r_{ij}, \text{ where } r_{ij} \sim N(0, \sigma^2) \tag{1}$$

In traditional models, r_{ij} is the random effect and β_{0j} is a fixed part. However, work complexity is not independent from the country where workers are surveyed. There is a correlation between observations within countries, resulting in differences in country intercepts, which may be expressed as follows:

$$\beta_{0j} = \gamma_{00} + u_{0j}, \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \quad (2)$$

The full model is specified by substituting (2) in (1):

$$Y_{ij} = \gamma_{00} + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \quad \text{and} \quad r_{ij} \sim N(0, \sigma^2) \quad (3)$$

This model allows decomposing the total variance into two independent components: the variance of individual-level errors (r_{ij}) and the variance of the country-level errors (β_{0j}). The intra-country correlation can be expressed as follows:

$$\hat{\rho} = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \hat{\sigma}^2}$$

It indicates the proportion of the variance explained by the grouping structure in the sample. It can also be interpreted as the expected correlation between two randomly chosen units that are in the same country. In other words, this intra-country correlation measures the portion of the total variance that occurs between countries.

Table 3.3 reports the results of the intercept-only model for work complexity in 1995, 2000 and 2005. The intra-country correlation is non negligible indicating that it is worth while analysing a country effect in work complexity. Moreover, this intra-country correlation tends to increase over time: 6,7% in 1995, 7,1% in 2000 and 8,5% in 2005, suggesting an increased heterogeneity in the country effect or a diverging trend in work complexity across EU15 countries. This result supports the application of a multilevel model on the pooled data from the different waves of the EWCS to explain micro and macro drivers of work complexity.

Five different models are estimated (Box 3.1), going from the simplest to the most elaborated one. The first model is the intercept only model. As the regressions are ran on the pooled data from the three survey waves, results are different from the ones displayed in table 3.3. Model 2 includes time dummies at the individual level, with 1995 as base year. Model 3 includes year dummies and worker level variables only. Model 4 includes year dummies and macroeconomic variables only. The last model is the complete one, with time dummies, micro and macro variables.

At the individual level, as for the work organisation variables, we have to limit ourselves to the EWCS variables that are consistently measured over the three waves of the survey. Thus, we are able to control for demographic information (gender and age), occupation (9 categories), employment status (contract duration, self-employed or salaried employee), sector of the workplace (5 categories), use of a computer and management position. Indeed, all these characteristics have a potential impact on work complexity. We would have liked to take into account explicitly educational attainment and work experience, but

this information is not available over the three waves of the survey. The age, occupation and management position could play a role of indirect measures of accumulated competences and skills.

At the macro-level, the variables entered into the model are also limited by the availability of time series. A first driver, which is consistently measured over time, is economic growth. Moreover, the issue of a knowledge based society implies to consider some indicators on education within European countries. Tertiary attainment for age group of 25-64 years old as a percentage of the population in that age group is an indicator of the education level of countries' population. The complexity of work could also be affected by sectoral and occupational structural evolutions that differ across European countries. Finally, in an ageing Europe where labour force is becoming more opened to women, a gender and age perspective is needed. The gender and age composition of population is represented by percentage of females and persons aged between 20 and 24 in the economically active population. We also include a part-time employment rate in total employment. These measures are based on OCDE and Eurostat data.

Results of the five models are reported in table 3.4. The estimation of model 1 shows that there is a significant country effect in work complexity, but that the variance is considerably higher among individuals. The estimated intra-country correlation is 6.6%. In model 2, 3 and 4 dummy variables for years 2000 and 2005, individual controls for workers characteristics and macro-economic controls for countries characteristics are successively and respectively introduced. The impacts of these controls on the different components of variance are first analysed. In model 2 statistically significant negative coefficients for both years are found but the coefficient for year 2005 is smaller in absolute value compared to that for year 2000 (-0.055 and -0.038).

Box 3.1: Five models

Model 1. Intercept-only model.

$$Y_{ij} = \beta_{0j} + r_{ij}$$

$$\text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + u_{0j} + r_{ij}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model 2. Inclusion of time dummy

$$Y_{ij} = \beta_{0j} + T_1 \text{Year}2000 + T_2 \text{Year}2005 + r_{ij}$$

$$\text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + T_1 \text{Year}2000 + T_2 \text{Year}2005 + u_{0j} + r_{ij}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model3. Inclusion of only individual variables

$$Y_{ij} = \beta_{0j} + T_1 \text{Year}2000 + T_2 \text{Year}2005 + \beta_{ij} \text{Ind}_{ij} + r_{ij} \text{ where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + T_1 \text{Year}2000 + T_2 \text{Year}2005 + \beta_{ij} \text{Ind}_{ij} + u_{0j} + r_{ij} \text{ where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model4. Inclusion of only macroeconomic indicators

$$Y_{ij} = \beta_{0j} + T_1 \text{Year}2000 + T_2 \text{Year}2005 + r_{ij}$$

$$\text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{0j} \text{Macro}_j + u_{0j}$$

$$\text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + \gamma_{0j}Macro_j + T_1Year2000 + T_2Year2005 + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

Model5. Full model with individual and macroeconomic determinants

$$Y_{ij} = \beta_{0j} + T_1Year2000 + T_2Year2005 + \beta_{ij}Ind_{ij} + r_{ij} \quad \text{where } r_{ij} \sim N(0, \sigma^2)$$

$$\beta_{0j} = \gamma_{00} + \gamma_{0j}Macro_j + u_{0j} \quad \text{where } u_{0j} \sim N(0, \tau_{00})$$

$$Y_{ij} = \gamma_{00} + \gamma_{0j}Macro_j + T_1Year2000 + T_2Year2005 + \beta_{ij}Ind_{ij} + u_{0j} + r_{ij} \quad \text{where } u_{0j} \sim N(0, \tau_{00}) \text{ and } r_{ij} \sim N(0, \sigma^2)$$

These findings support and confirm the descriptive statistics on trends over the two sub periods of time displayed in table 3.2 and discussed earlier. When individual characteristics only are introduced (model 3), the years' dummies remain significant with the same relation between 1995 and 2000 and 1995 and 2005 pointing out that the changes in explanatory individual variables do not account for observed average EU 15 changes in work complexity. Compared to the intercept-only-model the addition of individual variables explains 25%¹¹ of individual variance of work complexity. Model 4 introduces macroeconomic indicators only, which have been centred on the European mean. The year dummies remain significant but now the year 2005 dummy is greater in absolute value than year 2000 dummy (-0.082 versus -0.066). Taking into account macro level variables changes the results compared to simple descriptive statistics and to the model with individual covariates only. Once macro drivers are taken into account, the model registers a decrease in work complexity between 2000 and 2005. By introducing macroeconomics controls, we also explain the country level variance, which has diminished by 47%.

Table 3.4 here

What does the complete model (model 5) indicate? First of all, work complexity reacts very strongly to the personal characteristics of workers. At the individual level, the typical worker having the most routine job is a young woman (15-24 years old), working as a salaried employee with a temporary contract. She does not work with a computer and does not have a management position. She is a plant or machine operator (or in elementary occupation) in the manufacturing sector. Secondly, work complexity also reacts to the macro-economic drivers. The sector structure is a central component of the country effect: countries where manufacturing and service sector amount for a larger part of total employment are characterised by higher level of work complexity. Besides, the share of part time employment in total employment drives a decrease in work complexity.

Overall, this multilevel analysis makes the complexity paradox even deeper. When potential micro and macro drivers are taken into account in the analysis, the residual decrease in work complexity becomes larger and the observed increase in descriptive statistics between 2000 and 2005 fades away. This is because many forces should drive an increase in work complexity. At the individual level, occupations with higher educational attainments, management positions, age as a proxy of accumulated work experience, computer use are associated with higher levels of work complexity. At the macro level shifts in sector shares away from agriculture favour work complexity. Thus taking into account all these positive forces, we should have observed an increase in work complexity when we observe a slight decrease in simple descriptive statistics. What reasons could contribute to the explanation of the negative trend in work complexity?

Uncovering the complexity paradox

First, looking more closely at the results of the model we identify some possible drivers of a decrease in work complexity, connected with gender, part time, limited contracts and aging. There is a vast body of literature, theoretical and empirical, stretching back over more than two decades, on gender and work and the ways in which patterns of segregation are reinforced or challenged. Some positive assumption about changes in work organisation as regards to women are made, such as the idea that new career profiles offer more opportunities for women to follow a successful professional trajectory. Traditional forms of organisation, particularly bureaucracy, where learning opportunities are weaker, would have strictly defined gender roles, while new forms of organisation, would favour more porous gender roles. However, the empirical research often contradicts this assumption (Greenan and Walkowiak, 2005, Liff and Ward, 2001). As in table 2.7, results in table 3.4 show that, all things being equal, women perform more routine jobs. We also note that countries with greater percentage of part-time employment are characterised by a lower degree of work complexity. This indicator could reflect the degree of flexibility of the labour market and the quality of jobs, but it is also positively correlated with the percentage of females in economically active population. Like part time work at the macro level, limited contacts at the micro level are associated with lower levels of work complexity. Precarious employment relationship does not favour work complexity but routine jobs with less learning opportunities and competence developments. This result is in line with the one obtained in table 2.3 for year 2005. Using employee level data from an Italian nation wide survey on skills, Leoni and Gaj (2008) find negative impacts of gender, temporary contracts and part time contracts on employee level indicators of competences measured through a job requirement approach and in particular problem solving skills. They show that these negative impacts reflect three lacks: lack of experience accumulation at the workplace for the temporary contract effect, lack of further training for the part time effect and lack of access to jobs with innovative organisational characteristics for the gender effect. Finally, models 3 and 4 show an inverted U shape profile for work complexity related with age. The younger workers experience the more routine jobs. Then work complexity increases between 24 and 44 and decreases slightly afterwards, remaining at a higher level after 55 than for younger workers. In total regressions indicate that the development of precarious employment relationships on labour markets and the feminisation of the workforce contribute to decreasing work complexity. Age has a non linear effect, with an increase of work complexity up to 55, probably due in parts to an experience effect which we are not able to control and a slight decrease afterwards.

However, as the regression results show it, these factors taken together do not exhaust the decrease in work complexity. Other forces are at play, which are not captured in the analysis. Searching in the literature for alternative explanations, we identified four other possible culprits: growing standardisation, job polarisation, organisational change and skill mismatch. The first two rely on the idea that there is an objective and concrete decreasing trend in work complexity, whereas the second two discuss the fact that this trend is measured through a subjective assessment.

In his classic work on the structure of organisations, Mintzberg (1979) identifies two modes of coordination involving some standardisation in how work is performed: the standardisation of work processes when the content of tasks can be specified and programmed by means of rules and procedures to secure acceptable outcomes and the standardisation of output when tasks options are uncertain and when expected results can be clearly identified. These two types of coordination are associated to bureaucratic forms

of organisation. Over the past two decades, much emphasis in the literature has been put on other forms of organisations than the bureaucratic one as responses to the increased complexity and uncertainty in business environment and to the growing importance of knowledge in economic activity. These forms of organisation are more organic and decentralised and involve less standardisation than bureaucratic types of organisation. For example, according to Mintzberg (1979), the archetype of the innovative organisation is the adhocracy, a typical learning organisation where workers are organised in multidisciplinary project teams, with liaison devices to encourage mutual adjustment, which is the central coordination mechanism. Theoretically, as the adhocracy tries to break out from established patterns to innovate, it does not rely on standards.

However, since the mid-1990s, as a response to globalisation and backed up by the availability of ICTs that transformed communication costs and drastically reduced the cost of distant co-ordination, many organisations opened up their external boundaries, resulting in a restructuring of value chains. Drawing on material from four case studies on outsourcing practices in the UK, Grugulis, Vincent and Hebson (2003) come to the conclusion that “in every instance, the process of contracting meant that tasks were more strictly defined and monitored and employees were able to exercise less discretion”. Relying on fifty-six organisational case studies of restructuring processes across Europe conducted in the EC funded WORKS project, Greenan, Kocoglu and Walkowiak (2008) point out that the main change in work organisation associated with ICT diffusion is a higher standardisation of work and an increase in work control through electronic systems. When organisations decide to outsource or offshore some of their activity, they face a problem of loss of control that they partially master through the use of ICTs like Enterprise Resource Planning Software, workflow management technologies or supply chain management technologies which allow a quasi integration of business partners. A prerequisite of ICT use is then a standardisation process which generates routine tasks and specified products and services that can be easily outsourced or offshored. ICTs then play a role at two levels in the inter-organisation relationship: they embed standards and they structure the flow of information about the outsourced activity between business partners. If ICTs involve codification of knowledge and standards, many new management concepts also contribute to the generation of standards: quality certification (like the International Organisation for Standardization certification), traceability tools, Service Level Agreements, performance tracking systems etc. Unfortunately this trend towards growing standardisation connected to the diffusion of specific ICTs has not yet been assessed quantitatively by lack of available data on business practices and work organisation. Moreover, as pointed by Ellström (2001), the links between formalisation of work processes through the use of standards and organisational learning needs further investigation. Formalisation appears to be a double-edge sword. By reducing variations in task performance and inducing a focus on solutions that fit established procedures, standards are likely to cut some learning opportunities. However, standards save time and attention that may be reallocated to more creative tasks and by codifying previously tacit knowledge and best practices and creating more transparency they may contribute to organisational learning. There is thus indeterminacy and employers need to strike the right balance between standardisation and mutual adjustment which are two different modes of coordination.

The decrease in work complexity appears to be strongest in the UK, Germany, Spain and Italy. It is interesting to note that in UK and Germany, a case for growing job polarisation linked with ICT diffusion has been made (Goos and Manning, 2007, Spitz-Oener, 2006).

To understand the interplay between computerisation and job skill demands, Autor, Levy and Murnane (2003) built up measures of tasks performed in particular jobs and their change over time between 1960 and 1998 based on the Dictionary of Occupational Titles and applied to the census occupation codes. Five different types of tasks are identified within jobs: non routine analytic, non routine interactive, routine cognitive, routine manual and non routine manual. The documented task shift towards non routine cognitive tasks, pervasive in gender, education and occupation groups, is positively associated with the adoption of computer technology. Decreasing trends in both routine cognitive and routine manual tasks are the other side of the coin. Autor, Levy and Murnane also argue that technology cannot replace human labour in non routine manual tasks requiring the flexible use of the brain, eye, hands and legs.

Goos and Manning (2007) revisit this finding for the US, showing that jobs requiring nonroutine tasks tend to be at the top and at the bottom of the wage distribution, while the jobs that require routine tasks tend to be in the middle, leading to a job polarisation pattern which they also find in the UK between 1975 and 1999. Thus middling jobs, that are mainly clerical jobs, like book keepers or bank employees and skilled manual jobs have become less numerous. Spitz-Oener (2006) replicates Autor, Levy and Murnane's research using West Germany data and they also observe a hollowing out of middle class occupations between 1979 and 1999. We may also note that Polavieja (2005) mention a polarisation process in Spain over the 1987-1997 period, but he connects it with labour market reforms rather than with technology.

The positive correlation we find in table 3.4 between computer use and work complexity at the worker level is in line with the positive correlation between computer use and non routine cognitive tasks. The tasks performed by computer users are complex and they involve discretion, learning and problem solving abilities. The negative trend in work complexity could however reflect the displacement of workers from middling jobs to non routine manual jobs. According to Spitz-Oener, examples of such occupations are waiters, domestic staff, blacksmiths, or transport equipment operatives. Moreover, standardisation and polarisation could well be connected and indirectly linked to technological progress. ICTs contribute to the global restructuring of value chain. In this process, outsourced or off shored tasks and work processes are standardised. If these tasks were previously performed by occupations with intermediate skills, global value chain restructuring would induce both polarisation and decreased work complexity. This would reflect a "power biased" use of ICTs in value chain restructuring, in line with the increased intensity of work effort, which has been empirically documented by Green (2005) in the UK and with the theoretical model proposed by Guy and Skott (2007) where the use of ICTs allow firms to monitor low skill workers more closely and may drive a simultaneous occurrence of lower wages, higher unemployment and higher work effort for the lower skills.

This thesis would require further assessment both theoretically and empirically. In particular, it would be important to understand why some countries are hit more than others by the decrease in work complexity. If the explanation has something to do with technical progress, we need to identify some heterogeneity in the way it is embodied in work processes at the national level. Section 2 has made a step in this direction by showing a spread across Europe of different forms of work organisation. If the lean production model implies more standardisation than mutual adjustment, then this could explain the sharp decrease in work complexity in the UK where it is prevalent. In Spain and Italy, traditional and taylorist forms of organisation are more frequent, with some implications

probably on the way ICTs enter the work process. The German case is more difficult to analyse in the light of the work organisation typology as it is a country where the discretionary model is rather frequent.

Up to now, we have considered that the decreased work complexity reflected a hard fact. However, in trying to explain the complexity paradox, we need to consider the fact that even though questions in the European Working Conditions Survey are formulated in a simple and objective way, work assessments provided in employee declarations remain subjective in nature. Thus the average European workers could feel that his job is becoming less complex over time, even though, objectively, it is difficult to observe a decreased in skill content. Two main causes could generate such a feeling: organisational change and overqualification. Case study evidences show that organisational changes put into question the way employee view and assess the content of their jobs. If organisational changes have some deep consequences on task content, they can be viewed as deskilling, even when new skills are involved. The past trajectories of workers have an influence on how they value the content of their work. If some positively valued dimensions of work disappear, the new dimensions may be negatively considered, even when they incorporate new skills. For example Dahlman (2007) describes the restructuring of an IT help desk in a British local government involving an IT workflow management system. More interpersonal skills are required from the staff transferred to this help desk. However, IT staff with experience of the previous work organisation has a technical background. They feel that they have less discretion because the new IT system requires logging every work-related task and scheduling work to be carried out when before work tended to be carried out on an adhoc basis. Even if some training has been provided to update their skills and develop inter-personal skills, IT staff report that they do not feel they have learned more or developed new skills. Moreover, skill obsolescence may arise from repeated change, driving a feeling of loss and of work becoming less enriching.

Overqualification is a last culprit for the decrease in work complexity. It is quite widespread across Europe (Brunello and alii 2007, Brynin and Longhi, 2009). The European Community Household panel provides a self-reported measure through the question “do you feel to have skills or qualifications to do a more demanding job than the current one?”. In 2001, the proportion of workers who feel overqualified varies from 40% in the Netherlands to 66% in Belgium. It reached 46% in Italy and 63% in Spain. Unfortunately this measure is not available for UK and Germany. Overqualification is a puzzle for human capital theory and it does not fit well with the skill bias technological change evidence. Machin and McNally (2007) rule out the explanation in terms of over-supply of tertiary educated graduates. Other possible causes can be related to specific employment practices like flexible employment, to the fact that employers cannot discriminate easily between different skill levels (Brynin, 2002), to design problems in the educational system making it difficult to provide the skills needed by the market and to the interplay between institutions, educational choices and the labour market in matching the supply and demand of skills (Brunello and alii, 2007). Like for organisational change, overqualification could drive a relative assessment of work content: the worker compares his situation, not to a past one like for organisational change, but to a virtual one corresponding to his alleged level skill. A discrepancy between the two assessments could drive an underestimation of the level of work complexity.

Section 4: Behind innovation, employers and employees trade-offs

Section 1 has given a definition of a learning organisation. Using the European Working Conditions Survey, section 2 has assessed the spread of the learning model of work organisation across Europe, its relation to learning culture and human resource management practices, and its links with innovation and with labour market institutions. Section 3 has identified a trend of decreasing work complexity between 1995 and 2005 and proposed alternative explanations. This empirical analysis has pointed to the existence of an increasing heterogeneity across European nations in the way learning and knowledge enter production processes. It thus seems necessary to revisit the relationships between the diffusion of ICTs, organisational models and innovation and to identify the trade-offs that employers and employees face in these relationships. This will allow to better understand why organisations opt for different types of arrangements, sometimes translating into national models according to institutional settings at the national level. The learning organisation literature highlights that innovation is not only produced by structures and people doing scientific and technological work. In the following, we focus on the issues faced by organisations that are willing to encourage innovative work behaviours and organisational learning processes. We will first focus on the trade-offs that employers face when they decide to make new strategic decisions implying some changes in work methods, organisational structure, products or processes. We will then consider what happens on the employee side.

Designing adaptive or learning organisational structures

A new business generally starts with a new idea, new equipment, a new management concept or the identification of a non satisfied customer need. This critical resource is made out of knowledge, and it is the source of the entrepreneurial rent. Thus, the entrepreneur is facing a main problem which is how to enlist the cooperation of workers who will contribute to creating value out of this critical resource without ceding to them too much of the surplus that the new activity will generate (Rajan and Zingales, 2005). Organisational design and more precisely, the design of the structure of the organisation and of some core human resource management practices is a response to this problem. Rajan and Zingales (2005) propose a simple model to explore the implications of this founder primary trade-off. They explore two possible organisational structures, vertical and horizontal hierarchies and formalise three mechanisms that may tie workers to the firm's critical resource: access which is the ability to use or work with it, specialisation which is the acquisition of knowledge about the resource and learning about how to work with their superior (firm specific assets) or ownership of the resource. In the vertical hierarchy, the entrepreneur controls access to the critical resource so as to favour specialisation and then use specialised employees to control the action of their subordinate; in the horizontal hierarchy, where all employees are directly connected to the entrepreneur, access to the resource is limited and incentives to specialisation are given on the ground that ownership may be granted in a subsequent period (tactic of divide and conquer). They show that, because in human capital intensive industry it is easier to get hold of an entrepreneur critical resource, flat organisational structures, like in law or consulting firms, will be more prevalent, with up or out promotion systems. By contrast, in physical capital intensive industries where property right are more easily protected from expropriation, large and steep hierarchy with seniority based promotion will be more frequent, where promotion is simply a way of filling sensitive position with employees that proved loyal.

As the firm grows, the initial critical resource expands through learning by doing. Managers and employees develop informal communication channels for talking about the tasks that are performed, the precise equipment and production arrangements used and sharing tacit knowledge. Informal work routines, technical jargon and specific vocabulary patterns are developed which progressively develop into the own language of the firm as new projects are undertaken and valuable experience is gained. Chowdhry and Garmaise (2003) argue that the richness of a firm's language, measured by the breadth of the set of tasks covered by its communication channels, is the essential component of its organisational capital. They show that human resource management practices will have a crucial influence on the evolution of organisational capital. In particular employee retention and insider managerial succession are two important features for the accumulation of organisational capital.

Garicano (2000) provides another model of communication in organisations. His starting point is that production requires physical resources and knowledge about how to combine them. If communication is available, workers do not need to acquire all the knowledge involved in production activities. When matching problems with those who know how to solve them is costly, knowledge tasks can be divided between production workers and specialised problem solvers. Production workers acquire knowledge about the most common or easiest problems they are bound to face in their every day work and specialised problem solvers deal with more complex problems. They derive optimal knowledge hierarchies characterised by a number of layers, the problem solving ability of workers, reflecting the discretion they have and the proportion of problem solvers assigned to each layer. The key trade-off for the organisation occurs between communication and knowledge acquisition costs. Garicano (2000) then suggests that the different waves of ICTs had different cost implications. First, expert systems and codification allowed by computers has cut the cost of acquiring knowledge, leading to flattened hierarchies and empowerment of production workers. Second, email and network technology has reduced the cost of transmitting knowledge and this could also result in flatter hierarchies but with a smaller range of expertise or less empowerment for production workers. Bloom and alii (2008) test this theoretic result using a British international employer survey of management practices matched with a private technology database giving information at the establishment level on ICT uses. They find a positive relationship between some software use (ERP and CAD/CAM), employee discretion and management span of control, and a negative one between network technology and employee discretion. Spagnolo (1999) adds social relations to the analysis of communication and knowledge building. He shows that some value is generated from linking social and production relations. In other words, employing members of the same community in teams or encouraging social interactions between employees facilitate cooperation in production. A central reason is that it generates transfers of trust securing resource exchanges within teams, which are so critical for innovation (Tsai and Ghoshal, 1998).

Knowledge about the organisation's activity is a critical asset and the reviewed models which identify some important trade-offs linked to the setting up of a business, to knowledge accumulation over time and to the organisation of its efficient use in production. Here, we further elaborate on what organisational designs are conducive to a high capacity to adapt and to compete through learning. Dessein and Santos (2006) provide an answer to this question. This team theory model of "adaptive organisation" is interesting from two standpoints: it pinpoints a key trade-off for organisations willing to adapt to their environment and it links it to the use of ICTs. Adaptation needs an intensive use of

information, but this information is local, dispersed among employees. Some organisational design options contribute to fixing how “adaptive” or “information intensive” an organisation will be: the number of tasks assigned to an employee (task bundling), how much an employee can tailor his primary action to his local information (discretion) and the communication intensity between employees. The choice of an organisational design has to deal with a central trade-off between specialisation and adaptation. There is a positive return to specialisation, but coordination is more costly when specialised employees adapt to local information. Thus specialisation is limited by how adaptive or information intensive the organisation is. Improved ICTs have an ambiguous effect: on one hand, for a given level of employee discretion cheaper technology makes it easier to coordinate specialised activities, on the other, organisation can take advantage of improved ICTs to become more adaptive, increasing the need for task bundling. However, when the firm chooses its communication intensity, for a wide variety of communication technologies, intensive communication, broad task assignment and employee discretion are complementary organisational features. Thus, organisations tend to be of two very distinct types: either routine, specialised and with limited communication or adaptive, with broad task assignment and intensive communication.

In “adaptive organisation”, the employee is given the discretion to adapt continuously production to local conditions. This kind of adaptation regime does not repeatedly put into question organisational design parameters. But what about repeated organisational innovation, Is it sustainable? Is it reasonable to think that an organisation could keep on changing its strategy and structure? According to Hannan and Freeman (1984), the process of selection among businesses tends to favour the stability of the system at the cost of a high level of inertia. Thus companies that initiate major organisational change to cope with environmental threats face a higher risk of failure or mortality. Evolutionist approaches stress the importance of the timing of changes. Three factors are fundamental: the temporal pattern of changes in the organisation’s environment, the speed of learning mechanisms and the responsiveness of the structure to designed changes. Organisational structures will have a high degree of inertia “*when the speed of reorganisation is much lower than the rate at which the environmental conditions change*” (p. 151). When new sets of opportunities appear in the market, another key factor is the speed with which an entrepreneur can begin a new organisation. Hannan and Freeman (1984) also identify a trade-off between the reliability and accountability of modern organisations and the ability to respond quickly to new opportunities. As the modern world favours organisations that perform reliably and can account rationally for their actions, this trade-off generates structural inertia in a population ecology perspective. It does not mean, however that inertial pressures are uniform among populations of firm, they vary with age, size and complexity of organisations.

These issues echo our previous discussion of the trade off between standardisation and mutual adjustment. They have been further discussed in empirical work focusing on the effect of prior change on the likelihood of further change. A positive and significant relationship would imply that the process of change itself can be routinised. Nelson and Winter (1982), suggest that the opposition between routinisation and innovation may be overcome when the organisation innovates through new combinations of existing and reliable routines. Change routines and confidence in executing a certain organisational change develop with the accumulated experience of change, with a drawback, labelled as “competency” trap, where a change may be applied whether or not it actually solves problems. A consensus on the self-reinforcing nature of the process of change (“repetitive

momentum hypothesis”) has emerged: in the long term, the inertia of an organisation tends to increase, but the occurrence of a change makes it temporarily more flexible. Once the inertia forces have been surmounted, change may gain momentum but deceleration occurs with the age of the organisation and elapsed time since the last change (Amburgey, Kelly and Barnett, 1993). A more recent empirical study shows however that when controlling for unobserved heterogeneity, the opposite result shows up: the observed repetitive momentum effect comes from structural differences in organisational change propensities, linked to the fact that some organisations face more turbulent environments (Beck et Brüderl, 2008).

In total, from an employer point of view, some organisational design parameters are going to be critical for the long term perspective of the organisation. Its initial organisational structure is a core decision for an entrepreneur who sets foundations for a new business. By fixing how employees have access to the organisation’s critical resources and knowledge, it sets the basis of a psychological contract between the employer and the employees. As the initial critical knowledge resource expands through collective learning by doing, human resource management practices become another key feature. The structuring of the information system is another important area of organisational design: how are knowledge tasks divided between direct producers and specialised problem solvers? How do ICT contribute to information processing and communication? How are social relationships articulated with production relationships? Employers appear to be confronted with a central trade-off between standardisation/routine and mutual adjustment/innovation when making decisions in these areas. Designing a stable organisational structure with some dynamic properties is a key issue behind this trade-off. Another way to express it is that the changes or innovations induced by ‘adaptive’ or ‘learning’ forms of organisations have to be sustainable. Changes or innovation have to be in a range that do not put the structure into question or that preserve inertia forces. The point of view of employees is going to be critical in building this thin line between disruptive and sustainable change.

Organisational change, Innovation and employee outcomes

By focusing on learning organisations, this paper explores one option for organisations to become more innovative, which is to encourage their employees to develop innovative work behaviours. But why would an employee contribute to the development of organisational capital by giving his goods new ideas about how to improve the technology or reduce the cost of production? Carmichael and MacLeod (2000) address this issue of worker cooperation by considering the incentive system. If the output produced by the employee is observable, a simple solution is to pay a fixed piece rate: as increased output would then directly be reflected in their own salaries, workers should cooperate with technical changes. However, this is not what seems to have generally happened in the history of Western manufacturing: it is very seldom that innovative firms commit to a constant piece rate, leading to the “ratchet effect” and to a bad outcome where workers prefer to keep their good ideas to themselves. The authors argue that the leakage of knowledge to other firms is the main reason why a fixed piece rate is not sustainable for the employer. This is the same type of motive as the one stressed by Rajan in Zingales (2005) for employers in human capital intensive industries where it is difficult to protect critical knowledge resources. If piece rates are not optimal to obtain cooperation when firms face competition on their market, the employee’s involvement in the organisational learning should respond to compensation systems. MacLeod and Parent (1998) propose a theoretical framework linking jobs characteristics and compensation forms and question

the diffusion of performance pay (piece rate, bonus or commissions) in the U.S. without being able to analyse it jointly with trends in job characteristics. However, research on intrinsic motivation challenge this view by showing that environments which emphasise more on extrinsic rewards like performance pay may crowd out motivation derived from internal values and preferences (Frey, 1997). In particular, it is sometime argued that workers will be most creative when they feel motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself, like in artistic occupations, and not by external pressures or inducements. Further research is thus needed to establish whether employers should combine or set apart practices that favour extrinsic and intrinsic dimensions of motivation in a perspective of knowledge sharing and innovation. Galia (2007), using employer level data, makes a first step in this direction.

In their discussion of organisational change, Hannan and Freeman (1984) stress that the diversity of interest among members of the organisation generates loose coupling between the intentions of rational leaders and organisational outcomes. In this case, organisational outcomes depend on internal politics and on the balance of power among the stakeholders. The economic literature on employee resistance to change identify vested interest of different stakeholders in organisation as potentially disruptive for technological and organisational changes. When innovation generates productivity shocks on employees' relative productivity, some jobs may become threatened. If employees anticipate the future and adapt strategies accordingly, the group of employees with growing job insecurity may start lobbying against innovation. As a result, when employers decide to change the strategy or structure of their organisation, they have to deal with an employee participation constraint: changes must be such that employees are willing to support it. What are the factors generating support or resistance to changes?

In the economic literature, a classic determinant is employee representation or union presence. Unions are in the position to influence the adjustment costs of change and they can choose to oppose or support change according to its consequences through negotiation. Dowrick and Spencer (1994) refer to the Luddite revolts in England and try to identify when it is rational for trade unions to oppose labour saving innovation. They show that union opposition tends to occur when union value jobs rather than wage increases and when labour demand is relatively inelastic. Two interesting predictions also derive from the model: first, unemployment insurance, whether provided by the union or by government, is likely to reduce union concern about the threat of job loss and to generate more support for innovation. Second, as noted by Carmichael and McLeod (1993), multiskilling could mitigate resistance to innovation as an employee which task is hit by labour saving innovation can migrate to his other task without additional cost. Japanese firms would be better armed against asymmetric productivity shocks as those stemming from process innovation because they favour multiskilling. Menezes-Filho and Van Reenen (2003) survey the economic literature on the impact of trade unions on innovation and find no consensus, but a different pattern shows up between North American and European studies, the latter giving evidence of a more positive impact of unions. An interpretation of this pattern would be that European unions place a higher weight on jobs than on wages in their utility function.

Canton, de Groot and Nahuis (2002) and Bellettini and Ottaviano (2005) explore the assumption that age groups may have diverging vested interest. Age directly creates differences in time horizon. Canton, de Groot and Nahuis (2002) investigate how these differences impact innovation. Their theoretical model, with three overlapping generations

show how the demographic structure of a country may influence its growth. Belletini and Ottaviano (2005) assume that junior and senior employees do not value likewise different forms of innovation. The former prefer radical innovation, the latter incremental innovation (learning by doing) on the existing production process. This structure of preferences derives from differences in skill obsolescence induced by the two types of innovation for the two generations. Junior employees will encourage new routines whereas senior employees prefer not to challenge the organisational legitimacy. Hence, employees' anticipation about the benefits and costs of innovation will contribute to the setting up of barriers against innovative projects or conversely to collective support and appropriation of innovation. Only very few empirical studies on the determinants of innovation investigate factors that could influence employee support. Using a German innovation survey in the service sector, Zwick (2002) analyses the determinants of an indicator of employee resistance to innovation declared by employers. He shows that employees oppose innovations that endanger employment, intensify work or imply large adoption costs. Diaye and alii (2006) analyse the determinants of the adoption of ICTs and new organisational practices in French manufacturing firms. They find that age pyramids where junior employees are the most numerous are the most favourable to the adoption of technological and organisational changes. They also show that the employment instability of young workers relative to workers of intermediate age have a negative impact on changes.

A more recent literature on the outcomes of innovation for employee allows going deeper into the factors that facilitate or inhibit innovation from an employee and group level perspective. Janssen, Van de Vliert and West (2004) propose a psycho sociological analytical frame to identify the factors that regulate positive and negative outcomes of innovation for individuals and groups when they take the risk to engage in innovative activities. First, innovative work behaviour is demanding. It requires a broad variety of cognitive and socio-political efforts and investments which may lead to success or failure, high or low performance in the main task, conflict of cohesion with co-workers, positive or negative job attitudes and high or low levels of well being. The *characteristics of the innovative idea* are a first factor that moderates the outcome of innovative work behaviour. Radical innovation, directed to the core of the primary tasks of employees and with repercussions for the whole organisation should be more costly in terms of effort and more uncertain in terms of outcome than incremental innovation, directed to the periphery of primary tasks and limited to the work domain of the employee. *Skills and attitudes of the innovative employee* are a second factor. Cognitive and interpersonal skills, willingness to discuss and resolve disagreements will facilitate innovation and lower the incidence of conflict. Highly job-involved innovators for whom innovative performance is identity relevant will produce greater inter personal conflict in cases where innovation meets the resistance to change from other actors. *Group processes in the team of co-workers* are a third factor. Innovation is very seldom the result of the activity of one individual alone. Teamwork and cooperation are essential. Appropriate teams knowledge, skills and abilities will affect group processes. They include conflict resolution skills, collaborative problem solving skills, communication skills, goal setting and performance assessment skills. Group effectiveness will be enhanced by clarity and commitment to shared team objectives and participation in decision making. Group diversity and team tenure are two characteristics of teams that should favour positive innovation outcomes. The *leadership style of employee supervisors* is a fourth factor. Close monitoring of employees creates a negative climate for innovation. Innovators need some autonomy from organisational rules and procedure. Participation and direct support stimulate innovative work behaviour: a

participative leadership implies consultation and delegation and support relates to recognition and providing resources for innovation. Innovative employees are also likely to gain more from innovation if their supervisors approach and manage their innovative ideas from a mastery orientation rather than a performance orientation. The *organisational context* is a fifth factor influencing the outcome of innovative work behaviour. It can be thought of negatively, in terms of barriers to innovation or positively, in terms of promoting an adaptive or innovation culture. “Silo” mentality, blame culture, poor communication, short term perspective, risk avoidance, bureaucracy are organisational traits that impede positive outcomes from innovative work behaviour and thus negatively impact innovation. Innovating in a mechanistic organisation, designed to protect established courses of action is more likely to provoke conflict than in a more organic organisation where employees are expected to coordinate through mutual adjustment. Support for change, customer focus and organisational learning are three characteristics of the organisational context that contribute to the promotion of an innovation culture. Support for change is decisive in the face of potential conflict emerging from innovation. Customer focus is interesting from two standpoints: on one hand customers are an important source of feedbacks, comments and suggestions on the organisations’ activities, on the other changes initiated by customers’ feedback have a “natural” legitimacy and lower conflict potential than changes initiated from inside the organisation. This is particularly true in the public and service sectors where a large fraction of the labour force works in direct contact with the customer (whether client, citizen, pupil, patient etc.). Finally, as has already been stressed earlier, organisational learning is critical because it brings together and consolidates individual knowledge dispersed throughout the organisation as well as regulates knowledge appropriation by individual employees.

Empirical researches based on large scale databases and linking information on organisational structure and practices or innovation with employee outcomes are not numerous. Anderson, de Dreu and Nijstad (2004) note that although research interest among organisational scientists into innovation in the workplace has been growing with a strong development of empirical studies, it is very seldom that they study innovation as an independent variable, across countries and within a multi-level framework where the employee, group and organisational levels are distinguished. However, in the industrial relations field, the concern about employee level consequences of workplace innovation has contributed to a debate opening a stream of empirical research that has first exploited some employer level sources of information. This literature is more focused on organisational innovation than on other types of innovation. Workplace innovation generally designates the use or implementation of new organisational practices or work methods. Practices at stake are those that are core in the ‘learning’ or ‘lean’ models described in section 2: teamwork, job rotation, quality norms, incentive systems etc. Their implementation in an organisation could signal employer’s willingness to switch to a more ‘adaptive’ or ‘learning’ type of organisation.

As summarised by Kalmi and Kauhanen (2008) empirical results on the impact of workplace innovations on employee outcomes have been somewhat conflicting in the field of industrial relations with a view arguing on mutual gains for employers and employees and another one, more critical. The mutual gain literature emphasises the increase in discretion connected with workplace innovation and the resulting monetary and psychological benefits. Empirical studies mainly focus on well being, wages and employment stability. Ben-Ner and alii (2001), using an employer survey from a wide range of industries in the State of Minnesota, relates indicators of employee participation to

decision making and financial returns with employer level indicators of performance and employee outcomes. They find mixed evidence where firms do not seem to benefit from their human resource practices and workers outcomes are only partly favoured. Employee participation is associated with higher wages, but lower employer performance and employment stability. Freeman and Kleiner (2000) show on US data that employee involvement practices only have marginal productivity impacts, but they contribute to substantially increasing employee well being. Black, Lynch and Krivelyova (2004) show that self managed teams, job rotation and profit sharing increase inequalities within establishments and that their effect on employment reductions are mixed, depending on the presence of trade unions within the establishment. In contrast, the critical view argue that the limited gains accruing to employees are outweighed by increased stress, intensification and work injury (Ramsay and alii, 2000; Godard, 2001, Green, 2005). For example, using an establishment level database linking the use of a set of organisational practices to the rate of cumulative trauma disorders, Brenner and alii (2004) find a significant and positive link for quality circles and just in time production systems. This could reflect the loose coupling between employer and employee outcomes in the presence of a diversity of interest among members of the organisation or uncertainties about means-ends connections in a context of change (Hannan and Freeman, 1984).

Some step forward has been made more recently by papers either based on employee level surveys or taking advantage of the development of new survey instruments linking employer and employee levels of information. Using an Italian employee survey on skills, Leoni and Gaj (2008) explain indicators of levels of competences measured through a job requirement approach by a set of dummies indicating whether employees participate in continuous improvement groups or quality circles, make improvement suggestions, are submitted to formal performance appraisals, receive constant information flows and are involved and consulted by the organisation. They find a positive relationship with the levels of competences for these five organisational practice variables and show that it is robust to various specifications, confirming the influence of the organisational context on the elaboration of problem solving and interacting skills at the employee level.

Mohr and Zoghi (2006) and Kalmi and Kauhanen (2008) look at other outcomes than skills, linking them with organisational practices. Mohr and Zoghi (2006) exploit the potential of the linked employer-employee Workplace and Employee Survey (WES) pooled over 1999-2001 to investigate whether job enrichment increase job satisfaction. They examine the participation of employee in several forms of job enrichment: suggestion programs, information sharing, task teams and training, controlling for a large set of employee and employer level characteristics (including workplace organisation controls) and find that they increase job satisfaction and have no effect either on the probability to prefer shorter hour because of work related stress or number of sick days taken. Using the 2003 Finnish Quality of Work Life Survey, Kalmi and Kauhanen (2008) conduct similar regressions using a larger set of employee outcome indicators and fewer controls at the employer level. As employee outcomes, they consider job intensity, job influence, job security, stress and job satisfaction measured on multi-item scales as well as wages. These outcomes are related to participation in self managed team, participation in traditional teams, information sharing about changes, employer provided training and incentive pay. Their findings show that practices do not have the same outcome profile, but globally they support the mutual gain view : information sharing has positive consequences whatever the outcome considered, self managed teams and training are related to higher job influence,

wages, job satisfaction and job security (training only), incentive pay is positively related to job influence and wages.

Barth and alii (2009) and Østhus (2007) link indicators of change with employee outcomes. The study by Barth and alii (2009) exploits another linked employer-employee survey, the 2004 British Workplace and Employee Relations Survey (WERS). Measures of well being and job satisfactions at the employee level are related to three change indicators based on eight dummies of workplace level innovation over the two years prior to the survey: any kind of change, labour changes (working time arrangements, organisation of work, work techniques or procedures, initiatives to involve employees), capital change (upgrading of computers, upgrading of other types of new technology, introduction of technologically new or significantly improved product or service). They show that all types of workplace innovations are associated with lower average employee well being and job satisfaction. Collective bargaining agreement coverage and recognised union for pay bargaining at the workplace appear to mitigate the negative impact of innovation on employee well being. Østhus (2007) uses the 2003 Norwegian Survey of Living Conditions to investigate the consequences of workplace downsizing or reorganisation (declared by employees) on composite indicators of task discretion, work demands, job insecurity, work related health problem and job satisfaction. Workplace changes in Norway increase demands on employees to exert more effort, without any positive counterparts in terms of task discretion, job security or job satisfaction. The results further suggest negative effect on work related health problems which are stronger for internal reorganisations than for downsizing.

Section 4 has reviewed different strands in economic, industrial relations and socio-psychological literature that address organisational issues connected with innovation from the employer and employee points of view. One main organisational design challenge has been identified for employers: find ways of stimulating dynamic properties of organisations in a stable organisational structure. In dealing with this challenge, employers are confronted with a central trade-off between standardisation/routine and mutual adjustment/innovation. 'Lean' and 'learning' models described in section 2, can be interpreted as two potential responses, the former incorporating more standardisation than, the latter. From the point of view of organisation, innovation strategies also meet a challenge in the human resources area: employers willing to innovate have to deal with an employee participation constraint. If this participation constraint is not managed efficiently, conflicts between vested interests may arise that will constitute a strong barrier to innovation. In this context, human resources management practices are essential tools: employer provided further training or multiskilling policies contribute to alleviate skill obsolescence induced by innovation, formal systems of performance appraisals or evaluation interviews allow to address issues connected with the balance between effort and reward which can be upset by change, it also opens the path to some transparency in the incentives policy which is important to build in feelings of trust and fairness. The few available linked employer-employee surveys give some promising results on these issues. A linked employer-employee type of survey instrument covering more than one country with different institutional arrangements would allow to go further in identifying best practices.

Conclusion

This report began with a survey of the literature on learning organisations in order to provide greater definitional clarity. Although the literature is highly disparate and there is nothing like a unified definition or concept of the learning organisation that has been developed and empirically tested in a cumulative manner, some common definitional ground has been identified. First, most authors see the learning organisation as a multi-level concept involving interrelations between individual behaviours, team organisation, and organisational practices and structure. Secondly, there is an important emphasis in the literature on the role of learning cultures understood as beliefs, norms and values supportive of employee learning. Further, an important strand in the literature identifies specific HRM policies which are supportive, or constitutive, of learning cultures.

The multi-level nature of the concept as well as the emphasis on organisational culture poses a challenge for measurement and quantitative analysis. Drawing on the results of successive waves of the European Survey Working Conditions, the report provides evidence on the spread of learning organisations across the European Union and on the evolution of their characteristics over time. The results show firstly that while a large share of European workers have access to work settings that draw on their discretionary capacity for learning and problem-solving, there are important variations in the spread of learning organisations across EU member nations, with the percentage of salaried employees involved in 2005 ranging from a high of over 65 percent in Sweden to a low of about 20 percent in Spain and Bulgaria. Moreover, in the nations where work is organised to support high levels of employee discretion in solving complex problems, our evidence shows that firms tend to be more active in terms of innovations developed through their own in-house creative efforts. In countries where learning and problem-solving on the job are constrained, and little discretion is left to the employee, firms tend to engage in a supplier-dominated innovation strategy.

Secondly, the results show that in many European nations, and for the EU-15 on average, there has been a slight downward trend over 1995-2005 in the percentage of employees having access to work settings characterised by high levels of learning, complexity and discretion. This result is surprising given the emphasis placed in the European Union on policies for constructing the knowledge-based economy, and notably on those designed to increase the level of R&D expenditures, augment the supply of persons on the labour market with third-level science and technology degrees, and to promote the wide diffusion of information and communication technologies (ICT).

Taken together these cross-sectional and longitudinal results have some important implications for understanding the performance of national innovation systems. Firstly, in keeping with the OECD's emphasis on widening the concept of innovation, they imply the need to put the organisation of work more centrally in the analysis of innovation. Learning and interaction within organisations is at least as important for innovation as learning through interactions with external agents, and indicators for innovation need to capture how material and human resources are used and whether or not the work environment promotes the further development of the knowledge and skills of employees. Secondly, policies designed to promote innovation, especially in countries that are trailing or behind, have tended to focus on the need for increased expenditures on R&D, on raising the percentage of the population with third-level education and on furthering the diffusion of ICT. Considerable progress has been made with respect to the latter two indicators. The results presented here suggest that the bottleneck to improving the innovative capabilities of European firms might not be low levels of R&D expenditures, which are strongly

determined by industry structures and consequently difficult to change, but the widespread presence of working environments that are unable to provide a fertile environment for innovation. If this is the case, then the next step for European policy is to encourage the adoption of 'pro-innovation' organisational practice, particularly in countries with poor innovative performance.

At the level of management policies greater attention should be given to motivational factors including intrinsic motivation. When the lid on the organisational black box is opened, it can be shown that employee learning is closely connected to the organisation's culture and to the types of HRM policies used by employers. In order to be effective, innovative organisational designs and forms of work organisation need to be complemented by innovation in human resource and personnel policies, notably in the areas of further training, pay and assessment, and employee consultation and assistance, so as to foster employee commitment and better align employees' interests to the goal of organisational learning.

At the level of structural reforms, the analysis of the institutional framework condition for employee learning provides some guidance for the design of national policies. The results indicate that the way work is organised is closely connected to the structure of national labour markets and to the level of expenditures on labour market policies in the form of income maintenance for the unemployed and in the form of measures designed to move the unemployed into employment. There are alternative ways to build systems of learning and innovation, and different systems tend to organise work and distribute security and protection differently among citizens. While these conclusions are very preliminary and there is clearly a need for a more comprehensive analysis, they imply that the institutional set-up determining the dynamic performance of national systems is much broader than normally assumed when applying the innovation system concept. They point to the need for a transversal approach to policy that can take into account the interconnections between learning, innovation and the different institutional sub-systems of the knowledge-based economy.

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Table 2.1 Work Organisation Clusters: EU-15

	Percent of employees by work organisation cluster reporting each variable				
Variable	Discretionary learning	Lean production	Taylorism	Traditional organisation	Average
Learning new things in work	93.9	81.7	42.0	29.7	71.4
Problem solving activities	95.4	98.0	5.7	68.7	79.3
Complexity of tasks	79.8	64.7	23.8	19.2	56.7
Discretion in fixing work methods	89.1	51.8	17.7	46.5	61.7
Discretion in setting work rate	87.5	52.2	27.3	52.7	63.6
Horizontal constraints on work rate	43.6	80.3	66.1	27.8	53.1
Hierarchical constraints on work rate	19.6	64.4	66.5	26.7	38.9
Norm-based constraints on work rate	21.2	75.5	56.3	14.7	38.7
Automatic constraints on work rate	5.4	59.8	56.9	7.2	26.7
Team work	64.3	84.2	70.1	33.4	64.2
Job rotation	44.0	70.5	53.2	27.5	48.9
Quality norms	78.1	94.0	81.1	36.1	74.4
Responsibility for quality control	86.4	88.7	46.7	38.9	72.6
Monotony of tasks	19.5	65.8	65.6	43.9	42.4
Repetitiveness of tasks	12.8	41.9	37.1	19.2	24.9

Source: Lorenz and Valeyre, 2005.

Table 2.2 National Differences in Forms of Work Organisation: EU-15

	Percent of employees by country in each organisational class				
	Discretionary learning	Lean production	Taylorist organisation	Traditional organisation	Total
Belgium	38.9	25.1	13.9	22.1	100.0
Denmark	60.0	21.9	6.8	11.3	100.0
Germany	44.3	19.6	14.3	21.9	100.0
Greece	18.7	25.6	28.0	27.7	100.0
Italy	30.0	23.6	20.9	25.4	100.0
Spain	20.1	38.8	18.5	22.5	100.0
France	38.0	33.3	11.1	17.7	100.0
Ireland	24.0	37.8	20.7	17.6	100.0
Luxembourg	42.8	25.4	11.9	20.0	100.0
Netherlands	64.0	17.2	5.3	13.5	100.0
Portugal	26.1	28.1	23.0	22.8	100.0
UK	34.8	40.6	10.9	13.7	100.0
Finland	47.8	27.6	12.5	12.1	100.0
Sweden	52.6	18.5	7.1	21.7	100.0
Austria	47.5	21.5	13.1	18.0	100.0
EU-15	39.1	28.2	13.6	19.1	100.0

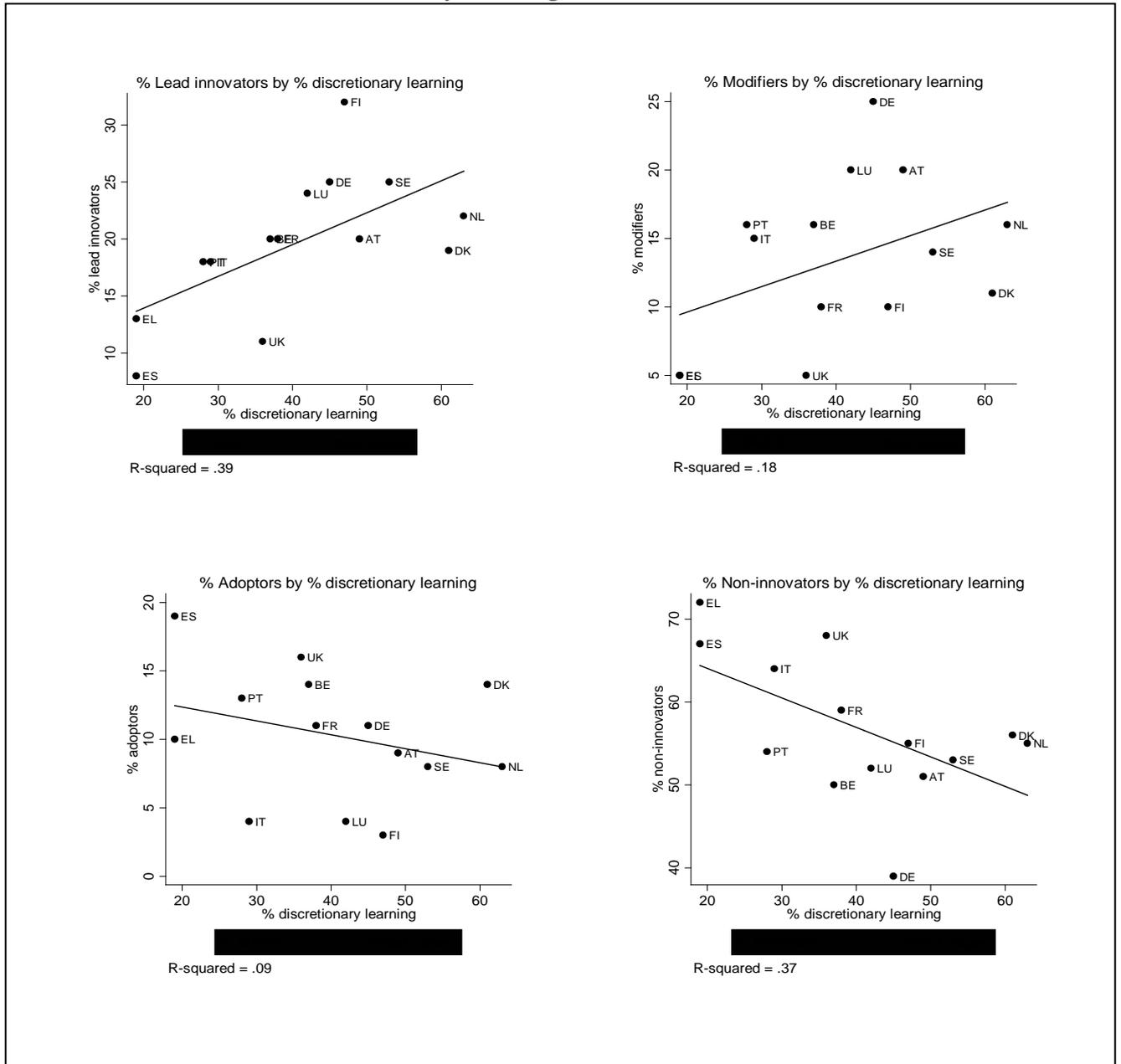
Source: Lorenz and Valeyre, 2005.

**Table 2.3 Distribution of Innovation Modes in
14 EU Member Nations, 1998 - 2000**

	Leaders	Modifiers	Adopters	Non – innovators	Total
Belgium	20	16	14	50	100
Denmark	19	11	14	56	100
Germany	25	25	11	39	100
Greece	13	5	10	72	100
Italy	18	15	4	64	100
Spain	8	5	19	67	100
France	20	10	11	59	100
Luxembourg	24	20	4	52	100
Netherlands	22	16	8	55	100
Portugal	18	16	13	54	100
UK	11	5	16	68	100
Finland	29	10	3	55	100
Sweden	25	14	8	53	100
Austria	20	20	9	51	100

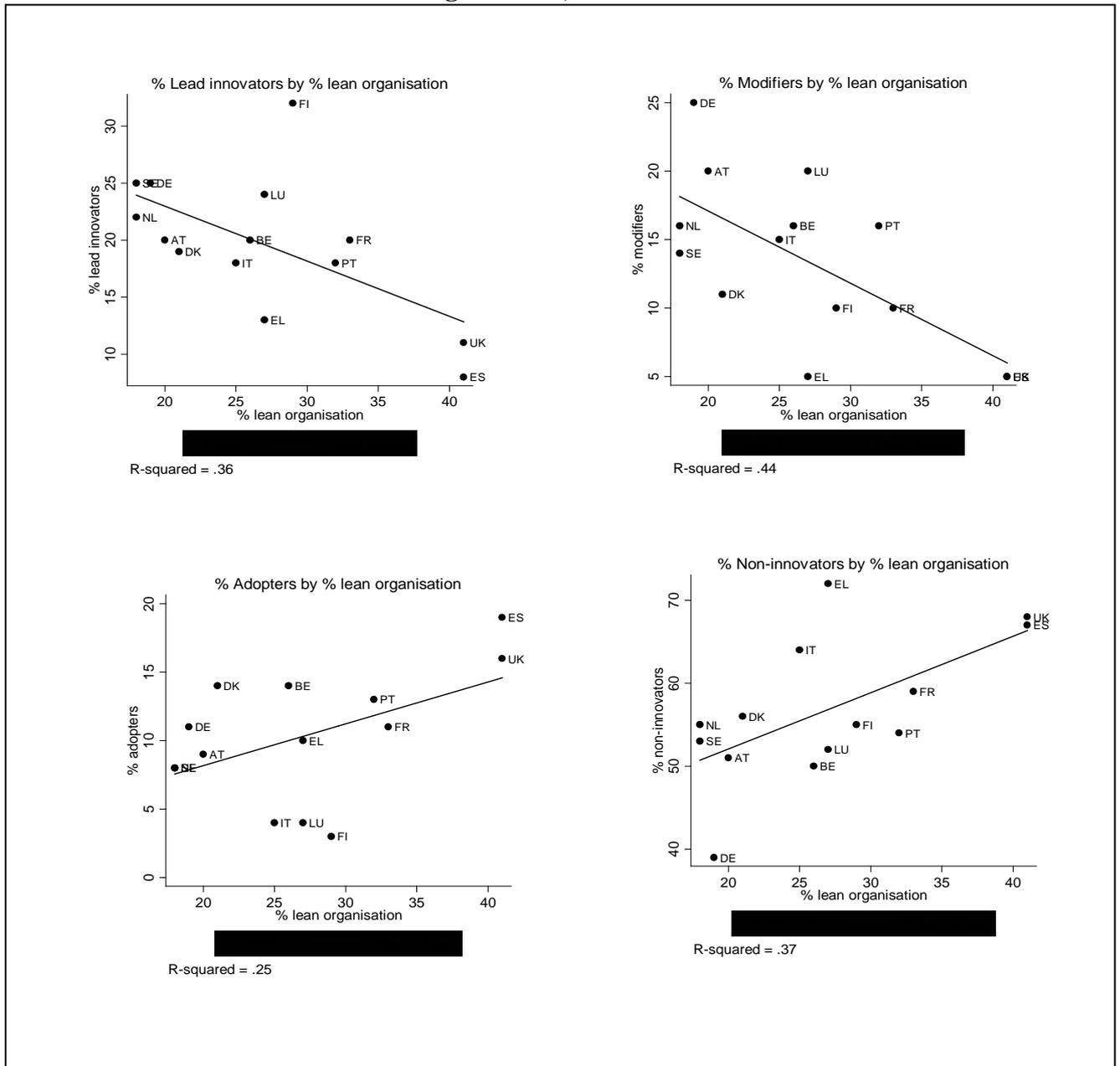
Source: Arundel et al. 2007.

Figure 2.1 Correlations between innovation modes and discretionary learning, all sectors



Source: Arundel et al. 2007.

Figure 2.2 Correlations between innovation modes and lean organisation, all sectors



Source: Arundel et al. 2007.

Table 2.4 Differences between countries in forms of work organisation: 2005
(EU-27 and Norway: weighted percent of employees by organisational class)

	Classes of work organisation			
	Discretionary learning	Lean production	Taylorist	Traditional or simple
Belgium	41.2	25.2	16.8	16.9
Czech Republic	30.2	25.1	22.8	21.9
Denmark	54.1	28.4	7.9	9.6
Germany	43.3	19.8	18.3	18.6
Estonia	40.8	32.7	11.4	15.1
Greece	22.9	28.9	24.5	23.6
Spain	20.6	24.9	26.3	28.2
France	46.7	24.8	17.6	10.9
Ireland	42.3	26.8	10.9	20.1
Italy	38.2	24.4	21.4	16.0
Cyprus	27.9	24.7	21.6	25.8
Latvia	35.2	32.6	17.1	15.1
Lithuania	24.5	30.8	22.0	22.7
Luxembourg	44.2	29.0	13.1	13.7
Hungary	39.6	16.4	23.9	20.1
Malta	47.0	34.3	10.6	8.1
Netherlands	52.8	22.7	11.9	12.6
Austria	48.1	21.4	17.9	12.6
Poland	33.5	31.3	20.0	15.2
Portugal	24.8	30.3	32.1	12.9
Slovenia	34.0	31.0	16.9	18.1
Slovakia	28.9	19.0	34.3	17.8
Finland	44.9	30.9	11.3	12.9
Sweden	67.2	14.9	7.1	10.8
UK	30.3	33.3	16.7	19.7
Bulgaria	20.3	28.1	30.2	21.3
Romania	24.3	32.5	28.2	15.0
Norway	55.6	28.2	6.0	10.2
All	38,2	25,7	19,0	17.1

Source: Holms et al. 2009

Table 2.5 Frequency of learning culture measures according to form of work organisation

(percentage of active persons in each class, weighted data)

	Discretionary Learning	Lean	Taylorist	Simple
Almost always or often applies one's own ideas in work	67	58	22	36
Almost always or often finds one's job intellectually demanding demanding work	60	58	23	36
Strongly agrees or agrees that has opportunities to learn and grow at work	65	59	28	33

Table 2.6 Forms of work organisation, HRM policies and learning culture

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Discretionary Learning	Lean	Taylorist	Simple	Discretionary Learning	Lean	Taylorist	Simple
Further training	.34***	.10*	-.35***	-.55***	.27***	.04	-.25***	-.44***
Payment system								
Piece rate	-.35***	.37***	.28***	-.64***	-.28***	.42***	.21***	-.50***
Pay based on group performance	-.22**	.38***	-.17	-.37**	-.29***	.31***	-.09	-.09
Pay based on enterprise performance	.37***	.02	-.54***	-.45***	.29***	-.01	-.42***	-.20*
Consultation and assessment								
Frank discussions with employer over performance	.09*	.13**	-.06	-.22***	.06	.11**	-.00	-.18***
Consultation over changes in working conditions	.23***	.30***	-.36***	-.46***	.15***	.25***	-.21***	-.27***
Regular formal performance assessment	-.13***	.44***	.06	-.57***	-.17***	.42***	.11*	-.46***
Assistance								
Assistance from employer	.22***	.07	-.19**	-.17***	.09*	-.01	.00	-.03
External assistance	.16***	.22***	-.63***	-.13*	.03	.15***	-.39***	-.11
Learning culture measures								
Apply one's own ideas in work					.64***	.12**	-.99***	-.36***
Intellectually demanding job					.25***	.49***	-.53***	-.55***
Opportunities to learn and grow at work					.28***	.21***	-.36***	-.53***

*** significant at .01 level, ** significant at .05 level, * significant at .1 level. The regressions control for sector, occupational category and gender.

Figure 2.3

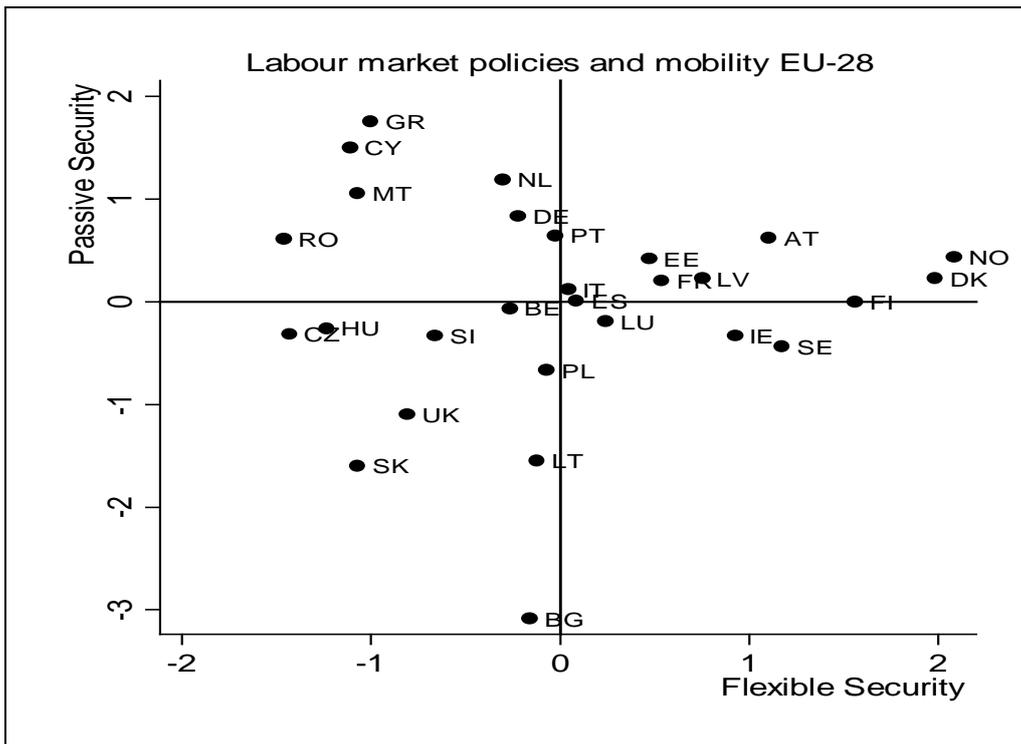


Table 2.7 Multilevel model of work organisation with random intercepts and slope and contextual effects: EU-27 and Norway

	Dependent Variable			
	DL	Lean	Taylorist	Simple
Level 1 Fixed Effects				
Intercept	-2.31***	-0.97***	0.21*	-1.58***
Medu	0.35***	0.16**	-0.40***	-0.24**
Hedu	0.87***	0.08	-1.23***	-0.65***
Mexp	0.22**	0.00	-0.53***	0.25**
Hexp	0.43***	-0.03	-0.69***	0.12
Occu1	1.48***	0.20***	-1.51***	-1.04***
Occu2	1.00***	-0.05	-1.23***	0.02
Occu3	0.69***	0.50***	-0.26***	-1.19***
Female	-.15***	-0.30***	0.52***	0.13**
Sect2	0.23***	0.02	-0.41***	0.24**
Sect3	0.43***	-0.45***	-0.58***	0.71***
Sect4	0.56***	-0.53***	-0.61***	0.55***
Sect5	0.58***	-0.38***	-1.34***	0.89***
Level 2 Fixed Effects				
FlexScr	0.27***	0.03	-0.25***	-0.27***
PasvScr	0.13	0.00	-0.01	-0.14*
EmpPrtc	0.02	-0.09*	-0.01	0.01
Level 2 Random Effects				
Intercept	0.14 (.057)	0.04 (0.023)	0.11 (0.053)	0.05 (0.03)
Medu	0.09 (.039)	0.01 (0.016)	0.08 (0.045)	0.10 (0.047)
Hedu.	0.06 (0.048)	0.05 (0.039)	0.19 (0.13)	0.31 (0.144)
Mexp	0.02 (0.019)	0.05 (0.027)	0.07 (0.049)	0.03 (0.034)
Hexp	0.01 (0.015)	0.00 (0.012)	0.01 (0.020)	0.02 (0.026)
<i>n</i> Workers	9649	9649	9649	9649
<i>n</i> Countries	28	28	28	28

Source: Holms et al. (2009)

Table 3.1 Indicators of work complexity in EU-15

Questions in EWCS	Synthetic indicators	EU-15		
		1995 (%)	2000 (%)	2005 (%)
(1)	(2)*	(3)	(4)	(5)
Intercept	-0.411			
Does your main paid job involve...?				
...meeting precise quality standards				
Yes	0.066	71.07	68.23	73.52
No	-0.066	28.93	31.77	26.48
...assessing yourself the quality of your own work				
Yes	0.089	75.58	74.04	71.44
No	-0.089	24.42	25.96	28.56
...solving unforeseen problems on your own				
Yes	0.145	83.77	81.97	80.93
No	-0.145	16.23	18.03	19.07
...monotonous tasks				
Yes	-0.019	43.72	38.78	41.39
No	0.019	56.28	61.22	58.61
...complex tasks				
Yes	0.101	58.55	55.51	58.18
No	-0.101	41.45	44.49	41.82
...learning new things				
Yes	0.122	75.79	70.41	69.56
No	-0.122	24.21	29.59	30.44
...rotating tasks between yourself and colleagues				
Yes	0.049	54.68	43.23	42.87
No	-0.049	45.32	56.77	57.13
Are you able, or not, to choose or change...?				
...your order of tasks				
Yes	0.123	65.7	64.17	63.44
No	-0.123	34.3	35.83	36.56
...your methods of work				
Yes	0.128	72.09	70.4	67.71
No	-0.128	27.91	29.6	32.29
Can you get assistance from colleagues if you ask for it ?				
Yes	0.039	83.48	82.45	81.63
No	-0.039	16.52	17.55	18.37
Can you take your break when you wish?				
Yes	0.081	63.12	60.46	63.34
No	-0.081	36.88	39.54	36.66
Are you are free to decide when to take holidays or day off?				
Yes	0.072	56.97	55.35	66.91
No	-0.072	43.03	44.65	33.09

Note: The weights in Columns 2 are computed so that the sum of weights of item responses for each variable sums to zero. A weight in bold indicates a high contribution of the variable to the synthetic indicator.

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, table from Greenan, Kalugina, Walkowiak, 2007.

Sample coverage: salaried and self-employed individuals from EU-15 in private and public sectors. Descriptive statistics are weighted.

Table 3.2 Change in the work complexity synthetic indicator between 1995 and 2005

	1995	2000	2005	Variation I2000-I1995		Variation I2005-I2000		Variation I2005-I1995	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Rank 1995	Rank 2000	Rank 2005	V1	V2	V1	V2	V1	V2
EU-15 average				-***		+***		-***	
Scandinavian countries									
Denmark	2	1	1	-	+**	+***	+	+***	+***
Finland	5	4	4	-***	-**	+***	+***	+	+
Sweden	1	3	2	-***	-***	+***	+***	+	+
British Isles									
Ireland	11	9	9	-	+	+***	+	+***	+**
Great Britain	4	5	10	-***	-***	-***	-***	-***	-***
Western Europe									
Austria	10	6	5	+***	+***	+**	-	+***	+***
Belgium	7	8	7	-	+	+***	+	+**	+
Germany	9	10	13	-**	+	-	-***	-***	-***
France	6	7	8	-*	+	+**	-	+	+
Luxembourg	12	12	6	-	+	+***	+	+***	+***
Netherlands	3	2	3	-	+**	+	-	+	+
Mediterranean countries									
Greece	15	15	14	-***	-	+***	+***	+***	+**
Italy	8	11	11	-***	-*	+***	-	-	-**
Portugal	13	14	12	-***	-***	+***	+***	-	+
Spain	14	13	15	-**	+	-	-***	-***	-***

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, table from Greenan, Kalugina, Walkowiak, 2007. Sample coverage: salaried and self-employed individuals from EU-15 in private and public sectors.

Table 3.3 A growing heterogeneity in work complexity across EU 15 over 1995-2005

Degree in complexity in work	1995	2000	2005
Intercept	-0.010	-0.063*	0,002
Random part			
Variance of the country level residual errors	0.015***	0,016***	0,018***
Variance of the individual level residual errors	0.206***	0,214***	0,197***
Intra country correlation in percentage	6.7%	7,1%	8,5%

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, table from Greenan, Kalugina, Walkowiak, 2007. Sample coverage: salaried and self-employed individuals from EU-15 in private and public sectors.

Table 3.4 A multilevel analysis of the determinants of work complexity in EU 15 over 1995-2005

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-0,017	0,016	-0,481***	0,034	-0,471***
Trend analysis					
Year 1995 is equal to 1 if it is year 1995	Reference				
Year 2000 is equal to 1 if it is year 2000		-0,055***	-0,048***	-0,066***	-0,055***
Year 2005 is equal to 1 if it is year 2005		-0,038***	-0,034***	-0,082***	-0,065***
Individual drivers					
Individual is female			-0,064***		-0,065***
Individual's age is between 15 and 24	Reference				
Individual's age is between 25 and 34			0,088***		0,087***
Individual's age is between 35 and 44			0,088***		0,088***
Individual's age is between 45 and 54			0,067***		0,066***
Individual's age is between 55 and +			0,045***		0,045***
Individual' main job involves working with computers: PCs, network, mainframe			0,214***		0,214***
Individual is self-employed			0,239***		0,239***
Individual is on an unlimited contract			0,077***		0,077***
Individual has people under his/her supervision, for whom pay increases, bonuses...			0,172***		0,172***
Agriculture			0,032**		0,030*
Manufacturing	Reference				
Services			0,020***		0,020***
Construction			0,067***		0,066***
Public sector			0,057***		0,057***
Legislators (and senior officials) and managers			0,256***		0,255***
Professionals			0,310***		0,310***
Technicians (and associate professionals)			0,300***		0,300***
Clerks			0,158***		0,158***
Service workers and (shop and market) sales workers			0,143***		0,143***
(Skilled) agricultural and fishery workers			0,205***		0,209***
Craft and related trades workers			0,229***		0,229***
Plant and machine operators	Reference				
Elementary occupations			0,007***		0,007
Macro drivers					
Macroeconomic indicators					
Real annual GDP growth				-0,008	-0,005
% Tertiary attainment for age group 25-64 / population in that age group				0,001	0,001
% Employment in Agriculture/ civilian employment	Reference				
% Employment in Industry/ civilian employment				0,022***	0,016***
% Employment in Services/civilian employment				0,021***	0,016***
% Part-time employment / total employment				-0,001	-0,003**
% aged 20-24 in economically active population 2024				0,001	-0,002
% females in economically active population				0,002	-0,001
Quality of the models					
Variance of the country level residual errors	0,015***	0,015***	0,011***	0,008**	0,008**
Variance of the individual level residual errors	0,216***	0,216***	0,163***	0,162***	0,162***
Intra country correlation	0,06547	0,065412	0,062644	0,047284	0,049
Intra country correlation in percentage	6,55%	6,54%	6,26%	4,73%	4,9%

Source: European Working Conditions Survey, European Foundation for the Improvement of Living and Working Conditions, table from Greenan, Kalugina, Walkowiak, 2007.

Sample coverage: salaried and self-employed individuals from EU-15 in private and public sectors.

Appendix: Multi-level learning organisation metrics based on the EU MEADOW project¹²

Employer	Employee
Learning and knowledge use	
<p>Do employees in this establishment regularly update databases that document good work practices or lessons learned?</p> <p>Does this establishment dedicate resources to continuously monitor external technological developments, or ideas for new or improved products, processes or services?</p> <p>What percentage of the employees at this establishment works in teams where the members jointly decide how work is done? These are sometimes referred to as <u>autonomous teams</u> or <u>self-directed teams</u>.</p> <p>What percentage of the employees at this establishment involved in groups who meet regularly to think about improvements that could be made within this workplace, for example a <u>problem-solving</u> or <u>service-improvement</u> group or a <u>quality circle</u>?</p>	<p>What proportion of the time does your job involve learning new things?</p> <p>What proportion of the time does your job involve helping your co-workers to learn new things?</p> <p>Over the last 12 months have you:</p> <ol style="list-style-type: none"> a. Figured out solutions for improving areas of your own work? b. Thought up new or improved products or services for your employer? c. Tried to persuade your supervisor or manager to support new ideas? <p>How would you compare the level of skills needed for your job with the level needed when you started working for you current employer? Would you say it has increased, decreased, or stayed the same?</p>
Learning culture and HRM practices	
<p>What proportion of employees has been given time off from their work duties to undertake training in the past 12 months?</p> <p>What proportion of employees has received instruction or training whilst performing their normal job in order to improve their skills in the past 12 months?</p> <p>Approximately what percentage of employees has a performance appraisal or evaluation interview at least once a year?</p> <p>Are decisions about employee promotion linked to the outcome of their performance appraisal?</p> <p>Approximately what percentage of the employees at this establishment has some part of their pay directly determined by their performance, or the performance of a wider group, rather than just by the number of hours worked?</p> <p>Do you have meetings between line managers or supervisors and all the workers for whom they are responsible?</p>	<p>How much do you agree or disagree with the following statement? “In my current job I have enough opportunity to use the knowledge and skills that I have”</p> <p>To what extent do you agree or disagree with the following statements about working for your employer>?</p> <ol style="list-style-type: none"> a. I share many of the values of my employer b. I do not feel loyal to My employer c. I am willing to work harder than I have to in order to help my employer. <p>Over the last 12 months, have you done any of these types of training or education connected with your <u>current</u> job?</p> <ol style="list-style-type: none"> a. Received instruction or training from someone which took you away from your normal job b. Received instruction whilst performing your normal job <p>Over the past twelve months have you participated in a performance appraisal or evaluation interview?</p>

¹ Section 1 of this report draws in part on a survey of the literature on learning organisations prepared by Rakhi Rashmi, GREDEG-CNRS, University of Nice.

² See <http://www.partnersforlearning.com/questions2.asp> for an electronic version of the questionnaire.

³ The survey design and the initial findings of the 2005 survey are presented in a European Foundation report by Parent-Thirion et al. (2007).

⁴ The term J-form is used because its archetypical practices and forms of work organisation are best illustrated by the 'Japanese-type' organisation discussed extensively in the research on Japanese automobile and electronics firms in the 1970s and 1980s. Some authors refer specifically to the diffusion of the 'lean production' model associated with Toyota. (Womack, John and Roos, 1990; MacDuffie and Pil, 1997).

⁵ The percentages are weighted.

⁶ Data are available for all EU member nations in 2000 with the exception of Ireland. The original Arundel, Hollanders, and Crowley classification makes a further distinction between lead innovators that make continuous use of R&D and are active on national or international markets and lead innovators that make only occasional use of R&D and/or are only active on local or regional markets. Since our interest is the relation between forms of work organization and the capacity for creative in-house development of novel products or processes regardless of R&D expenditures or the scope of markets, we have merged these two categories into a single 'lead innovator' group. For full details on the methodology for innovation modes, see Annex B of the Trend Chart document 'EXIS: An Exploratory Approach to Innovation Scoreboards <http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/EXIS.pdf>).

⁷ The correlations between the frequency of discretionary learning and the frequencies of lead innovators and non-innovators are significant at the .05 level.

⁸ All these correlations are significant at the .05 level or better with the exception of the positive correlation between lean and the frequency of adopters which is significant at the .10 level.

⁹ For a further discussion of this approach see the EU MEADOW project designed to develop guidelines for undertaking linked employer-employee surveys of organizational change and its economic and social impacts. <http://www.meadow-project.eu/>

¹⁰ The full descriptive report of the Fourth European Working Conditions Survey is available on the European Foundation website: <http://eurofound.europa.eu/ewco/surveys/EWCS2005/index.htm>.

¹¹ More precisely, by comparing variance of the individual level residual errors in model 1 and 3, we have $(0.216 - 0.162) / 0.216 = 0.25$.

¹² The metrics are taken from the Meadow project draft employer and employee-level questionnaires currently undergoing cognitive testing in 8 EU member nations. See: <http://www.meadow-project.eu/index.php>